DELAYS IN PERFORMING EMERGENCY CAESAREAN SECTIONS AT HARARE MATERNITY HOSPITAL AND MBUYA NEHANDA MATERNITY HOSPITAL – CAUSES AND OUTCOMES.

BY **Dr. ANNIE FUNGAI MUYOTCHA**

R029532K

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ABSTRACT

Introduction

The ideal decision-to-delivery interval (DDI) for emergency Caesarean sections (ECS) quoted in international guidelines is 30minutes. Achieving this DDI is anticipated to improve perinatal outcomes. It has however been found in several institutions that it is not achievable in routine practice. There had not been a study in Zimbabwean institutions to determine our achieved DDI for ECS. In the event that we fail to achieve a 30minute DDI, there was no data on what were the influences or causes of delay in performance of ECS, and the maternal and perinatal outcomes thereof.

Objective

What is the achievable DDI for ECS performed at Harare Maternity Hospital (HMH) and Mbuya Nehanda Maternity Hospital (MNMH). What are the causes of delay in performing ECS and what are the perinatal and maternal outcomes.

Design

Hospital based prospective descriptive study.

Setting

Harare Maternity Hospital and Mbuya Nehanda Maternity Hospital

Study population

Consenting women that had undergone emergency Caesarean section.

Methods

Convenience sampling of women who had had ECS and were able to give consent to participate in the study was done.

Data was collected by the researcher using a questionnaire on the day after they had ECS. On day 7 after the operation, a follow-up interview was conducted to check on the condition of both mother and baby. Data analysis was done using EPI INFO version 3.22 statistical software. Ethical approval was obtained from the ethics boards of each institution.

Main outcomes of measure

The indication of the ECS and the achieved DDI were explored. We also looked at the demographics and obstetric history of the participants, the stated causes of delayed DDI, the maternal morbidity and perinatal morbidity and mortality associated with delayed DDI.

Results

The total number of deliveries performed at both hospitals during the study period was 3 724 of which 1 050 (28.2%) were performed as Caesarean sections. Of all Caesarean sections, 866 were ECS (82.5%). The calculated sample size was 183. The study included 200 participants. The median age of participants was 25.5years. The majority of participants were married (94.5%), educated to secondary level or better (74%), Christian (68.5%), housewives (67.5%). 81 participants were primiparous. 13 participants delivered twins, therefore the total number of delivered infants was 213. Of these, 38 (17.8%) were delivered prematurely and 130 (16.9%) were term. 177 participants (88.5%) had booked their pregnancies. On admission, 147 (73.5%) were referred from within the Greater Harare Maternity Unit (GHMU), 26 (13%) were self-referrals and 27 (13.5%) were from outside the GHMU. The majority of participants had not had previous uterine surgery (75.5%). Most had successful regional anaesthesia (68%). In the study group, 92 participants (46%) had category 1 ECS and 108 (54%) had category 2 ECS. The median DDI for the whole group was 201.5minnutes (3hours 21minutes). Notably MNMH achieved a median DDI which was 1hour less than that at HMH. The top five causes of delay were delays in pre-operative preparation of the patient, theater being otherwise occupied, laboratory delays, delays in accessing blood products and delays in obtaining consent for theater. Of the 200 participants, only 14 (7%) had postpartum haemorrhage, and only 3 (1.5%) of these were still admitted 7days after the ECS while awaiting blood transfusion, the rest were home and in satisfactory condition. Of the 213 infants born, 186 (87.4%) had a 5minute Apgar of >7, 89 (41.8%) were admitted to neonatal unit and 27 (12.7%) suffered perinatal death.

Conclusion

A 30 minute DDI is not achievable in our institutions but with minimal adverse effects on the parturient or her infant.

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GLOSSARY OF TERMS

ACOG	American College of Obstetricians and Gynecologists
DDI	Decision-to-delivery interval
ECS	Emergency Caesarean section
GHMU	Greater Harare Maternity Unit
HMH	Harare Maternity Unit
NICE	National Institute for Health and Clinical Excellence
NNU	Neonatal Unit
NRFHR	Non-reassuring Foetal Heart Rate
RCOG	Royal College of Obstetricians and Gynaecologists
WHO	World Health Organisation

CHAPTER 1 - INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Caesarean section is the delivery of a foetus via surgical incisions on the abdominal wall and uterine wall. It is performed for maternal or foetal indications, or even for maternal preference. In the etymology of "Caesarean section," both words mean "cut" or "incision." For this reason, some authors prefer the term Caesarean delivery.

In a press statement released in April 2015, the WHO acknowledged that although Caesarean section is one of the most common surgical procedures performed worldwide, it should only be performed when there is a medical indication. This is in the hope of reducing short term and long term morbidity to the parturient or the foetus that would otherwise not have been exposed because of a lack of medical indication for the procedure. ("WHO | Caesarean sections should only be performed when medically necessary," n.d.)

Zimbabwe had a neonatal mortality rate of 39 per 1000 live births in 2012. This has increased from 19 in 1988, 29 in 1999 and 24 in 2005. Infant mortality rate (under 1year) was 50 in 1990, 60 in 2005 and 56 in 2012 per 1000 live births. The under 5 mortality rate is 82 per 1000 live births. Neonatal complications account for 29% of under 5 mortality. It has been postulated that prolonged first and second stage of labour and also a prolonged DDI for ECS impacts negatively on neonatal and maternal morbidity and mortality. ("National Child Survival Strategy for Zimbabwe 2010 - 2015," 2010, "Statistics," n.d.)

1.1.1 Classification of Caesarean sections

Several classification methods have been quoted in literature. The two most common methods are those proposed by Lucas and Robson.

The Lucas classification method is a four tier method of determining the urgency of the Caesarean section. (Lucas et al., 2000)

- In category 1 there is immediate threat to either the parturient or the foetus.

- In category 2 there is a threat but is not immediately life threatening.

-In category 3 there is no threat to life but there is need for early delivery.

-Category 4 encompasses the Caesarean sections done without urgency in doing them, therefore they are done at the convenience of the clinician and the parturient. See appendix 1.

In this study and other literature, emergency Caesarean sections are those in categories 1 and 2.

The Robson 10 group classification was justified by its author who intimated that the absolute Caesarean Section rate was not as important as whether the Caesarean Sections performed were actually necessary having considered all the relevant information that could guide the decision for Caesarean Section. There are four main areas considered in this classification system:-

1. Category of the pregnancy (lie and presentation).
2. The woman's previous obstetric history.
3. The type of labour and delivery.
4. The gestational age.

This method was developed in a bid to formulate a system to monitor and compare the true Caesarean Section rate so as to improve perinatal care.

It can also be used to compare the performance of different institutions, regions or countries. The groups denoted are mutually exclusive and totally inclusive. That is to say only one group will truly be applicable to each individual case. (Robson, 2001) See appendix 2.

Having found that there were so many classification methods being used around the world, a systematic review was conducted of 60 methods that met the inclusion criteria to assess their advantages and disadvantages. The reviewers found that the methods that were woman-based, especially the Robson classification were better at meeting local and international needs for ECS. The authors highlighted that there still was a need to develop a standard classification method that could be used internationally to facilitate audit and comparison. (Torloni et al., 2011)

1.1.2 Decision-to-delivery interval

The DDI is the time period from when a decision is made to conduct an emergency Caesarean section (ECS), to the time the baby is delivered. In some literature it is explored as the decision-to-incision interval. In this case the end point is the time at which the surgeon begins the skin incision.

The American College of Obstetricians and Gynecologists (ACOG) together with the American Academy of Pediatrics first proposed an ideal DDI of 30minutes for ECS. (American Academy of Pediatrics, 2000) This recommendation however was arbitrarily made without any basis on data from trials or observational studies. (“Normal and Problem Pregnancies: Indications for Cesarean Delivery,” 2002) Similar recommendations were made by the Royal College of Obstetricians and Gynaecologists (RCOG). A 30minute DDI is a requirement of the Clinical

Negligence Scheme for Trusts. This therefore carries an implication for malpractice litigation should it not be achieved. ("Clinical Negligence Scheme for Trusts. Maternity Clinical Risk Management Standards. Version 1," 2013)

The 2011 update on Caesarean section guidelines from the National Institute for Health and Clinical Excellence (NICE), explored evidence for and against the 30minute DDI. They found no difference in iatrogenic surgical injury with a DDI of <30minutes versus DDI >30minutes. (Soltanifar S, Russell R, 2012)

Neonatal outcomes were poorer when a DDI of <30 minutes was achieved. This was thought to be because the more compromised babies had ECS done faster. In this case therefore, the neonatal outcomes are more a reflection on the pre-operative condition of the foetus rather than the benefit or the lack thereof, of a short DDI. (Bloom et al., 2006)

There was no difference in odds ratios of Apgar score <7 with DDI < 15minutes versus DDI 16-75minutes. There was however a higher risk of Apgar <7 if DDI >75minutes. The authors concluded that though a DDI of <30minutes was not always achieved, it should not go beyond 75minutes. Maternal outcomes were also poorer with DDI >75minutes versus DDI <15minutes, adjusted OR 1.5 (95% CI 1.2-1.8). (Thomas et al., 2004)

Overall the NICE guidelines update adhere to set clinical standards, but also caution that due care should be given for each individual case

- Category 1 ECS should be done within 30minutes.
- Category 2 ECS should be done within 75minutes
- Take into account both maternal and foetal condition when making a decision for rapid ECS.
- Proposed DDI standards can be used for auditing the overall performance of an obstetric unit but not to judge performance of a single ECS.

NICE overally states that; failure to achieve a DDI of 30minutes is not necessarily suboptimal practice. (Soltanifar S, Russell R, 2012)

1.2 Statement of the problem

The two hospitals in this study are constantly inundated by obstetric emergencies of varying urgency. Harare Maternity Hospital (HMH) has a Caesarean Section rate of 22% and Mbuya Nehanda Maternity Hospital (MNMH) has a Caesarean Section rate of 17%. These figures have not been published but were calculated using delivery data from both hospitals from the first half of 2014. There is no official data to assess the standard of care offered at these hospitals for patients undergoing ECS. With a high burden of obstetric emergencies and the current challenges with adequate provision of qualified staff and resources in health care institutions in the country, delays in DDI can be expected and poor perinatal outcomes anticipated.

This was a prospective study looking to determine the mean DDI at these two hospitals, to describe the demography of women undergoing ECS as well as the immediate perinatal outcomes. We endeavored to outline the factors influencing the DDI and determine if any of these are modifiable.

1.3 Literature review

1.3.1 Is a 30minute DDI achievable?

The ACOG guidelines state that if a facility is to offer obstetric care, it should be capable of doing ECS within 30minutes of the decision. The OB Pearls Committee of the American Society of Healthcare Risk Management on the contrary suggests that each institution must provide obstetric care based on its own capacity. (Veltman L, Grelyak A, Kradel EC, 2000) Over the years many institutions have audited their own performance to determine if a 30minute DDI was achievable. They also endeavored to answer questions about the impact of a delayed DDI on

neonatal and maternal outcomes, the causes of delay and also whether their systems could be modified in order to improve the achieved DDI.

A review panel from the Mayo clinic in the USA looked at literature on the proportion of ECS done within 30minutes. They included articles on decision to incision or delivery, and compared the neonatal outcomes in deliveries achieved within 30minutes versus those that took longer than 30minutes. The reviewers included papers on emergent and urgent Caesarean Sections, categories 1 and 2. They found that 79% of category 1 (95% CI 61-97%) and 36% of category 2 (95% CI 24-48%) were achieved within 30minutes. For the most part, category 1 ECS had a shorter DDI than category 2 ECS, [21.2minutes VS 42.6minutes, $P<0.001$]. Of the 34 studies included in the review, 13 of the studies reviewed also included neonatal outcomes in their analyses. It was found that for the deliveries with the shorter DDI, there was a higher risk for a 5minute APGAR score <7 (OR 3.1, 95% CI 1.93-4.96), or an umbilical artery pH<7.10 (OR3.4, 95% CI 2.38-4.87). However analysis for just category 1 ECS did not show statistically significant higher risk for low Apgar score or umbilical artery acidosis. There was no difference in neonatal intensive care unit (NICU) admission, [OR 1.23, 95% CI 0.90-1.68]. The conclusion from this review was that delivery within 30minutes was not achieved in a good proportion of cases; however the clinical significance of this finding is still uncertain. (Tolcher et al., 2014)

Tuffnell conducted 3 audit cycles in a United Kingdom hospital over a 32month period. He found that 66% of the time a DDI of 30minutes was achieved for ECS. Cumulatively 88.3% were delivered within 40minutes. Only 4.0% of cases were not delivered after 50minutes. When analysed by DDI, there was no significant difference in the perinatal outcomes for term babies. The authors concluded that a DDI of 30minutes was not being achieved in routine practice. (Tuffnell et al., 2001)

The specific indication for the ECS appears to influence the DDI significantly. A study undertaken in Israel to look specifically at the effect of DDI for patients with suspected placental abruption delivered by ECS. They found the overall rate of placental abruption in the study period to be 0.5% of all deliveries.

Of all patients with placental abruption, 46% were delivered by ECS. The indication for ECS was NRFHR in 49.3% of cases, maternal bleeding in 30.7% of the cases and other indications in the remaining 20%. DDI was shortest in cases where there was NRFHR, then for maternal bleeding then other causes. Umbilical artery pH was lower in those who had NRFHR. The incidence of poor neonatal and maternal outcome was 66% and 40% respectively, without a statistically significant difference in relation to the specific indication for ECS. Overall, the conclusion was that for cases of placental abruption, the short term neonatal outcome was not only dependent on the indication for ECS but also on the DDI. (Gabbay-Benziv et al., 2014)

In developed countries, it would therefore appear that a DDI of 30minutes is achievable more than 50% of the time, however this has not been the case in resource-limited referral centers. In 2 tertiary hospitals in Nigeria over an 8month period, 224 ECS were analysed for DDI. None of the ECS were done within the recommended 30minute DDI. The most common causes for delay were anaesthetic delays and difficulty sourcing essential materials. No significant correlation between DDI and perinatal outcome was found. The authors proposed that litigation on the basis of a poor perinatal outcome after a prolonged DDI might not be justified as it had not been demonstrated. (Onah et al., 2005)

Information from 150 ECS done at Calabar Teaching Hospital in Nigeria was collected over a 7month period. A 30minute DDI was not achieved in any of these deliveries. Only 4.7% of the ECS performed were delivered within 1hour. Mean DDI was calculated to be 3.4hours.

Perinatal mortality rate for this population was 73 per 1000 births. The notable reasons for delay were theatre being otherwise busy or the anaesthetist was unavailable. (Inyang-Etoh, 2013)

1.3.2 Impact of DDI on perinatal and maternal outcomes

In England 66% of ECS were delivered within 30minutes and 88% were done within 40minutes. 4% remained undelivered at 50minutes. There was no significant impact of DDI on term babies. A DDI of 30minutes was not a significant predictor of neonates admitted to neonatal unit (NNU). They concluded that 30minute DDI was not routinely achievable in clinical practice, and failure to achieve it did not translate to adverse neonatal outcomes. (Tuffnell et al., 2001)

A multicenter cross-sectional survey was conducted in England and Wales to determine if DDI affected maternal or neonatal outcomes. There was no significant difference in babies born within 15minutes versus those born within 75minutes. After 75minutes however, babies were more likely to have a 5 minute Apgar of less than 7 and 50% chance of NNU admission. (Thomas et al., 2004)

In Texas the median achieved DDI was 20minutes. However they found that more babies born within 30minutes had lower 1 and 5 minute Apgar scores, cord pH <7.0 and neonatal seizures than those born after 30minutes. This small difference was not statistically significant though. There was no difference in NNU admission or length of stay. (Nasrallah et al., 2004)

In retrospective data collected in cases of serious foetal hypoxia, it was found that foetal salvage was possible if DDI was 5minutes. After 15minutes it was not beneficial. This applied to cases of cord prolapse, major placental abruption, massive haemorrhage from placenta praevia and prolonged foetal bradycardia. (Katz et al., 1986)

1.3.3 What are the causes of delay in DDI

There are numerous influences on DDI. The pre-operative preparation of a patient is important and can take a significant amount of time. In the audit by Tuffnell et al, the investigators looked at the different things involved in preparing the patient for delivery in theatre. There is potential of delay with any of these activities. (Tuffnell et al., 2001)

- Obtaining informed consent.
- Intravenous access.
- Blood samples drawn.
- Blood samples to the laboratory.
- Run intravenous fluids.
- Administer premedication.
- Shaving.
- Catheterisation.
- Inform anaesthetist.
- Inform theatre staff.
- Inform obstetric consultant.
- Arrival of anaesthetist.
- Moving patient to theatre.
- Preparation of operating theatre.
- Scrubbing of surgeon and assistant(s).
- Arrival of paediatrician.
- Check resuscitaire
- Administration of anaesthesia.
- Skin preparation.
- Incision into skin and sheath.
- Opening of peritoneum.
- Bladder reflection
- Uterine incision.
- Deliver baby.

In Nuffield, United Kingdom data collected from 415 ECS over a year including the day, time, DDI, seniority of the surgeon and condition of the baby at birth. DDI for foetal distress was 42.9minutes. DDI for ECS without foetal distress was 124.7minutes. Seniority of the surgeon, the day of the week and the time of day did not affect results. General anaesthesia shortened the DDI compared to regional anaesthesia. It was concluded from this study that there was no evidence to suggest that a DDI of more than 120 minutes worsened perinatal outcome. (MacKenzie and Cooke, 2002)

In a bid to make recommendations for the ideal DDI for ECS in Poland, researchers sought to review the significant factors affecting DDI. The common obstetrician-dependent factors were the expertise in making the diagnosis of indication for ECS and skill in performing Caesarean Section. Midwife-dependent factors were to do with the pre-operative preparation of the patient and theatre as well as transporting the patient to theatre. Anaesthetist-dependent factors were the determination of the suitability of the patient for anaesthesia and the procedure for anaesthetising her. Hospital management factors were in the provision of qualified staff members, training in emergency procedures, availability of operating room, as well as fast and safe transport of the patients to theatre. They found that ultimately, achieving an optimal DDI depends on proper collaboration of numerous teams. (Kotarski and Bobiński, 2014)

In an Oxford tertiary institution, an audit was conducted over 1 year to determine the DDI. The staff was blind to the audit as the information collected was part of the routine documentation for all ECS. This allowed for more accurate interpretation of the achieved DDI. A 30 minute DDI was achieved 50% of the time. This was similar to results from an audit 7 years prior to this one, in which the median DDI was 34 minutes. (MacKenzie and Cooke, 2002)

Possible explanations for the delayed DDI were thought to be:

Inadequate staffing

Increased Caesarean section rate

Use of regional anaesthesia

Less clinical experience amongst the obstetric staff

1.3.4 Possible interventions to reduce DDI

In a paper on understanding DDI, the authors postulated that DDI could be improved particularly by strategies to improve teamwork and reduce delays in pre-opertative preparation of the patient for theater and induction of anaesthesia. (Rashid N, 2007)

In Tel Aviv, Israel a study to determine the effect of a departmental program aimed at shortening DDI for ECS done for Non Reassuring Foetal Heart Rate (NRFHR), the DDI was reduced from 21.7±9.1 minutes to 12.3±3.8 minutes $P<0.001$; after the implementation of the program. The rate of umbilical cord blood pH ≤7.1 and 5minute APGAR score of <7 also decreased; $P\leq0.016$ and $P=0.031$ respectively. Overall, the incidence of a poor neonatal outcome decreased from 32.2% to 15.6%, $P\geq0.001$. It was concluded from these findings that the introduction of a management protocol to reduce the DDI for ECS for NRFHR improved early neonatal outcomes without any changes in maternal complications. (Weiner et al., 2014)

In a study to determine surgical and anaesthetic response times after the implementation of a "crash Caesarean section" protocol, it was found that the protocol had reduced the mean DDI from 14.9minutes to 7.7minutes. Their success in reducing DDI was attributed to:

- Refinement of the protocol over the past 6 years since it was first introduced
- Having the operating theater on the same unit as the delivery suite (50meters away)
- Use of a public address system to alert the obstetricians, anaesthetists, neonatologist and theater staff at once instead of having to individually contact each team
- A dedicated operating theater and staff reserved for crash cases only
- Adequate manpower 24 hours a day who are well trained and familiar with the protocol
- Anaesthetic drugs drawn and prepared beforehand. (Lim et al., 2005)

In a 5 part audit cycle on DDI, a time sheet was introduced after the first part of the cycle. This time sheet was to be filled out in real time from when a decision for ECS was made. A 30minute DDI was achieved in 64% of cases before the introduction of the timesheet and after improved to 71% by the final survey. They found that a 30minute DDI was not always achievable, but the use of a timesheet for conscious accountability could improve the DDI. (Helmy et al., 2002)

Other interventions that have been attempted to improve DDI include:

- Doing the ECS in the delivery suite and reducing time spent on aseptic techniques for emergent Caesarean sections. This was not found to increase perinatal morbidity, especially with the use of prophylactic antibiotics. (Hillemanns et al., 2003)
- If patient was voiding bladder frequently during labour, you may omit pre-operative catheterization. Caution should be taken for patients with a previous uterine scar. (Senanayake, 2005)
- Crash caesarean section drills

- Senior surgeons for emergent caesarean sections. (Kolås et al., 2006)
- Antenatal counseling on possibility of obstetric complications warranting ECS to facilitate quicker consent process
- Ready availability of blood and laboratory services.

1.4 Justification for study

Mbuya Nehanda Maternity Hospital and Harare Maternity Hospital are tertiary institutions to which high risk pregnancies are referred from the council clinics in Harare (the Greater Harare Maternity Unit - GHMU,) and also from the district and provincial hospitals in northern Zimbabwe. For the most part these hospitals manage high risk pregnancies which accounts for the relatively high Caesarean Section rates than the recommended 10-15%. (Gibbons L, Belizan JM, Lauer JA, Betran AP, Merialdi M, Fernando A, 2010)

The ability of these hospitals to cope with this burden of patients in maternity is therefore questionable. One way to measure this would be an assessment of the DDI. Having triaged the patients in labourward properly, and being teaching hospitals with different levels of doctors and midwives, patients should be able to receive optimal care. It is the intention of this study to objectively assess one aspect of the standard of care given for patients undergoing ECS as measured by DDI and also to assess the effect of the achieved DDI on perinatal outcomes. The average DDI in these hospitals has not been assessed to date inspite of them being major referral centers with notable perinatal mortality rates.

Concurrent to this, data was collected on referrals from the local referring clinics over the same period to make an assessment of the burden of referral patients from these clinics. The aim with this is to answer the question of whether the Greater Harare Maternity Unit's need for ECS is greater than its capacity to conduct them at the two hospitals.

It is of note that in literature, although the ideal DDI is well stated at a 30minute threshold, most obstetric units have failed to achieve this standard. Some writers have proposed that for ECS, should a DDI of 30minutes not be achieved, then the surgeon should not exceed 75minutes as perinatal morbidity will be significantly increased. (Thomas et al., 2004)

A search of local guidelines revealed that there is no stated DDI for ECS. There are recommendations for expediting delivery in some emergency cases although there is no timeline stated. Notably in cases of placental abruption, local guidelines advise delivery within 6hours of the diagnosis, this however could be a vaginal or Caesarean delivery.

The ultimate goal of this study was to be able to identify preventable and modifiable factors that affect the DDI and therefore to make relevant recommendations in an endeavor to improve the standard of care for emergency cases.

CHAPTER 2: RESEARCH METHODS

2.1 Research questions

1. What is the mean DDI at MNMH and at HMH?
2. What are the factors affecting the decision to delivery interval for emergency Caesarean Sections performed at Harare Maternity Hospital and Mbuya Nehanda Maternity Hospital and what are the perinatal outcomes?

2.2Objectives

2.2.1 Primary objectives

1. To determine the average decision to delivery interval for emergency Caesarean Sections performed at Harare Maternity Hospital and Mbuya Nehanda Maternity Hospital.
2. To assess the effect of the decision to delivery interval on maternal and perinatal outcomes.

2.2.2 Secondary objectives

1. To determine the causes of any delays from decision to delivery.
2. To make recommendations for timeous performance of emergency Caesarean Sections at these hospitals.
3. To determine the ECS burden referred from within the Greater Harare Unit.

2.3Measures of outcome

1. Socio-demographic data.
2. Labour information.
3. Decision to delivery of baby interval.
4. Indication for Caesarean Section.
5. Type of anaesthetic.
6. Seniority of surgeon.
7. APGAR score.
8. Neonatal unit admission.
9. Perinatal death.
10. Reasons for delay
11. Estimated blood loss
12. Postpartum pyrexia within 72hours
13. Anaesthetic complications

2.4Methodology

2.4.1 Study setting

Participants were recruited from the postnatal wards at Harare Maternity Hospital and Mbuya Nehanda Maternity Hospital after having an emergency Caesarean Section. Both hospitals are referral units and manage mostly high risk pregnancies. The catchment area for both hospitals combined includes the 12 Harare city council clinics, as well as clinics and hospitals in Mashonaland Central, Mashonaland East, Mashonaland West, Manicaland and part of Midlands province. Both hospitals are teaching institutions affiliated to the University of Zimbabwe. Harare Maternity Hospital has 5 clinical firms and Mbuya Nehanda Maternity Hospital has 4 clinical firms. In general each firm has 2-4 consultant obstetricians/gynaecologists, 1 senior registrar, 2 – 4 junior registrars and 3 – 5 interns at any given time.

2.4.2 Study design

This was a prospective descriptive cross-sectional study.

2.4.3 Study population

Women who had undergone an ECS at MNMH or HMH.

Study participants were recruited from postnatal ward and were enrolled into the study with their consent. A questionnaire was administered and other information was collected from the participant's notes.

2.4.4 Inclusion criteria

1. Patients for whom a decision for emergency Caesarean Section was made.
2. Patients who consent to take part in the study.

2.4.5 Exclusion criteria

1. Patients who do not give consent.
2. Patients who are too ill to give informed consent.

2.4.6 Sampling method

Patients who met the inclusion criteria and were willing to participate in the study were enrolled. Consecutive sampling was performed.

2.4.7 Sample size calculation

In a pilot study at the two hospitals done before data collection started, it was found that none of the ECS done in a 2 week period were done within 30 minutes. Arbitrarily for this study it was decided to test if it was possible to achieve a 30 minute DDI in 5% of ECS.

The minimum required sample of study participants was 183 emergency caesarean sections given a 95% confidence level, a 5% margin of error, a design effect of 2, an 80% expected response rate and assuming that 5% of all emergency caesarean section births have a decision to delivery interval within 30 minutes.

The following equation was used to calculate the minimum required number of pregnant women having an emergency caesarean section for this study.

$$n = \left(\frac{Z^2 p(1-p) \times DEFF}{e^2}\right) \div 80\% = \left(\frac{1.96^2 \times 0.05(1-0.95) \times 2}{0.05^2 \times 0.8}\right) = 182.5 \approx 183$$

p=expected proportion of emergency caesarean section births with a decision to delivery interval within 30 minutes = 5% [1]

1-p = expected non-prevalence (q)

z = the z-test statistic for a 95% confidence interval

e = relative desired precision = 5%

DEFF = design effect = 2

n= minimum required sample size of pregnant women having emergency caesarean section.

2.4.8 Data collection and analysis

Once consent was given, data was collected using the questionnaire in Appendix 3.

The questionnaire explored:

1. socio-demographic data,
2. obstetric history,
3. elements of the Robson 10 group classification method
4. indication for ECS and category
5. immediate maternal and neonatal outcome
6. clinical condition of patient and neonate 7 days after ECS

Data was collected by the researcher in the postnatal ward at a time when the participant could comfortably give informed consent. The questionnaire and consent form were both administered in a language that the participant was comfortable with. Other information was collected from the participant's clinical notes. Participant numbers were used and not the patient's name in order to maintain confidentiality. On day 7 after the ECS, the participant was visited in hospital for a follow up interview if they are still admitted. If the participant had been discharged from hospital, they were be contacted by telephone. This follow up interview was to obtain information on the clinical condition of both the mother and baby 7 days after delivery.

The collected information was entered into EPI INFO version 3.22 for analysis.

Categorical data was reported using tables and graphs, and interpreted using Chi-square tests as well as proportions. Continuous variables were interpreted by use of means/medians, standard deviations and 95% confidence intervals.

T-tests were used to test for differences between continuous variables which are normally distributed. Regression analysis was employed to assess the significance of risk factors and possible predictors.

2.5Ethical considerations

Permission to conduct the study was obtained from the ethical committees at both institutions before commencing data collection.

Individual informed consent was obtained before administering the questionnaire. Participants were no offered any monetary or material compensation for participation in the study. All participants received their due medical care without any alteration from that prescribed by their given care givers.

There is no conflict of interest on the part of the researcher.

CHAPTER 3: RESULTS

3.1Deliveries performed at the hospitals

Over a 2 month period from January to February 2015. The total deliveries at MNMH were 1 558 of which 470 (30.2%) were done as Caesarean sections. At HMH, 2 166 total deliveries were conducted of which 580 (26.8%) were Caesarean sections. 200 participants were recruited in total.

	MNMH	**HMH**		
Total deliveries	1 558	2 166		
Total Caesarean sections (% of total deliveries)	470 (30.2)	580 (26.8)		
Emergency Caesarean sections (% of total Caesarean sections)	390 (83)	476 (82.1)		
Elective Caesarean sections (% of total Caesarean sections)	80 (17)	104 (17.9)		
Patients from GHMU (% of total deliveries)	1 336 (85.8)	197 (91)		
Patients from outside GHMU (% of total deliveries)	222 (14.2)	195 (9)		
Recruitment	98	102		

Table 1: Deliveries and recruitment at Mbuya Nehanda Maternity hospital and Harare Maternity Hospital

3.2Demographic data

The median age of participants was 25.5 years [IQR 20 – 32]. Most of the 200 participants were married, 189 (94.5%). Of all participants, 148 (74%) were educated to Ordinary level or better, 137 (68.5%) were Christians and 54 (27%) attended Apostolic churches, 1 (0.5%) was Muslim and 8 (4%) had no religious affiliation. The majority of participants, 135 (67.5%) were housewives, 31 (15.5%) were self-employed, 17 (8.5%) were skilled workers, 14 (7%) were unskilled works and 3 (1.5%) were students at different levels of education.

Variable (N = 200)	N	Percentage
Age at last birthday (in years)		
Median (IQR)	200	25.5 (20-32)
Age group (in years)		
14-19	36	18
20-29	91	45.5
30-39	64	32
>=40	9	4.5
Marital status		
Single	9	4.5
Married	189	94.5
Divorced	1	0.5
Widowed	1	0.5
Level of education		
Primary	16	8
ZJC	36	18
O-level	128	64
A-level & more	20	10
Maternity hospital were enrolled		
Mbuya Nehanda Maternity Hospital	98	49
Harare Maternity hospital	102	51
Religious affiliation		
Christian	137	68.5
Apostolic	54	27
Muslim	1	0.5
None	8	4
Occupation		
Unemployed	135	67.5
Self-employed	31	15.5
Skilled worker	17	8.5
Unskilled worker	14	7
Student	3	1.5

Table 2: Demographic characteristics of enrolled women at Mbuya Nehanda Maternity Hospital and Harare Maternity Hospital

3.3Obstetric characteristics

3.3.1 Gravidity

In the study group, 81 participants (40.5%) were in their first pregnancy, 46 (23%) were in their second pregnancy, 39 (19.5%) participants were in their third pregnancy and 34 (17%) were in their fourth pregnancy or more.

3.3.2 Gestational age

Taking into account that 13 of the 200 pregnancies in the study were twin pregnancies, a total of 213 babies were delivered to the study participants. Of these, 38 (17.8%) babies were delivered prematurely while 130 (61%) were delivered at term. 36 (16.9%) were post-dates. 9 participants (4.2%) were not sure of gestational age at the time of delivery.

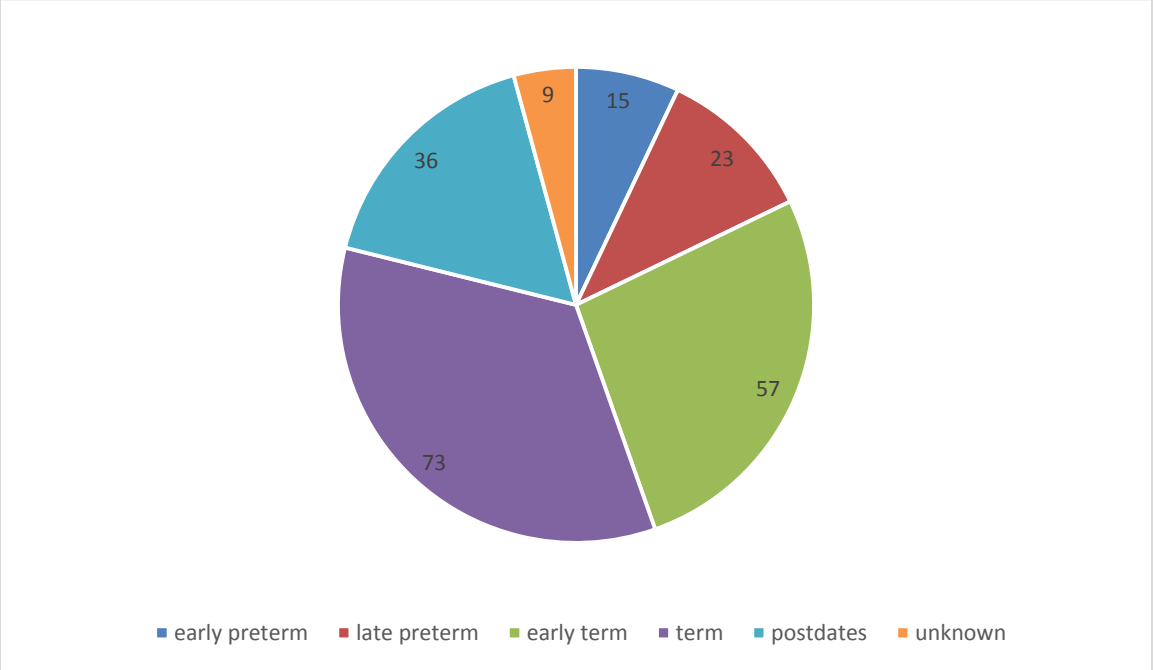

Figure 1: distribution of gestational ages at time of delivery

3.3.3 Booking status

177 participants (88.5%) had booked their pregnancies before the delivery. Only 23 participants (11.5%) were seen for the first time at the admission leading to the delivery and had not received any antenatal care prior to this admission.

3.3.4 Referral status

For the admission that ended with delivery of the baby, 147 participants (73.5%) had been referred either from the GHMU clinics or from the antenatal clinic at the admitting hospital. Due to different symptoms of complications, 26 (13%) referred themselves to the hospital. Referrals to the admitting hospital from outside the GHMU amounted to 27 (13.5%).

3.3.5 Previous uterine surgery

The majority, 151 participants (75.5%) had not had previous uterine surgery before this Caesarean section, while 38 (19%) had had 1 previous Caesarean section and 11 participants (5.5%) had had 2 or more previous Caesarean sections.

3.3.6 Type of anaesthesia

Most participants, 136 (68%) had successful spinal anaesthesia performed before their Caesarean section. The remaining 64 participants (32%) had the Caesarean section done under general anaesthesia. Of these patients, 58 patients had general anaesthesia performed as the first choice and 6 of them had general anaaesthesia performed after a failed attempt at spinal anaesthesia.

3.3.7 Indication of Caesarean section

For 92 participants (46%), the indication was classified as Category 1 ECS, while 108 (54%) were Category 2 ECS.

Table 3: Obstetric characteristics of enrolled participants

Variable (N = 578)	N	Percentage
Gravidity		
1	81	40.5
2	46	23.0
3	39	19.5
4+	34	17.0
Gestational age		
early pre-term (<35 wks)	15	7.1
late pre-term (35-36 wks)	23	10.8
early term (37-38 wks)	57	26.8
term (39-40 wks)	73	34.2
post-term (>40 wks)	36	16.9
Missing	9	4.2
Booking status		
Booked	177	88.5
Unbooked	23	11.5
Referral status		
Self-referral	26	13.0
From GHMU including this hospital	147	73.5
Outside GHMU	27	13.5
Previous uterine surgery including Caesarean section		
1 previous CS	38	19.0
2 previous CS	8	4.0
3 previous CS	3	1.5
None	151	75.5
Number of foetuses		
One	187	93.5
Two	13	6.5
Type of anaesthesia		
Regional	136	68.0
General	64	32.0
Indication of caesarean section		
Category 1	92	46.0

Category 2	108	54.0

3.4Decision-to-delivery interval in study group

Overall, for the study group, the median DDI was 201.5minutes (3hours 21minutes). At MNMH the median DDI was 176minutes (2hours 56minutes). At HMH the median DDI was 237minutes (3hours 57minutes)

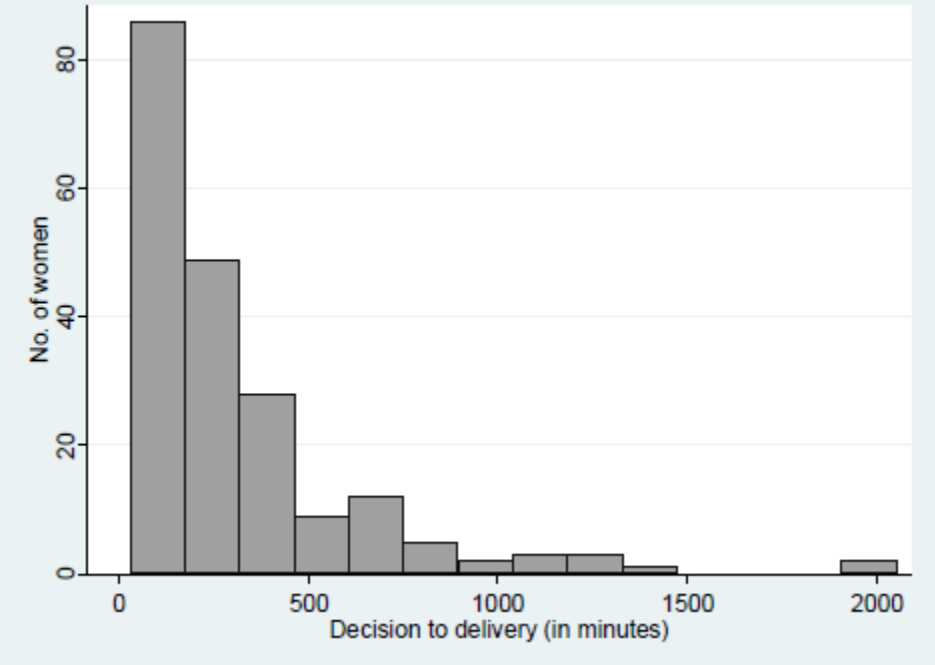

Figure 2: Decision-to-delivery interval among women in the study group

Facility	N	Median (IQR)
Mbuya Nehanda Maternity hospital	98	176 (105-323)
Harare Hospital Maternity	102	237 (153-450)
Total	200	201.5 (125-358)

Table 4: Decision-to-delivery interval among enrolled women by health facility

3.5Causes of decision-to-delivery interval > 30 minutes

The influences on the DDI were noted in the participants' notes. Some participants had more than one cause of delay in the performance of their ECS. All participants were noted to have delays in the pre-operative preparation for theater, although they were not specified. The second commonest cause of delay was theater being busy at the time that the decision for ECS was made. This was noted in 131 participants (65.5%). For 24 (12%), delays related to waiting for the laboratory to process necessary results pre-operatively. This was noted in the affected participants to be delays in processing of biochemistry results in patients who had preeclampsia or eclampsia. Delays in accessing blood or blood products which were required affected 11 (5.5%). Anaesthetic delays were noted in 8 (4%) due to failed attempt of spinal anaesthesia and subsequent conversion to general anaesthesia. For 11 participants (5.5%), the delays were related to staff change over. For 2 participants (1%), the ECS were delayed because of prolonged turnover time in theater due to the recovery ward being full and patients being discharged to postnatal ward late.

Reason	N	N	%
Preparation of patient	200	200	100
Theatre busy	200	131	65.5
Lab	200	24	12
Blood bank	200	11	5.5
Consent	200	10	5
Failed Spinal	200	8	4
Looking for anaesthetist	200	7	3.5
Change-over of staff	200	4	2
Recovery full	200	2	1

Table 5: Causes of Decision-to-delivery interval>30 minutes

Predictors of Decision to Delivery Interval among participants Variable (N =200)	n (%)	Univariate coefficient (95% CI)	p-value	Multivariate adjusted coefficient (95% CI)	p-value
Gravidity					
1	38 (46.9)	Reference		reference	
2	26 (56.5)	1.47 (0.71; 3.05)	0.299	1.37 (0.55; 3.41)	0.501
3	17 (43.6)	0.87 (0.41; 1.89)	0.732	0.67 (0.25; 1.82)	0.435
4+	19 (55.9)	1.43 (0.64; 3.21)	0.381	1.47 (0.58; 3.75)	0.415
Gestational age					
early pre-term (<35 wks)	6 (46.2)	reference		reference	
late pre-term (35-36 wks)	12 (63.2)	2.00 (0.48; 8.4)	0.344	2 (0.41; 9.64)	0.389
early term (37-38 wks)	27 (52.9)	1.31 (0.39; 4.45)	0.663	1.53 (0.39; 5.94)	0.538
term (39-40 wks)	36 (50.0)	1.17 (0.36; 3.81)	0.799	1.4 (0.37; 5.27)	0.615
post-term (>40 wks)	14 (38.9)	0.74 (0.21; 2.67)	0.648	0.8 (0.19; 3.35)	0.756
Missing	5 (55.6)	1.46 (0.26; 8.05)	0.665	1.25 (0.18; 8.58)	0.818
Booking status					
Booked	88 (49.7)	Reference		reference	
Unbooked	12 (52.2)	1.1 (0.46; 2.63)	0.825	0.95 (0.34; 2.69)	0.924
Indication of Caesarean section					
Category 1	46 (50.0)	Reference		reference	
Category 2	54 (50.0)	1 (0.57; 1.74)	>0.999	1.08 (0.55; 2.14)	0.822
Presentation of foetus					
Cephalic	86 (48.3)	Reference		reference	
Breech	11 (68.8)	2.35 (0.79; 7.05)	0.126	2.85 (0.78; 10.4)	0.112
Face/arm	2 (40.0)	0.71 (0.12; 4.37)	0.715	0.57 (0.08; 4.09)	0.577
Missing	1 (100)	-	-	-	-
Previous uterine surgery					
No	76 (50.7)	Reference		reference	
Yes	23 (46.9)	0.86 (0.45; 1.64)	0.651	0.85 (0.36; 2.05)	0.724
Missing		-	-	-	

Type of anaesthasia					
Regional	66 (48.5)	Reference		reference	
General	34 (53.1)	1.2 (0.66; 2.18)	0.544	1.49 (0.72; 3.10)	0.283
Variable (N = 200)	**n (%)**	**Univariate coefficient (95% CI)**	**p-value**	**Multivariate adjusted coefficient (95% CI)**	**p-value**
Day of ECS					
Week day	76 (47.2)	Reference		reference	
Weekend	24 (61.5)	1.79 (0.87; 3.66)	0.111	1.89 (0.81; 4.4)	0.139
Time of delivery					
Call	70 (53.0)	Reference		reference	
Cover	30 (44.1)	0.7 (0.39; 1.26)	0.233	0.97 (0.48; 1.96)	0.935
Seniority					
nurse anaesthetist (NA)	35 (59.3)	Reference		reference	
Intern	38 (38.8)	**0.43 (0.22; 0.84)**	**0.013**	0.51 (0.25; 1.04)	0.064
Student NA	24 (61.5)	1.1 (0.48; 2.51)	0.826	1.6 (0.64; 4.00)	0.319
Consultant/registrar	3 (75.0)	2.06 (0.2; 20.98)	0.543	1.46 (0.13; 16.51)	0.761

Table 6: Predictors of Decision-to-delivery interval among enrolled women

3.6Maternal and perinatal outcomes

Of the 200 participants, 14 (7%) had postpartum haemorrhage defined as an estimated blood loss of 1 000ml or more. At the seven day post-operative follow up visit 190 of them, (97.4%) were reported to be in good condition and had been discharged from the hospital. 7 participants (3.5%) were lost to follow-up. 3 participants (1.5%) were still admitted in hospital and were still awaiting blood transfusion following postpartum haemorrhage.

Of the 213 neonates delivered, 186 (87.4%) had a 5 minute Apgar score ≥ 7. Only 89 neonates (41.8%) were admitted to neonatal unit (NNU) for various reasons listed in the table below. A total of 27 neonates (12.7%) suffered perinatal death. Perinatal death was defined as either macerated stillbirth, fresh stillbirth or neonatal death. Analysed as a

composite of perinatal morbidity, 67 neonates (31.5%) were affected. Perinatal morbidity was a combination of neonates that had low 5 minute Apgar <7 and NNU admission for more than 1 day.

Maternal and Perinatal outcomes of participants and their neonates

Variable	N	n	%
Maternal Outcomes			
Post Partum Haemorhage			
No (< 1000mL)	200	186	93
Yes (≥1,000mL)	200	14	7
Condition of mother at 7 days postpartum			
Good	200	190	95
Poor	200	3	1.5
Unknown	200	7	3.5
Perinatal Outcomes			
5-minute APGAR score			
low APGAR score (< 7)	213	27	12.6
high/normal score (≥ 7)	213	186	87.4
Neonatal admission			
No	213	124	58.2
Yes	213	89	41.8
*Perinatal Morbidity**			
No	213	146	68.5
Yes	213	67	31.5
*Perinatal death***			
No	213	186	87.3
Yes	213	27	12.7

*Perinatal morbidity is defined as i) low APGAR score ii) NNU admission & iii) a duration of NNU admission >1 day

**Perinatal mortality is defined as either experiencing a macerated, fresh or neonatal death

Table 7: Maternal and peribatal outcomes of participants and their neonates

Reason for NNU Admission		
Variable	**n**	**%**
Meconium aspiration syndrome	28	31.5
Low apgar	18	20.2
Respiratory distress	9	10.1
Prematurity	15	16.9
Safe-keeping	19	21.3
Total	**89**	**100**

Table 8: Reason for Neoanatal Unit admission

CHAPTER 4: DISCUSSION

The purpose of the study was to determine if achieving a DDI of 30minutes as stated in international guidelines was at all possible in these two tertiary hospitals. Basing on a pilot study done over a week before commencing the study, it had been noted that none of the ECS done at either institution achieved this DDI. These results were maintained through the study. The overall median DDI was 201.5minutes (3hours 21minutes). The DDI achieved at MNMH was an hour shorter than that at HMH. MNMH median DDI was 176minutes (2hours 56minutes) and at HMH it was 237minutes (3hours 57minutes). These results are consistent with those found in resource limited referral centers in Nigeria where they failed to achieve a 30minute DDI in any of their ECS. The median DDI in one of these Nigerian institutions was 3.4hours, comparable to the results of this study. (Inyang-Etoh, 2013; Onah et al., 2005) The results in this study are however in contrast to those found by Tuffnell who found that a DDI of 30minutes was achieved 66% of the time and cumulatively 88.3% of ECS were done within 40 minutes. (Tuffnell et al., 2001) Nasrallah et al also found a 30 minute DDI achievable and their median DDI was 20minutes. (Nasrallah et al., 2004)

There is no formal system in the study institutions for classifying Caesarean sections. The indication for Caesarean section is stated as a clinical diagnosis. There is no formal triaging system to determine the urgency of ECS, particularly for “crash” Caesarean sections. In a systematic review of studies on classification of Caesarean sections, the authors identified 27 classification systems in use all over the world. They concluded that the use of a universal classification system would rationalize the use of caesarean section. It would also potentially facilitate auditing and analysis of aspects of Caesarean section in order to optimize Caesarean section rates. (Torloni et al., 2011) Evidence from a review by Tolcher et al showed that category 1 ECS had shorter DDI than category 2 ECS, 21.2minutes versus 42.6minutes $p<0.001$. (Tolcher et al., 2014) The formal classification of urgency of category 1 ECS allows all people

involved in the care of the patient to have an appreciation of the urgency and would potentially allow for quicker response times.

This was clearly demonstrated by Lim et al when they showed that crash Caesarean sections were done promptly by dedicated staff when their crash Caesarean section protocol was activated. (Lim et al., 2005)

In our setting, category 1 ECS were generally done in a shorter DDI than category 2 ECS, inspite of not being formally classified as such.

For all participants in this study, there were delays in the pre-operative preparation. There are many processes involved in in the preparation of a patient for theater. Tuffnell produced a list of these and they can individually be explored for their influence on the DDI. (Tuffnell et al., 2001) This was however not possible due to the structure of this study. Some procedural delays may be due to inadequate staffing of the wards, or inadequate supplies which are needed for use on the wards. In other instances, delays may be associated with the working protocols that might need refining to streamline procedures and deal with bottlenecks in the system. This is worth pursuing in another study.

Pre-operative delays specifically noted in this study were:

1. Delays in getting laboratory results for 24 participants (12%). This was noted for the biochemistry results. No delays were experienced with getting haematology results as the processing of these takes a shorter time than biochemistry samples.
2. Delays in accessing blood and blood products for 11 participants (5.5%). For maternity patients there is a donor-funded payment system in place for blood products. Inasmuchas payment might not be an issue, this does not always guarantee availability. For critical patients this can lead to life threatening delays should blood be

needed pre-operatively but is not available at the time. Inadequate supplies also affected patients post-operatively. It resulted in prolonged hospital stay beyond 7days post-operatively for 3 participants (1.5%) as they awaited blood transfusion.

3. Delays in getting patient consent for ECS affected 10 participants (5%). For the most part these patients were determined to have a normal delivery and the sudden change in the delivery plan was not a welcome change. For 2 of these participants, the delay in getting consent to operate was because they had reservations against delivering preterm babies and they wanted to prolong the gestation inspite of the complications of severe preeclampsia that had been explained to them. As Rashid et al suggested, it would be worthwhile to counsel patients antenatally on the possibility of unforeseen emergent indications for Caesarean section so that it is easier and faster to get consent. (Rashid N, 2007)

Overall the commonest cause of delay in both institutions was theater being busy at the time a decision is made for ECS. This was noted in 131 participants (65.5%). Participants would have to wait for different lengths of time before going to theater. The urgency of going to theater depended on the number of pending ECS and the individualized triaging system of the team of doctors on duty at the time. This was based on their judgement of maternal and foetal condition. For that reason, patients later classified as category 2, generally had to wait longer and this contributed to a lack of satisfaction in services rendered. This is consistent with results from Israel where they found that the specific indication for ECS influenced the DDI. They found that cases with a non-reassuring foetal heart rate were done in a significantly shorter time. (Gabbay-Benziv et al., 2014) Delays associated with theater being busy or the anaesthetist being unavailable were also noted in Nigeria. (Inyang-Etoh, 2013; Onah et al., 2005) This is in contrast to results from Singapore where they had a theater, full staff complement and ready supplies reserved specifically for crash Caesarean sections. (Lim et al., 2005)

Similar to findings in Nigeria, inspite of the significant delay in DDI, there was no association with major poor perinatal outcomes. (Inyang-Etoh, 2013; Onah et al., 2005) Tuffnell concluded that a DDI of more than 120minutes did not translate to adverse perinatal outcomes. (Tuffnell et al., 2001)

Thomas et al however found the babies born within 30 -75minutes had good outcomes, but those born after 75minutes were more likely to have a 5minute Apgar score of less than 7 and a 50% chance of admission to NNU. (Thomas et al., 2004)

In this study, the majority of neonates, 186 (87.4%) had a 5minute Apgar score of more than 7. Of the 89 neonates admitted to NNU, 19 were admitted only for safekeeping as their mothers were not well enough to care for the neonate in the immediate post-operative period. This means that only 70 neonates of the 213 (32.9%) were admitted to NNU for actual morbidity. When analysed as a composite of perinatal morbidity, including low Apgar score and NNU admission for more than 24 hours, only 67 babies (31.5%) were affected. Perinatal mortality, here defined as macerated stillbirth, fresh still birth and neonatal death affected 27 babies (12.7%). This is comparable to the above mentioned studies that demonstrated that delayed DDI did not necessarily translate to poor perinatal outcomes for the majority of babies. Maternal outcomes in this study group were also very favourable. Postpartum haemorrhage affected 14 participants (7%), with 190 known to have been discharged and in satisfactory condition 7 days post-operatively. 3 participants were still admitted on the seventh post-operative day as they awaited blood transfusion. 7 participants could not be contacted for the 7 day follow-up interview.

Potential predictors of delayed DDI were quantitatively analysed using both univariate and multivariate analysis methods. Different factors were analysed to see if they could predict the likelihood of delayed DDI. The only statistically significant predictor noted was the anaesthesia being administered by an intern. The study hospitals are both teaching hospitals with new

interns rotating through anaesthesia every 4 months. The cause of delayed DDI associated with interns ituis due to their relative inexperience with anaesthetic procedures.

In trying to answer the question of whether the two referral hospital had the capacity to deal with the referrals they received from the GHMU, it was found that the total number of deliveries at both hospitals was 3 724 over the 2 month study period. The total number of Caesarean sections was 1 050, accounting for a 28.2% Caesarean section rate for the institutions. This is so much more than the 5 -15% recommended by WHO for any institution. In absolute figures, 3 307 (88.8%) of all deliveries at the two institutions were from within the GHMU The hospitals however being consultant-led tertiary institutions cater for complicated cases and can therefore be expected to have a relatively high Caesarean section rate. Having said that, the overall capacity of the institutions in dealing with their quota of patients is questionable. This is reflected in the queuing for ECS and the prolonged DDI noted in this study. To have theater busy most of the time when an ECS arises does not speak well of the ability of the institutions to provide optimal care as and when needed. The fairly good maternal and neonatal outcomes inspite of the delayed DDI for ECS is not justification enough of a system that is coping with its workload. Another reflector of failure to appropriately meet its operative obligations is seen in that one of the noted causes of delay of ECS was because the recovery ward was full and patients were having to be recovered on the theater table till the ones in recovery could be discharged to postnatal ward. The reason for recovery being full was that the postnatal wards were full and did not have beds for the new patients being discharged from theater. Therefore using the timeous performance of ECS as a measure of ability to cope with the burden of patients referred, it can be concluded that the two hospitals are overwhelmed by their given workload.

4.1Conclusion

Based on the findings of this study, we conclude the following:

- A DDI of 30minutes is not achievable in a resource limited tertiary institution.
- A delayed DDI does not always translate to poor maternal or foetal outcomes unless there was significant pre-operative compromise of either of them.
- The major causes of delayed DDI are in the pre-operative preparation of patients and theater being otherwise occupied.
- There are no major predictors for delayed DDI.
- MNMH and HMH are currently operating beyond their capacity for provision of Caesarean sections.

4.2 Strengths of the study

The study was conducted prospectively, allowing for more accurate collection of data. Consent was obtained from all participants in the study. Confidentiality was maintained throughout the study.

This was the first study into this subject conducted at these institutions. It was answered some questions and also raised questions on how the response time to ECS can be improved. The information gathered can potentially be used to improve service delivery.

4.3Limitations of study

The study included only women that were well enough to give consent for their participation in the study. This excluded very ill patients who had had ECS and their outcomes as well as those of their foetuses might have altered the results attained.

The collection of data about the preparation for ECS was done after the fact. This limited the specificity of causes of delay in some cases. A study that follows the patients in realtime and data is collected as things happen may be more accurate especially in identifying bottlenecks it the preparation process.

The study did not explore the attitudes of healthcare professionals involved in the care of the patients undergoing ECS. This may reveal vital information on how to improve response times to ECS.

4.4Recommendations

- The institutions must adopt a formal method of classifying Caesarean sections with charts displayed in the labourwards for quick reference.
- Formal definition of “crash” Caesarean sections that take priority in triaging patients.
- Optimize the availability of blood and blood products.
- Have more experienced clinicians perform the anaesthesia and ECS for crash procedures
- Have staff on stand-by that can be called in when there is need to open a second operating theater after hours.

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APPENDICES

APPENDIX 1: LUCAS CATEGORISATION FOR CAESAREAN SECTIONS(Lucas et al., 2000)

- Category 1 – immediate threat to the life of the woman or foetus.
- Category 2 – maternal or foetal compromise which is not immediately life threatening.
- Category 3 – no maternal or foetal compromise but needs early delivery.
- Category 4 – no urgency for delivery.

APPENDIX 2: ROBSON'S 10 GROUP CLASSIFICATION OF CAESAREAN SECTIONS(Robson, 2001)

1. Nullipara, singleton, cephalic, ≥37/40, spontaneous labour.
    a. Spontaneous labour.
    b. Augmented labour.
2. Nullipara, singleton, cephalic, ≥37/40
    a. Induced labour.
    b. Caesarean Section before labour.
3. Multipara, singleton, cephalic, ≥37/40, spontaneous labour.
    a. Spontaneous labour.
    b. Augmented labour.
4. Multipara, singleton, cephalic, ≥37/40
    a. Induced labour.
    b. Caesarean Section before labour.
5. Previous Caesarean Section, singleton, cephalic, ≥37/40
    a. Spontaneous labour.
    b. Induced labour.
    c. Caesarean Section before labour.
6. All nulliparous breeches
    a. Spontaneous labour.
    b. Induced labour.

c. Caesarean Section before labour.

7. All multiparous breeches including previous Caesarean Section
    a. Spontaneous labour.
    b. Induced labour.
    c. Caesarean Section before labour.
8. All multiple pregnancies including previous Caesarean Section
    a. Spontaneous labour.
    b. Induced labour.
    c. Caesarean Section before labour
9. All abnormal lie including previous Caesarean Section but excluding breech
    a. Spontaneous labour.
    b. Induced labour. Caesarean Section before labour.
10. All singleton, cephalic, ≤36/40 including previous Caesarean Section.
    a. Spontaneous labour.
    b. Induced labour.
    c. Caesarean Section before labour.

APPENDIX 3- CONSENT FORM

P.O. Box A178
Avondale,
Harare, Zimbabwe
Telephone: **263-4-707707/731000**
Fax: **263-4-794272/621345**
***Telegrams*:** **UNIVERSITY**
Email: **obsgynpari@zol.co.zw**

UNIVERSITY OF ZIMBABWE Department Of Obstetrics & Gynaecology

Subject Informed Consent

PROTOCOL TITLE: DELAYS IN PERFORMING EMERGENCY CAESAREAN SECTION AT HARARE MATERNITY HOSPITAL AND MBUYA NEHANDA MATERNITY HOSPITAL – CAUSES AND OUTCOMES

NAME OF RESEARCHER: DR ANNIE FUNGAI MUYOTCHA
PHONE: 0773 662 609, 0716 800 545

PROJECT DESCRIPTION

This study intends to determine the average time taken from decision for emergency Caesarean Section to the delivery of the baby at these two hospitals. It also seeks to determine the causes for delay for a decision to delivery interval that goes beyond the recommended 30minutes and the effect of this delay on neonatal and maternal outcomes soon after delivery and upto seven days after delivery.

YOUR RIGHTS

Before you decide whether or not to volunteer for this study, you must understand its purpose, how it may help you, the risks to you and what is expected of you. This process is called informed consent

PURPOSE OF RESEARCH STUDY

The purpose of the research study is to determine the causes of delays in doing emergency Caesarean Sections after the decision has been made. The research also intends to see if there are poor neonatal or maternal outcomes if there is a delay in doing the Caesarean Section. Ultimately the findings of this research will be used to make recommendations to the two hospitals on how to minimise delays in conducting emergency Caesarean Sections.

PROCEDURES INVOLVED IN THE STUDY

You will be followed up from the time that you are recruited after your Caesarean section until seven days after delivery. You will have been prepared for, and have undergone Caesarean section as determined by the team of doctors on duty. This study will have no influence on that

process or the care given in your recovery. After the delivery you will be interviewed briefly to collect information about you and your baby. Some information will be collected from your notes. At seven days after delivery, a follow-up interview will be conducted to assess your condition and that of the baby in the ward or over the phone if you have been discharged from hospital.

DISCOMFORTS AND RISKS

PHYSICAL HARM

There will not be any physical harm related to your participation in the study as your management will be according to your doctors.

PSYCHOSOCIAL HARM

There will be some invasion of your private life due to the information that will be collected especially if there is complication in your condition or that of your baby after the delivery.
This harm will be minimised by keeping all information confidential. Only information relevant to the research will be collected. Data will also be stored in a secure place and will only be accessible to the researcher and their staff and no personal identifying information will be recorded on data collection. You will also receive counselling to minimise this harm.

POTENTIAL BENEFITS

You will not be paid for your participation in the study. The results of the study will be used to influence how quickly emergency Caesarean Sections will be conducted at the two hospitals.

STUDY WITHDRAWAL

You may choose not to enter the study or to withdraw from the study at any time without loss of benefits entitled to you

CONFIDENTIALITY OF RECORDS

Information collected from you will be stored in a secure place only accessible to the researcher and their staff. No personal identifying information will be recorded on the data collection tools.

PROBLEMS/QUESTIONS

Please ask questions about this research or consent now. If you have any questions in future please ask Dr Annie Fungai Muyotcha.

AUTHORIZATION

I have read this paper about the study or it was read to me. I understand the possible risks and benefits of this study. I know being in this study is voluntary. I choose to be in this study. I know i can stop being in the study and I will not lose any benefits entitled to me. I will get a copy of this consent form. **Client signature** **Date**

Researcher Signature **Date**

APPENDIX 4- QUESTIONNAIRE

P.O. Box A178

Avondale,

Harare Zimbabwe

Telephone: **263-4-707707/731000**

Fax: **263-4-794272/621345**
***Telegrams*:** **UNIVERSITY**

Email: **obsgynpari@zol.co.zw**

UNIVERSITY OF ZIMBABWE Department Of Obstetrics & Gynaecology

QUESTIONNAIRE

SUBJECT NO. _____

1. Date of ECS

Weekday ☐ Weekend ☐

2. Time of delivery

Call ☐ Cover ☐

3. Age in years_____

4. **Marital status**

Single ☐ Married ☐ Divorced ☐ Widowed ☐

5. **Level of education**

Uneducated ☐ Primary ☐ ZJC ☐ O-level ☐ A-level ☐ Tertiary ☐

6. **Religious affiliation**

Christian ☐ Apostolic ☐ Muslim ☐ None ☐

7. **Occupation**

Unemployed ☐ Skilled worker ☐ Unskilled worker ☐ Self-employed ☐

Student ☐

8. **Parity** _____

9. **Gravidity** _____

10. **Gestational age at delivery** _____ weeks

11. Previous uterine surgery including Caesarean section

☐ 1previous CS ☐ 2previous CS ☐ 3previous CS ☐ None ☐

12. Booking status

Booked ☐ Unbooked ☐

13. Referral status

Self-referral ☐ From GHMU including this hospital ☐ Outside GHMU ☐

14. Type of labour

Spontaneous ☐ Induced ☐ Augmented ☐ No labour ☐

15. Number of foetuses

One ☐ Two ☐

16. **Presentation of foetus**

Cephalic ☐ Breech ☐ Face ☐ Arm ☐

17. Indication for Caesarean Section

Category 1 ☐ Category 2 ☐

18. Seniority of the surgeon

Consultant ☐ Registrar ☐ Intern ☐

19. **Decision to delivery interval in minutes** _____

20. Reason for delay if decision to delivery interval is more than 30 minutes

_____

21. Number of theaters in use at the time Caesarean Section was performed

One ☐ Two ☐

22. Type of anaesthesia

Regional ☐ General ☐

23. **Anaesthetic time in minutes** _____

24. Seniority of anaesthetist

Consultant ☐ registrar ☐ nurse anaesthetist ☐ intern ☐ sna ☐

25. APGAR score

1minute_____ 5minute_____

26. Neonatal unit admission

Yes ☐ No ☐

27. Reason for NNU admission_____

28. Duration of NNU admission

<1day ☐ 1-7days ☐ >7days ☐

29. Perinatal death

Macerated stillborn ☐ Fresh stillborn ☐ Neonatal death ☐ N/A ☐

30. **Estimated blood loss in millilitres** _____

31. Patients satisfaction/dissatisfaction with the DDI

Very unhappy ☐ Unhappy ☐ Indifferent ☐ Happy ☐ Very happy ☐

32. Condition of mother at 7 days postpartum

Good ☐ Poor ☐ Unknown ☐

33. Condition of baby at 7 days after delivery

Good ☐ Poor ☐ Unknown ☐