UTS UNIVERSITY OF TECHNOLOGY SYDNEY

A descriptive study of umbilical cord clamping practices by midwives, obstetricians and other medical staff in Zambia

By Bupe Mwamba

Thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

Under the supervision of Professor Caroline Homer
Doctor Deborah Debono
Doctor Choolwe Jacobs

University of Technology Sydney, Australia
Faculty of Health

February 2022.

Certificate of Original Authorship

I, Bupe Mwamba declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Nursing and Midwifery/ Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

"This research is supported by the Australian Government Research Training Program."

Signature: Production Note:
Signature removed prior to publication.

Date: 25th February 2022.

Acknowledgements

Being the first in the family to have received a Masters of Philosophy and now a Doctor of Philosophy, indeed just like my Bupe, this is a gift to my family and every person that I will come in contact with. I will forever be grateful to God for this opportunity and will always endeavour to do unto others what I would love them do to me. I am very grateful to God for seeing me through this program, how can I repay the Lord for his goodness to me? Like Mary, I will sing Luke 1:46-54 because the almighty God has done marvellous things in my life. I have come this far by faith. Crossing over to completion was not an easy road; however, it has built my faith. All I did was to depend on God and believe that everything will work together for good because I believe, trust and obey (Joshua 3:1-19 and Romans 8:28). Indeed, everything happens for a purpose and at God's own time, I have come to the end of the program. Thank you, Lord.

Further Gratitude's goes to the following:

To my Main Supervisor Professor Caroline Homer, may God bless the works of your hands, reaching this far is because of your support. Words alone cannot describe how grateful I am to you.

To my Co-Supervisors Dr Deborah Debono and Dr Choolwe Jacobs, thank you very much for your tireless effort in guiding me throughout this degree.

For my previous Supervisors Professor Maralyn Foureur, A/Professor Lynn Sinclair and Professor Joanne Travaglia, thank you very much and may God bless you.

To Father Godwin Mulenga, the University Teaching Hospital Lusaka Zambia, Chaplain, thank you very much for walking this journey of faith with me. You stood with me in prayer as I navigated this journey. It was a journey of faith. Your words of encouragement kept me going. May our good Lord bless the works of your hands.

To the former Minister of Health, Ministry of Health Zambia, Dr. Chitalu Chilufya- may God enlarge your territory. You overrode the decisions of my Senior Medical Superintendent and Permanent Secretary in releasing me to embark on this journey. Thank you very much and I will forever cherish your office for this achievement.

To Dr. Ngwisha, thank you very much for your words of wisdom. Our chat in the street of the University Teaching Hospital in Lusaka inspired me to pursue this doctoral degree.

To Prof. Lackson Kasonka, our former Senior Medical Superintendent University Teaching Hospital in Lusaka and current Permanent Secretary Ministry of Health Zambia, thank you very much for supporting my career advancement.

To Prof. Peter Mwaba, our former Managing Director and former Permanent Secretary Ministry of Health Zambia, thank you very much for supporting my career advancement.

To my Global Leadership Mentoring Community Mentor, Dr Liz Westcott, you came into my life when I was going through the valley, you took up the role of a mother and provided the needed direction, guidance and strategies that helped me navigate the challenges I was facing. Thank you very much.

To the University of Technology Sydney, thank you for the full funding of my studies throughout this training.

To my colleagues, thanks for the friendship and for always being there to make sure that we were all happy.

To my family, thank you very much for trusting in my abilities.

To Mr Urbano Mutati and Cindy Chirwa, thank you very much for your continued support.

To the Catholic Charismatic intercessory family, thank you very much for your support in prayer throughout this journey.

To my network, thank you very much for your continuous cheering. The cheering gave me more strength to work even harder.

To my late mom (Victoria Kangwa), dad (Peter Mwamba) and elder brothers (Anthony and Charles Mwamba), may your souls rest in eternal peace. This is a dedication to you all. Mum, your absence has made me to be strong because it is the only option I have.

To my late prayer partner and friend, Dr. Sr. Charity Chishimba, I cherish the journey I shared with you. It breaks my heart that you had to die of COVID-19, which you contracted in the line of duty. March 8, 2021 turned the world upside down for me. You died at the time when I needed you most. I wish you were still alive to see me to the end of this program. We had a lot of unfinished charity work to accomplish. Your prayers and your support in the storms were unmatched. I had found an elder sister in you.

Format of the thesis

Chapter One: The presentation of the thesis will start with the introduction, background, context, significance and overview of the study.

Chapter Two outlines the literature review that was undertaken to inform the development of the study.

Chapter Three presents the theoretical underpinnings and the overview of the methods.

The following three chapters also include a detailed section on the different methods used in each phase of the study.

Chapter Four presents Phase 1, which was a survey that determined cord-clamping practices by midwives, obstetricians and other maternity health care workers.

Chapter Five presents Phase 2, which was the review of a series of umbilical cord clamping guidelines and an analysis using the AGREE II tool.

Chapter Six presents Phase 3, which explored the motivation to delayed cord clamping practices among midwives who are the majority of maternity care workers in Zambia. This chapter also presents the Zambian perspective on implementation of innovations in maternal, newborn and child health from interviews with key informants.

Chapter Seven ends the thesis. The chapter discusses an integration of all the findings, which is followed by a section explaining the strengths and limitations of the study. The chapter finishes with a series of recommendations and the conclusion.

Appendices: Each appendix is a supplement document to the thesis.

References: The reference list has been generated using the recommended reference guide, which is Harvard UTS.

I declare that I received assistance with the final editing of the thesis from a copyeditor. This was supported by UTS and did not alter the substance or findings.

Table of contents

List of tables

List of Figures

Abstract

Title

A descriptive study of umbilical cord clamping practices by midwives, obstetricians and other maternity care workers in Zambia.

Background

Delayed cord clamping, defined as clamping of the umbilical cord at 1 to 3 minutes after birth, has benefits, plays a vital role in improving haematological outcomes in infants and may reduce the lifetime risk of anaemia. The World Health Organization recommends delayed cord clamping. Implementation of this recommendation and diffusion of delayed cord clamping into clinical practice in Zambia is unknown.

Aim

The purpose of this thesis was to explore umbilical cord clamping practices by midwives, obstetricians and other maternity care workers working in Zambia.

Method

An explanatory sequential mixed method study was conducted with three phases. Phase 1 used an online survey to explore the cord clamping practices by midwives, obstetricians and other maternity care workers across Zambia. Phase 2 collected and analysed guidelines that informed cord clamping practices from 100 birth units across Zambia. Phase 3 was a qualitative study with midwives and key informants from the Ministry of Health using semi-structured interviews. The qualitative data were analysed using the Theoretical Domain Framework.

Results

In the survey, delayed cord clamping was reported to be practised in term healthy newborn babies by 40% of the 239 survey respondents. Half the respondents (51%) said they did not have guidelines to inform cord-clamping practice. In Phase 2, seven different guidelines were analysed. Of these, three provided information on delayed cord clamping while the other four emphasised immediate cord clamping. In Phase 3, the motivation to delayed cord-clamping practice by midwives was because of the identified benefits for babies. Key informants from the Ministry of Health identified the benefits that come with delayed cord clamping as the reason for its implementation.

Conclusion

Delayed cord clamping was identified as a challenge especially with few guidelines and a lack of dissemination. Immediate cord clamping was still prevalent. In order to bring about change, adopters need information to make an informed decision to embrace the new practice. There is a need for a national guideline on delayed cord clamping, which should be developed and disseminated through information sharing. Informal and formal information sharing about delayed cord clamping by prior adopters may result in practice change.

Implication for practice

The insights from this study will formulate strategies to increase the diffusion of delayed cord clamping in birth units across Zambia. A national guideline on delayed cord clamping, education and dissemination through education may result in change in birth units.

Keywords

Delayed cord-clamping practice, immediate cord clamping, midwives, obstetricians, benefits, risks, anaemia.

List of abbreviations

AIDS	Acquired Immunodeficiency Syndrome
AMTSL	Active management of the third stage of labour
CI	Confidence interval
DCC	Delayed cord clamping
DHS	Demographic Health Survey
DIC	Disseminated intravascular coagulation
dL	Decilitre
EM	Enrolled midwife
EmONC	Emergency Obstetrics and Newborn Care
ENC	Essential Newborn Care
g	Grams
g/L	Grams per litre
GNMCZ	General Nursing and Midwifery Council of Zambia
Hb	Haemoglobin
Hct	Haematocrit
HIV	Human Immunodeficiency Virus
ICC	Immediate cord clamping
IDT	Innovation Diffusion Theory
IQ	Intelligence quotient
JBI	Joanna Briggs Institute
LMIC	Low and middle income countries
MAZ	Midwives Association of Zambia
mg	Milligrams
mg/dL	Milligrams per decilitre
min	Minutes
mL	Millilitres
mL/kg	Millilitres per kilogram
MOHZ	Ministry of Health Zambia
MTCT	Mother to child transmission
NICU	Neonatal intensive-care unit
OSCE	Objective structured clinical examination
PC	Pulsation cessation

PMTCT	Prevention of mother to child transmission
PPH	Post-partum haemorrhage
RCT	Randomised controlled trial
RM	Registered Midwife
RNM	Registered Nurse Midwife
RR	Risk ratio
sec	Seconds
TDF	Theoretical Domains Framework
UNICEF	United Nations Children's Emergency Fund
WHO	World Health Organization
ZAGO	Zambian Association of Gynaecologists and Obstetricians
µg	Micrograms
µmol	Micromole

CHAPTER 1

1.1 INTRODUCTION AND BACKGROUND

Umbilical cord clamping and cutting occurs at almost every birth attended by a health professional although there is uncertainty as to the timing of this practice. This thesis concerns the issue of delayed cord clamping of the umbilical cord at birth. In this context, 'delayed' is defined as clamping the cord at between 60 seconds to 180 seconds. This is in contrast to usual umbilical cord clamping practices, which means the cord was clamped immediately after birth. There are benefits associated with delayed cord clamping (Fogarty et al. 2017; McDonald et al. 2014), although this is not a universal practice in many countries around the world.

This thesis was conducted in Zambia. There is no recent published evidence on the umbilical cord clamping practices in Zambia and anecdotal experience suggests that delayed cord clamping practice was below 50%. The overall aim was to explore umbilical cord clamping practices among midwives, obstetricians, nurses and other medical staff working in maternity care in Zambia.

This chapter presents an introduction, a brief background to the issues and context, problem statement, purpose and significance of the study. The chapter ends with an outline of the remaining chapters.

1.2 BACKGROUND TO UMBILICAL CORD CLAMPING

Umbilical cord clamping is a procedure performed on all babies to separate them from the placenta after birth (Sellers 2018). The usual practice of umbilical cord clamping has been 'Immediate Cord Clamping' defined as clamping within one minute of birth, which is included in guidelines taught for active management of the third stage of labour in midwifery programs in most countries (Sellers 2018). This method involves the application of controlled cord traction after signs of placental separation appear. The definite sign that placental separation has occurred is a gush of blood from the vagina, and the elongation of the cord (Sellers 2018). In most cases, placental separation occurs soon after the administration of a uterotonic and/or 'rubbing up' of the fundus of the uterus by the midwife, to stimulate a contraction (Sellers 2018).

In the past two decades, evidence has emerged revealing that immediate cord clamping may not be beneficial as it could deprive the newborn of the small volume of blood available through the physiological process of placental transfusion. Research has showed that delaying cord clamping for between 60 to 180 seconds after birth, or until cessation of pulsations of the cord after birth (Fogarty et al. 2017; Rabe et al. 2012; World Health Organization 2013, 2014c) facilitates the transfusion of the optimal amount of blood to the newborn. Twenty five percent of the placental transfusion occurs at 15 to 30 seconds after birth, while most (50-78%) occurs at about 60 seconds, and the remaining 22% by 180 seconds after birth (Aladangady et al. 2006). Studies have demonstrated that the placental transfusion that occurs during delayed cord clamping can increase the iron stores of young infants by over 50% at six months of age, and reduce by 61% the rate of anaemia requiring blood transfusion in children (World Health Organization 2014d).More detail on the benefits and potential harms is presented in Chapter 2.

1.3 ANAEMIA AS A PUBLIC HEALTH CONCERN

For the last several years there has been an increasing focus on the importance of delayed cord clamping at birth for the reduction of anaemia. Anaemia is a major public health issue in low, middle, and high-income countries. It affects approximately 24.8% of the world's population, with a prevalence rate of more than 40% (World Health Organization 2015). The most affected groups are children, pregnant and non-pregnant women of childbearing age. It is estimated that 43% of children, 38% of pregnant women and 29% of non-pregnant women of reproductive age have anaemia (World Health Organization 2015). Anaemia in pregnancy is associated with an increased risk of premature labour, low birthweight and increased risk of maternal and perinatal mortality (Khan, Nasrullah & Jaleel 2016). Anaemia affects approximately 293 million preschool age children globally, with 68% of these children in low and middle income countries (LMICs) (World Health Organization 2015). Anaemia in pregnancy has implications for the current pregnancy, the labour and birth and the future health of the baby.

Anaemia is characterised by low haemoglobin (Hb) concentration, which affects the size and number of red blood cells (Bhagavan & Ha 2015). When the Hb concentration falls below an established cut-off value, changes occur within the transport capabilities

of the blood in the transportation of oxygen around the body. The Hb threshold among children from six months to five years is 110g/L, which means any child with an Hb concentration of <110g/L is considered to have anaemia (World Health Organization 2015). Anaemia in children results in increased morbidity and mortality.

1.4 Predisposing Factors to Iron Deficiency Anaemia

The major contributing factors to iron deficiency anaemia are a diet low in iron intake, malabsorption of iron as a result of consuming a high phenolic compound diet, intestinal worm infestation, and periods in life when iron requirements are high like infancy, childhood, adolescence, and pregnancy (World Health Organization 2015). The phenolic compounds are considered to interfere with iron absorption by complex formation with iron in the gastro-intestinal lumen, making the iron less available for absorption. Other contributing factors include heavy blood loss from menstruation, repeated pregnancies and other chronic diseases (World Health Organization 2015). Iron requirements during infant growth may not be met when mothers follow the World Health Organization (WHO) recommendation to breastfeed for the first six months of life exclusively, as the iron content in breast milk is too low to meet the demands of the growing infant, especially in women with iron deficiency anaemia (World Health Organization 2013, 2014c). It is estimated that 29% (496 million) of non-pregnant women and 38% (32.4 million) of pregnant women aged 15–49 years are anaemic with half of these women having anaemia as a result of iron deficiency (Stevens 2013; World Health Organization 2015).

1.5 Importance of iron

Iron is a mineral essential for health as it is an important component of haemoglobin, a protein responsible for transporting oxygen throughout the body. During pregnancy, increased red cell volume is required for both the mother and developing fetus thus increasing iron requirements (Bhagavan & Ha 2015; Dewey & Chaparro 2007). Iron is important because it is required for the normal function of enzymes and metabolic pathways (Bhagavan & Ha 2015). Significant iron accretion in the fetus occurs from 32 weeks of gestation onwards, and its transportation throughout the body is intensified from 37 weeks; therefore infants born prematurely have little iron stores

(Backes et al. 2014; Beard 2008; Bradley et al. 2004; Katheria et al. 2017), which makes them at an increased risk of iron deficiency anaemia.

Iron plays a pivotal role in the development of the brain for neurogenesis (neuron generation), and differentiation of some brain cells and brain regions (Chaparro 2011; Dewey & Chaparro 2007). Severe or chronic iron deficiency anaemia during fetal life and infancy can result in severe neural developmental and behavioural disorders in the child (Chaparro 2011; Chaparro et al. 2006; World Health Organization 2014c). Research from more than a decade ago showed that the behavioural effects of iron deficiency in children include being more fearful, shy, wary, hesitant, unhappy, tense, exhibiting less pleasure, and wanting to be more attached to their parents (mainly the mother) when playing (Beard 2008). Iron deficiency can also impair the mental, psychomotor, hearing and vison development in children (Beard 2008). A study by Lozoff et al. (2006) has associated iron deficiency with adverse effects on developmental and behavioural outcomes in infants with chronic iron deficiency (Lozoff et al. 2006; Lozoff & Georgieff 2006). However, more recent research has revealed that iron deficiency anaemia can be reduced with strengthening of preventive measures (World Health Organization 2014d).

The morbidity associated with anaemia is costly because of the prolonged hospital stays and increased mortality associated with the disease (Stevens 2013; World Health Organization 2015). Midwives and obstetricians have an important role to play in reducing anaemia in children, by embracing cost effective preventive measures, a primary one of which is delayed umbilical cord clamping at birth as will be explained later in this chapter (World Health Organization 2014d).

1.6 PREVENTION OF IRON DEFICIENCY ANAEMIA IN WOMEN OF CHILDBEARING AGE

The WHO has placed the reduction of iron deficiency anaemia as the second global nutrition target for 2025 and calls for a 50% reduction of anaemia in women of childbearing age (World Health Organization 2014b). Iron deficiency anaemia is especially a priority in low and middle income countries (LMIC), where its prevalence remains high and in many cases, it is among the top ten causes of morbidity and mortality across all age groups (World Health Organization 2014c). The WHO has identified ways of preventing iron deficiency anaemia through increasing iron supplies

in the body (World Health Organization 2015). The strategies include: a maternal diet containing adequate amounts of iron, malaria control, and offering mothers deworming treatments, as well as delayed umbilical cord clamping at birth, which enables the transfusion of an extra volume of blood from the placenta to the infant, thereby increasing iron stores (World Health Organization 2014c).

1.7 THE IMPORTANCE OF PLACENTAL TRANSFUSION AT THE TIME OF BIRTH

Placental transfusion is the process by which an extra amount of blood from the placenta flows to the newborn at birth through the intact umbilical vein (Diagram 3) (Chaparro et al. 2006; Duley & Batey 2013). During pregnancy, the placenta connects to the fetus for gaseous exchange, nutrition and excretion (Diagram 3) (Sellers 2018). The placenta transports oxygen in the blood from the maternal circulation through the umbilical vein to the fetal circulation, whereas umbilical arteries transport this blood from the fetus to the placenta (Backes et al. 2014; Katheria et al. 2017; Vain et al. 2014). At birth, the baby is separated from the placenta and it is at this point where placental transfusion has been found to increase haemoglobin (Hb) levels; higher Hb enhances arterial oxygen content, cardiac output and improves oxygen delivery to the tissues (Chaparro et al. 2006; Duley & Batey 2013).

The placenta transports oxygen in the blood from the maternal circulation through the umbilical vein to the fetal circulation (Backes et al. 2014; Katheria et al. 2017). In utero, 29% of the blood output in the combined fetal heart ventricles is approximately 130mLs/kg of the fetal body weight (Linderkamp 1982; Linderkamp 1987; Vain et al. 2014). Umbilical arteries transport this blood from the fetus to the placenta, whereas the umbilical vein transports blood to the fetus (Vain et al. 2014). At approximately 45 seconds after the baby is born, during the third stage of labour, the umbilical arteries constrict, which slows down blood flow from the newborn to the placenta (Yao & Lind 1974). The umbilical vein remains patent for a much longer time after birth, which allows for the transfusion of blood from the placenta to the newborn (Yao & Lind 1974).

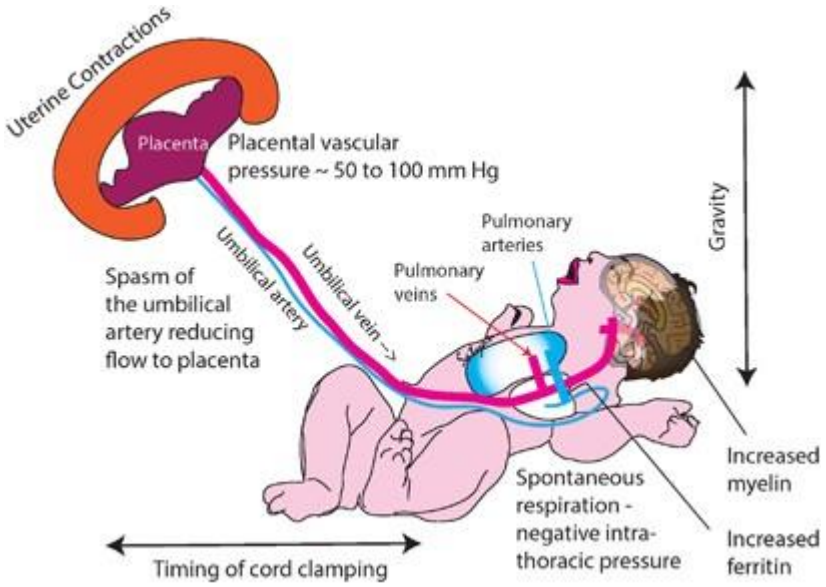
As will be shown in the literature review that informed this study (Chapter 2), there is strong evidence that shows that delayed cord clamping can play a vital role in improving haematological outcomes in infants, and that this can reduce the lifetime risk of anaemia (Fogarty et al. 2017). In 2013, this evidence prompted the World

Health Organization to strongly recommend a shift in umbilical cord clamping from immediate to delayed cord clamping (World Health Organization 2013).

Until recently, Yao and Lind (1974), who are proponents of delayed cord clamping, recommended that at birth, the birth attendant, a midwife, doctor or other clinician, should place the newborn on the mother's abdomen or between the mother's legs, to optimise placental transfusion (Yao & Lind 1974). The recommended placement was measured at either 10 centimetres above the placenta (on the mother's abdomen) or below the placenta (between the mother's legs) for placental transfusion to occur (Chaparro & Lutter 2007). Previous research found the rate of flow increased with the placing of the newborn below the level of the placenta, and this process appeared to aid faster placental transfusion (Linderkamp 1982; Linderkamp 1987). This early research recommended the placing of the newborn below the level of the placenta because in the earliest randomised controlled trials (RCT) it was thought that gravity reduced the rate of blood flow through the blood vessel if the newborn was held above the placenta (Yao & Lind 1974; Yao, Moinian & Lind 1969). These assumptions have since been challenged.

In the last five years, research has suggested that the issue of positioning as a factor that contributes to effective placental transfusion is insignificant. A RCT that aimed to assess the effect of gravity on placental transfusion (Vain et al. 2014) that included 391 newborns, found that the differences in placental transfusion between the two groups were statistically and clinically insignificant. The researchers concluded that the position of the infant on the abdomen does not affect the rate of transfusion (Vain et al. 2014). This study suggested that, when delayed cord clamping is performed at 120 seconds, the volume of placental transfusion is not affected by position (Diagram 1). This means that the only factor that affects placental transfusion is time. Therefore, clinicians can focus on the timing of cord clamping with the newborn placed on the mother's abdomen for bonding, prevention of hypothermia, and initiation of breastfeeding as the best practice in umbilical cord clamping.

Diagram 1: Factors that enhance placental transfusion (Katheria et al. 2017)



Despite the benefits of delayed cord clamping, its implementation in many countries and especially in low and middle-income countries where the burden of anaemia is a major global health issue has been slow. This could be attributed to previous training that focused more on the active management of the third stage of labour to prevent postpartum haemorrhage which includes immediate cord clamping and concerns about possible risks associated with delayed cord clamping (Ibrahim et al. 2017; Leslie et al. 2018). The possible risks to the baby associated with delayed cord clamping include polycythaemia, jaundice and anecdotally the risk of maternal transmission of human immunodeficiency virus (HIV). The risk of polycythaemia and jaundice are physiological, which can occur with or without delayed cord clamping because upon separating the neonate from the placenta, fetal circulation ceases and adult circulation begins (Maisels & McDonagh 2008).

In order to understand the potential issues associated with delayed cord clamping, it is important to recap the fetal circulation. In the fetal circulation, the lungs are usually not active and the liver is not fully developed. Blood circulation avoids the lungs and liver and flows through shunts, which are special openings in the heart of the baby (Sellers 2018). The umbilical vein plays a vital role in the transportation of oxygen and nutrients from the mother's blood via the placenta to the fetus through a temporal shunt called the ductus venosus. Oxygenated blood from the mother enters the right side of the heart into the right atrium of the baby. Blood flows across to the left atrium through a shunt called the foramen ovale. Blood moves down into the left ventricle

from the left atrium where it gets pumped into the ascending aorta. The oxygenated blood from the aorta is first sent to the brain and the heart muscle followed by the lower body. This is the reason why most babies are born with blue extremities because oxygenated blood is prioritised for vital organs. Deoxygenated blood and waste products move from the fetal body to the heart through the right atrium and flow through the right ventricle, where in adult circulation they will be sent to the lungs for oxygenation. In the fetal circulation, blood bypasses the lungs and flows through the ductus arteriosus into the descending aorta to the umbilical arteries, which transport it back to the placenta. It is in the placenta where carbon dioxide and waste products are released into the maternal circulation and where oxygen and nutrients are transferred from the maternal circulation across the placenta to the fetal circulation.

At the time of the birth, major physiological changes take place. With the first breaths of air, the lungs start to expand, and the ductus arteriosus and the foramen ovale both close. The baby's circulation and blood flow through the heart now function like an adult. The liver begins to function and because of its immaturity for the increased red blood cell break down, polycythaemia and jaundice are likely to occur.

Usually, the serum bilirubin levels in physiological neonatal jaundice do not go beyond the requirement for treatment, usually phototherapy. It is recommended that phototherapy should be started when the total serum bilirubin level is at or above 15 mg per dL (257 μmol per L) in infants 25 to 48 hours old; 18 mg per dL (308 μmol per L) in infants 49 to 72 hours old, and 20 mg per dL (342 μmol per L) in infants older than 72 hours (Maisels & McDonagh 2008). The other issue that has been noted anecdotally with the practice of delayed cord clamping is concern about increasing the rate of mother to child transmission of HIV.

With regards to mother to child transmission of HIV, now that most low and middle income countries are implementing the use of antiretroviral medications during pregnancy to prevent mother to child transmission treatment, the risk of transmission with adherence is closer to zero (Fasawe et al. 2013). This treatment option is the lifelong treatment of all HIV positive woman of childbearing age. Before, the implementation of this choice of treatment, treatment was only commenced after CD4 count and viral load estimations and depending on the gestation age. But with the current option (known as Option B+), treatment is commenced at the first contact regardless of the gestation age, CD4 count and viral load results (Fasawe et al. 2013).

Therefore, with adherence to prevention of mother to child transmission of HIV, there is no longer a reason for immediate cord clamping.

Diagram 2: The placental transfusion (Source RCOG.Umbilical cord clamping in term deliveries: the RCOG perspective PowerPoint Presentation. ID: 4765803).

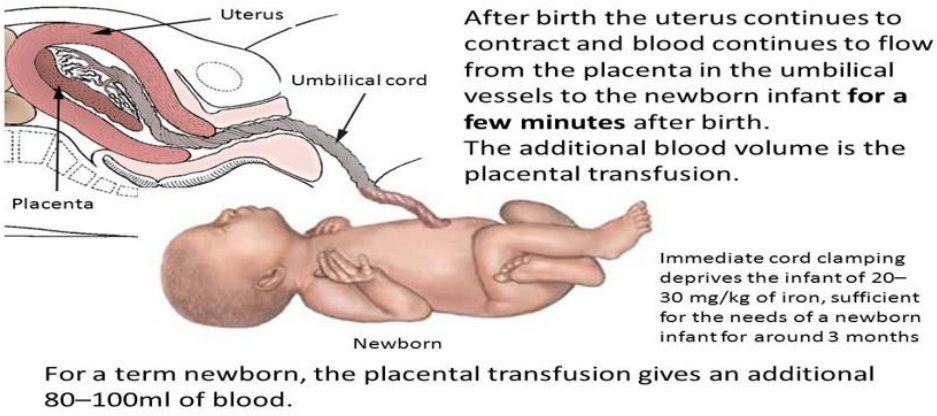
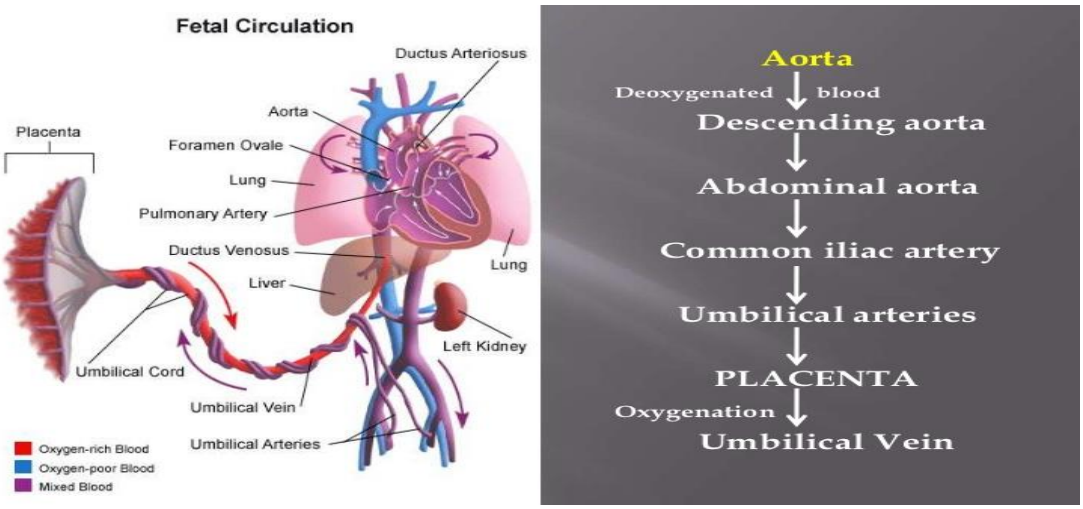


Diagram 3: Fetal Circulation



(Chapter 16: Neonatal care 2015)

Volume of blood transfusion

An average sized newborn baby (around 3.5kg) will have approximately 290mL of blood volume at birth that is equivalent to 80-85mL per kilogram of body weight (Prendiville, Elbourne & McDonald 2000). During the physiological process of placental transfusion, studies have revealed that approximately 80 to 100 mL of blood is transfused into the newborn via the umbilical blood vessel. The placental transfusion results in the addition of about 10 to 50% of blood volume to the newborn, and the red cell mass increases by 25 to 60% (Dewey & Chaparro 2007; Fogarty et al. 2017; Levy & Blickstein 2006; Linderkamp 1982; Linderkamp 1987; Vain et al. 2014). Researchers have suggested that placental transfusion provides up to 75mg of iron for the infant's first six months of life (Blouin et al. 2013).

Whilst the haemodynamic changes that occur with placental transfusion improve the perfusion, haemoglobin, and iron content of blood in the newborn, some argue that it also carries risks (Ghavam et al. 2014). Some studies have associated placental transfusion with the development of polycythaemia and jaundice in the newborn (Fogarty et al. 2017; Maisels & McDonagh 2008; Rabe et al. 2012). However, the benefits of placental transfusion outweigh the risks, as described in the review of the literature in the next chapter. For optimal placental transfusion to occur, studies have indicated that certain events need to happen. These events include: 1) uterine contractions, 2) delayed cord clamping to allow for complete placental transfusion to

occur (Duley & Batey 2013), and 3) the position of the infant during delayed cord clamping in relation to the placenta (although recent evidence contradicts this finding (Vain et al. 2014)).

It is suggested that the use of uterotonic drugs to enhance a contraction following birth of the baby, facilitates placental transfusion (Duley & Batey 2013). In Zambia, and several other LMICs countries, intramuscular uterotonic injections are usually used immediately after the birth of the newborn following an abdominal palpation to confirm the empty status of the uterus (Sellers 2018). The uterotonic drug aids the separation of the placenta from the uterine wall, and closure of the cervix, as well as controlling bleeding from the placental bed (Sellers 2018).

1.8 CONTEXT FOR THIS STUDY

Of the total cases of anaemia, Africa has the highest number of cases at approximately 68% of all global cases (Benoist et al. 2008; World Health Organization 2015). As Table 1 indicates, in Zambia, 58% of children under five, and 28% of non-pregnant childbearing women had iron-deficiency anaemia in 2015 (World Health Organization 2015). Recent evidence shows that 31% of women aged between 15 to 49 years in Zambia have anaemia, with 16% being classified as mildly anaemic, 14% as moderately anaemic, and 1% as severely anaemic (Central Statistical Office & Zambia 2018). Maternal consequences of iron deficiency anaemia include preterm birth, post-partum haemorrhage, disseminated intra coagulopathy, perinatal mortality, and postpartum depression (Lubeya & Vwalika 2017). These women are at an increased rate of having preterm babies as a complication of anaemia. Preterm babies are also at greater risk of anaemia and this poses additional risks in countries with high rates of preterm birth. For example, in Zambia, the preterm birth rate is 12.9% of all live births and therefore this group are at increased risk of developing anaemia (Zambia Demographic Health Survey 2014). In addition, children whose mothers had iron deficiency anaemia in pregnancy are more likely to develop iron deficiency anaemia because of the low iron build-up in utero (Linderkamp 1987; World Health Organization 2015). As Table 1 indicates, the 2018 Zambia Demographic Health Survey (DHS) has shown that 58% of children in Zambia have anaemia, of which 29% are classified as mildly anaemic, 28% had moderate anaemia, and 2% were severely anaemic. This is similar to the findings of the 2013-2014 survey, which calls for

concerted actions in reducing anaemia (Zambia Demographic Health Survey 2014). Anaemia is higher among children aged 9-11 months and 12-17 months (both 77%) compared to other age groups (Tables 4 and 5). This is a further reason why delayed cord clamping at every birth should be embraced for placental transfusion, which has been associated with reducing the risk of anaemia in the first 1000 days of life.

Table 1: WHO iron deficiency anaemia estimates in Zambia

Age and sex group	**Haemoglobin (Hb) threshold (g/L) Estimated as a percentage (%)**
Children (males and females) < 6 months	Not specified
Children (males and females) 6 months – 5 years	
Hb <110 g/L	58
Hb <70 g/L (Severe Anaemia)	2.9
Non-pregnant women ≥ 15 years	
Hb <120g/L	28
Hb <80g/L (Severe Anaemia)	1.2

(World Health Organization 2015)

Table 2: Prevalence of anaemia in women in Zambia

Percentage of women aged 15-49 with anaemia, according to background characteristics, Zambia DHS 2018

	Anaemia status by haemoglobin level				
Background Characteristics	**Any anaemia (<11.0 g/dl)** %	**Mild anaemia (10.0-10.9 g/dl)** %	**Moderate anaemia (7.0-9.9 g/dl)** %	**Severe anaemia (<7.0 g/dl)** %	**Number of women**
Age					
15-19	33.4	19.0	13.1	1.3	2,903
20-29	28.6	15.6	11.7	1.3	4,815
30-39	31.3	15.6	14.2	1.5	3,435
40-49	33.1	14.5	17.0	1.7	2,082
Number of living children					
0	34.7	18.8	13.8	2.1	3,233
1	32.9	16.2	15.1	1.6	2,236
2-3	28.8	14.7	13.0	1.0	3,324
4-5	30.2	15.9	13.5	0.8	2,254
6+	28.1	14.6	12.1	1.4	2,187
Pregnant Status					
Pregnant	41.2	21.3	19.1	0.8	1,083
Breastfeeding	27.6	16.5	10.3	0.8	2,985
Neither	31.0	15.4	13.9	1.7	9,166
Residence					
Urban	32.1	15.4	15.0	1.8	6,131
Rural	30.2	16.8	12.2	1.1	7,104
Education					
No education	30.7	15.8	13.9	0.9	1,004
Primary	30.6	16.7	12.6	1.3	5,895
Secondary	31.1	15.5	14.1	1.6	5,622
Higher	35.1	17.4	16.1	1.5	713

Table 3: Prevalence of anaemia in women in Zambia

Percentage of women aged 15-49 with anaemia, by province and wealth quintile, Zambia DHS 2018

	Anaemia status by haemoglobin level				
Background Characteristics	**Any anaemia (<11.0 g/dl) %**	**Mild anaemia (10.0-10.9 g/dl) %**	**Moderate anaemia (7.0-9.9 g/dl) %**	**Severe anaemia (<7.0 g/dl) %**	**Number of women**
Province					
Central	23.8	12.6	10.5	0.7	1,145
Copperbelt	29.2	15.6	12.0	1.5	2,114
Eastern	27.6	16.0	11.0	0.6	1,555
Luapula	29.8	17.5	11.3	1.0	978
Lusaka	35.6	15.7	17.7	2.2	2,686
Muchinga	27.6	15.5	11.6	0.5	745
Northern	28.0	17.0	10.4	0.6	1,048
North Western	32.2	17.1	13.7	1.5	696
Southern	35.3	18.3	14.7	2.3	1,501
Western	37.9	17.2	18.8	1.9	767
Wealth quintile					
Lowest	30.2	16.4	13.2	0.7	2,358
Second	30.6	18.1	11.3	1.2	2,320
Middle	30.5	16.2	12.9	1.4	2,406
Fourth	30.6	14.4	14.2	1.9	2,945
Highest	32.8	16.1	15.0	1.7	3,205

Table 4: Prevalence of anaemia in children in Zambia

Percentage of children aged 6-59 months classified as having anaemia, according to background characteristics, Zambia DHS 2018

	Anaemia status by haemoglobin level				
Background characteristics	**Any anaemia (<11.0 g/dl) %**	**Mild anaemia (10.0-10.9 g/dl) %**	**Moderate anaemia (7.0-9.9 g/dl) %**	**Severe anaemia (<7.0 g/dl) %**	**Number of children aged 6-59 months**
Age in months					
6-8	73.1	28.8	42.2	2.2	451
9-11	77.1	25.4	48.8	3.0	479
12-17	76.6	30.9	43.1	2.6	960
18-23	71.8	33.8	36.8	1.2	944
24-35	59.1	30.3	27.3	1.5	1,968
36-47	49.5	28.6	19.4	1.5	1,988
48-59	41.1	24.0	16.8	0.3	1,834
Sex					
Male	59.7	28.4	29.5	1.8	4,268
Female	56.6	28.9	26.5	1.2	4,355
Residence					
Urban	58.1	27.8	28.7	1.6	2,982
Rural	58.2	29.1	27.6	1.4	5,641
Mother's education					
No education	63.9	27.7	32.9	3.3	815
Primary	57.5	29.3	26.8	1.4	4,081
Secondary	59.9	27.9	30.9	1.1	2,742
Higher	52.8	32.3	19.2	1.3	314

Notes: Table is based on children who stayed in the household on the night before the interview and who were tested for anaemia. Haemoglobin is in grams per decilitre (g/dl). Total includes four children (five unweighted) for whom information on mother's education is missing.

Table 5: Prevalence of anaemia in children in Zambia

Percentage of children aged 6-59 months classified as having anaemia, according to province and wealth quintile, Zambia DHS 2018

	Anaemia status by haemoglobin level				
Background characteristic	**Any anaemia (<11.0 g/dl) %**	**Mild anaemia (10.0-10.9 g/dl) %**	**Moderate anaemia (7.0-9.9 g/dl) %**	**Severe anaemia (<7.0 g/dl) %**	**Number of children aged 6-59 months**
Province					
Central	50.0	28.4	21.2	0.3	773
Copperbelt	57.2	26.1	29.7	1.4	1,104
Eastern	55.9	28.9	25.8	1.2	1,134
Luapula	70.7	29.7	38.2	2.8	796
Lusaka	57.9	28.7	27.7	1.5	1,334
Muchinga	53.5	27.4	25.1	0.9	535
Northern	61.3	29.0	29.5	2.7	773
North Western	61.6	31.7	28.8	1.1	492
Southern	55.7	28.6	25.9	1.1	1,145
Western	60.9	30.2	29.1	1.6	537
Wealth quintile					
Lowest	61.0	30.0	29.2	1.9	2,088
Second	57.4	27.0	28.9	1.4	1,933
Middle	57.8	30.7	25.8	1.3	1,646
Fourth	56.8	26.5	29.1	1.2	1,628
Highest	56.8	29.0	26.4	1.5	1,327
Total	58.1	28.7	28.0	1.5	8,623

The usual practice of umbilical cord clamping has been immediate cord clamping and this is embedded in active management of the third stage of labour and part of basic training for all skilled birth attendants in Zambia. Where there is a significant workload for the midwives, immediate cord clamping seems quicker than delayed cord clamping because the midwife has to conclude the birth as soon as possible, and move on to the next woman. However, as will be highlighted in this thesis, immediate cord clamping deprives the newborn of a small volume of blood that may have a significant effect on several haematological parameters as well as physiological and adaptive processes (Fogarty et al. 2017) and so this usual practice must be challenged.

In 2013, the WHO recommended delayed cord clamping as a cheap and cost-effective way to reduce infant and early childhood iron deficiency anaemia due to its haematological impact (World Health Organization 2013). In Zambia, the Ministry of Health placed delayed cord clamping on the national agenda by embedding it in the 2014 Essential Newborn Care guideline (Ministry of Health Lusaka Zambia 2014). In addition, many obstetricians, midwives, and nurses have undergone additional training in Emergency Obstetrics and Newborn Care (EmONC), Helping Mothers Survive, and Helping Babies Breathe, all of which have a focus on delayed cord clamping (Ersdal et al. 2017). However, anecdotally, and from my own observations of clinical practices across Zambia, the implementation and uptake of delayed cord clamping by midwives and obstetricians remains slow.

1.9 MY INTEREST IN DELAYED CORD CLAMPING

I am a Nurse-Midwife who is passionate about seeing changes in practice for the improvement of the quality of care, and the implementation of evidence based practices in women and newborn care. The doctoral research described in this thesis builds on previous research I undertook in this area and this work made me interested in exploring this issue further in this PhD.

In 2015, I won the Sanofi Espoir Foundation Midwife for Life Award to implement delayed cord clamping education in Zambia. Prior to this, I had observed that many midwives were still practising immediate cord clamping despite the strong recommendation from the World Health Organization to shift the practice to delayed cord clamping for reduction of iron deficiency anaemia among infants. When the Sanofi Espoir Foundation announced the call for proposals, I designed an educational intervention with the aim of increasing the knowledge about delayed cord clamping in Zambia.

I implemented the education sessions in March 2016 in eight institutions, which included seven midwifery schools and the University Teaching Hospital in Lusaka (Mwamba 2015). Pre and post-test questionnaires were administered. The target populations for the education sessions were student midwives, student nurses, practising midwives, practising nurses, midwife educators, tutors and clinical instructors. The objective of the education sessions was to increase the number of midwives with up-to-date knowledge of placental transfusion and the impact of

delayed cord clamping. The findings of the education sessions were that the majority of participants were knowledgeable on the timing of cord clamping and mostly practised immediate cord clamping. They attributed their decision to practise immediate cord clamping rather than delayed cord clamping to lack of local evidence to establish the relationship of immediate cord clamping with infant anaemia, together with the issue of increasing mother to child transmission (MTCT) of Human Immunodeficiency Virus (HIV) and other risks associated with delayed cord clamping, like neonatal polycythaemia, and jaundice.

Before 2013, during midwifery training in Zambia, we learnt to clamp and cut the cord immediately to prevent hypothermia of the newborn and MTCT of HIV. Furthermore, as midwives, we were taught that too much blood in the newborn increases haemolysis, which contributes to jaundice (Sellers 2018). This has since been shown to be incorrect as jaundice resulting from delayed cord clamping is usually physiological, not worrying and treatable with the use of phototherapy where necessary (Maisels & McDonagh 2008). Moreover, evidence has shown that this type of jaundice occurs in more than 60% of all healthy newborns (Maisels & McDonagh 2008). Despite this evidence and available information, in my experience the prevailing practice and belief from midwives was that immediate cord clamping would reduce neonatal jaundice and therefore was better than delayed cord clamping. This initial project sparked my interest in this topic and hence I embarked on this project for my PhD.

In order to better understand the context for this study and my interest in this area, an explanation of midwifery practice in Zambia is required and is presented next.

1.10 MIDWIFERY PRACTICE: MY PERSPECTIVE FROM ZAMBIA

Midwifery practice has evolved in recent years in Zambia. The first formal midwifery training started in 1951, which was Zambia Enrolled Midwifery (Maimbolwa 2004). Zambia Enrolled Midwifery was a one-year program that was offered to Zambia Enrolled Nurses, who had undergone a two-year general nursing program that started in 1947. Training of Registered Nurses and Midwives started in the late 1960s and was intensified in the early 1970s (Maimbolwa 2004). By 2004, Zambia had two midwifery educational programs, which were Enrolled Nurse Midwifery (ENM) and Registered Nurse Midwifery (RNM) (Maimbolwa 2004). The differences between the two programs was that to qualify for the ENM program, a person had to have nine years of

school education while RNM required 12 years of school education (Maimbolwa 2004). The University of Zambia also offered a post basic degree in Nursing, which was basically a mechanism for training nursing and midwifery lecturers (Maimbolwa 2004).

Recent years have seen the introduction of direct entry midwifery programs at colleges, which are hospital based and at the University of Zambia, which include the Registered Nurse Midwifery, Certified Midwifery, Bachelors, Masters and Doctoral degrees in midwifery. A Registered Nurse Midwife is trained in both nursing and midwifery whereas a Certified Midwife is only trained in midwifery.

I was trained as a Registered Midwife in 2008 at the then Kitwe Central Hospital and now Kitwe Teaching Hospital. Throughout my training, midwifery was defined as the practice of being with the woman from antenatal, labour up to six weeks postpartum (Bryar & Sinclair 2011; Sellers 2018). My motivation for professional development was the passion of being with women and babies in the neonatal intensive care unit (NICU) where I was allocated upon completion of my general nursing training as a Registered Nurse in 2005. I am grateful to the then Nursing Director who saw potential in me by allocating me to the NICU. In the early years of my nursing career, I developed passion towards the mothers and the babies I was nursing. It is the passion for women and babies that led me into pursuing midwifery.

At that time, the country had very few specialties that included Operating Theatre, Midwifery and Post Basic Nursing Degree. The last decade has seen major developments in midwifery practice with the addition of more than one midwifery categories, which include direct-entry midwifery (DEM), advanced diploma in nursing and midwifery, Bachelor of Science and Masters of science, and Doctor of Philosophy (PhD) in midwifery programs.

I chose midwifery because it was very close to my passion. The midwifery curriculum in Zambia is a duo module, which covers neonatal care and midwifery practice. During training, the fetal circulation, fetal skull and the pelvis were my favourite structures in viva voce examinations. The requirement to become a midwife was to attend 20 births, 50 short palpations and 20 long abdominal palpations among other things. In the process of becoming a midwife, putting myself in other women's shoes (empathy) was

paramount as was being resilient, open and being aware of the feelings, thoughts and processes that women and their families are experiencing (Bryar & Sinclair 2011). Most midwives have acute skills of observation because we use our sight patiently and with passion to assess any deviations from normal. We also use the sense of touch to palpate and interpret findings in assessing the progress of labour therefore, we touch with sensitivity and kindness. I am grateful that I am a midwife and my midwifery lens is brought to this thesis.

Reflexivity

Before I started this PhD journey, I was an executive member of the Midwives Association of Zambia, which shows how popular I am in Zambia. Election in the executive follows a democratic process in which fully paid up members of the association across the ten provinces of Zambia vote and the one with the highest votes wins the position. My previous work on delayed cord clamping was shared in midwifery platforms across Zambia. Most midwives may have heard about my previous work on delayed cord clamping, which I undertook in five provinces of Zambia through the midwifery networks. My position on delayed cord clamping has involved championing the practice at every birth for reduction of the lifetime risk of anaemia. As someone who is passionate about maternal, newborn and child health, which is evident from my professional achievements. It is possible that my position on delayed cord clamping before this project may have affected the responses from participants. However, this is unlikely because participants in the face-to-face interviews were able to express themselves because of my personality. I am a very easy going person, who is a good listener and friendly, which gives people confidence in confiding in me. Therefore, I strongly feel that their answers were not influenced by my position on the topic.

1.11 SIGNIFICANCE OF THE STUDY

Delayed cord clamping is beneficial with positive outcomes for newborn babies. This will be discussed in detail in Chapter 2 of the thesis.

In 2013, the World Health Organization recommended widespread implementation of delayed cord clamping. Despite this, in many countries, including Zambia, there is little knowledge about the current practices of the timing of cord clamping and whether

delayed cord clamping has been implemented. Delayed cord clamping was placed on the Ministry of Health's priority list in 2014 as part of their Essential Newborn Care document (Ministry of Health Lusaka Zambia 2014). Despite this, it is not clear to what extent the practice has been translated into practice; hence this study.

It is essential to have evidence on the current practices amongst midwives, obstetricians and other medical staff in Zambia to better understand delayed cord clamping, especially implementation at scale. The study will add to the body of knowledge on umbilical cord clamping, and it will provide evidence to the Ministry of Health in Zambia, as well as the health services and clinicians, on the current practices of the timing of cord clamping and the future needs. In addition, the study will also outline some recommendations on strategies that could be used in the diffusion of delayed cord clamping and other clinical interventions in practice.

1.12 OVERVIEW OF THE STUDY

This PhD study was undertaken from 2019 to 2021. The overall aim was to explore umbilical cord clamping practices among midwives, obstetricians, nurses and other medical staff working in maternity care in Zambia.

The study was an explanatory sequential mixed methods study with three phases. Phase 1 used a survey to collect quantitative data about the umbilical cord clamping practices among maternity health providers. The findings from the first phase informed two subsequent phases (Phases 2 and 3). Phase 2 analysed guidelines from birth units across Zambia. Phase 3 was a qualitative study that explored midwives' motivation to undertake delayed cord clamping practices. It also helped us to better understand the implementation process for new programs in maternity practice, like delayed cord clamping, from key informants from the Ministry of Health in Zambia.

1.13 PHASE 1

Objective: To determine umbilical cord clamping practices by midwives, obstetricians, nurses and other medical staff in Zambia.

Sub-objective:

1. To describe the current practice of umbilical cord clamping among midwives, obstetricians and other medical staff in Zambia.

2. To describe the type of guidelines on umbilical cord clamping available in Zambia.

1.14 PHASE 2

Objective: To analyze the available guidelines that inform umbilical cord clamping practice in 100 birth units across Zambia.

1.15 PHASE 3

Objective: To explore the motivation to undertake delayed cord clamping practices by midwives and to better understand the implementation process for new programs in maternity practice, like delayed cord clamping, from key informants from the Ministry of Health in Zambia.

Sub-objectives

1. To explore factors influencing cord clamping practices by midwives in Zambia.
2. To understand the implementation process of new programs into maternity practice in Zambia.

1.16 THESIS OUTLINE

Chapter 1 has presented the introduction, background, context, purpose and significance of the study. This discussion has provided the rationale for why delayed cord clamping should be encouraged for the prevention of infant anaemia through increasing placental transfusion at birth, which builds up the infant's iron stores. The chapter has also provided the research questions, aims and objectives for the three-phased study. To note is the use of some very old references throughout this thesis because of the importance of the research to this thesis. Chapter 2 focuses on the literature review that looked at the evidence on the effectiveness of delayed cord clamping and its implementation. Chapter 3 presents the methodology and the theoretical framework of the study. Chapter 4 presents Phase 1 of the study (quantitative study) from which follow up studies emerged. Chapter 5 will discuss Phase 2, which looked at guideline collection and analysis as the first follow up study from survey. Chapter 6 will present Phase 3, which explored the motivation to practice

by midwives and an exploration of the Zambian context of the implementation process through interviews with key informants from the Ministry of Health Zambia. Chapter 7 will present the discussion, conclusion and recommendations of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

As described in Chapter One, there has been strong recommendation by the World Health Organization (WHO) for a shift from immediate umbilical cord clamping at birth to delayed cord clamping to reduce the life time risk of anaemia (World Health Organization 2014d). Anaemia is a major public health concern globally and affects approximately 2 billion people (World Health Organization 2015). More than half of the global cases of anaemia are found in low and middle-income countries (LMIC). The consequences of anaemia are lifelong. In Zambia, approximately 58% of children between the ages of 6 months to 59 months are living with haemoglobin count of less than 11g/dl, which means they have some form of anaemia (Zambia Demographic Health Survey 2018). Therefore, it is important for midwives and obstetricians to implement effective preventive measures to reduce the incidence of anaemia and one of these is delayed cord clamping (World Health Organization 2014d). In order to determine the gap in literature on the topic, a structured narrative literature review was undertaken to inform the development of this PhD study (Onwuegbuzie, J & Frels 2016).

2.2 AIMS OF A STRUCTURED NARRATIVE LITERATURE REVIEW

The aims of this structured narrative literature review were to:

- Describe the evidence associated with the practice of delayed cord clamping in preterm and term infants including the benefits, risks and timing.
- Examine the trials conducted in LMICs on delayed cord clamping.
- Review studies that have been undertaken globally, on the implementation of delayed cord clamping.

This review has three parts; the first part presents a critical synthesis of systematic reviews of RCTs comparing the effectiveness of delayed cord clamping with immediate cord clamping. The second part presents evidence from individual randomised controlled trials from LMICs in particular. The final part reviews studies that have explored the implementation of delayed cord clamping practice.

2.3 METHOD

A structured narrative review of literature was chosen to help ascertain what has been published on the benefits and risks of delayed cord clamping and to examine literature on the current cord clamping practices by midwives and obstetricians globally. This approach was selected as the most appropriate method as it was able to provide a wider choice of articles for synthesis of evidence (Onwuegbuzie, J & Frels 2016). A systematic literature search was conducted in four bibliographic databases and two network and search engines, that is, Wiley and Google Scholar. Citation review of included studies was conducted to check for references that met the inclusion and exclusion criteria for this review.

2.3.1 Search Strategy

A search of four bibliographic databases, Medline, Scopus (Elsevier), ProQuest, CINAHL and two network and search engines, Wiley and Google Scholar, was undertaken. The key terms of delayed cord clamping, immediate cord clamping, and their alternatives, practice, midwives, obstetricians, low and middle-income countries were identified using population, intervention, comparison and outcome (PICO) framework. The search timeframe was from 1966 to 2021. For the current umbilical cord clamping, the included studies were from 2013 to 2021 in order to capture studies that were conducted after 2013 when the World Health Organization recommended a change in practice from immediate cord clamping to delayed cord clamping.

2.3.2 Inclusion criteria

The inclusion criteria included systematic reviews, individual randomised controlled trials on umbilical cord clamping and research papers that described the current umbilical cord clamping practice by midwives and obstetricians.

2.3.3 Exclusion criteria

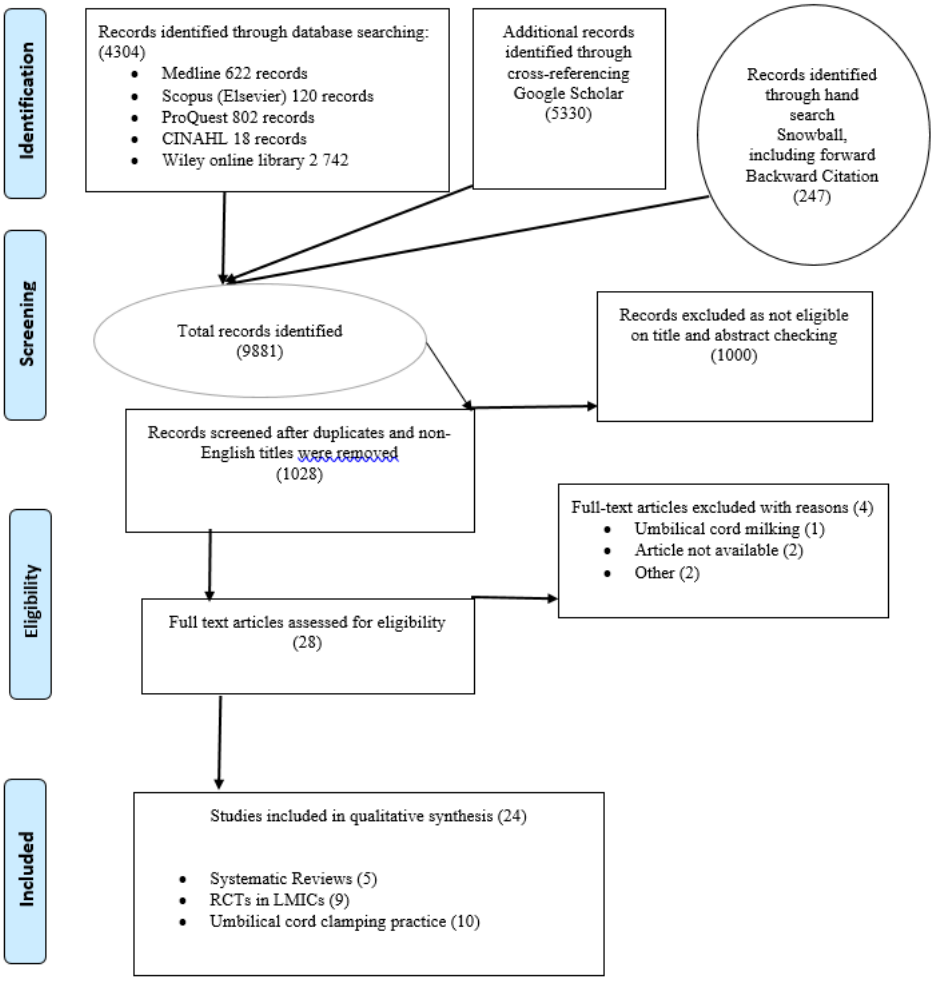
The exclusion criteria were non-English studies and studies that did not focus on umbilical cord clamping.

2.3.4 Process of extraction of data

The Selection Process

The search process is displayed in Figure 1 and described in this section.

Figure 1 PRISMA flow diagram of literature reviews



The search identified a total of 9881 papers of which 9634 were from the systematic search and a hand search of references (snowball, forward and backward citations) yielded 247 additional references. The 9881 articles were reduced to 1028 after the removal of 8854 duplicates, non-English studies and studies that did not focus on umbilical cord clamping.

The articles were further screened on title and abstract and 1000 articles were excluded based on title and abstract review. The remaining 28 articles were read in full and four articles were removed because they did not meet the eligibility criteria. Three people including two supervisors and the doctoral student reviewed the final 24 articles and agreed that these studies should be included.

The final 24 studies that have been included in this review included five systematic reviews, nine RCTs conducted in LMICs that were extracted from the systematic reviews and ten studies on current umbilical cord clamping practices. The five systematic reviews had a total of 68 (after the removal of duplicates) RCTs on the topic of delayed cord clamping compared with immediate cord clamping available for appraisal. The quality of the included studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal checklist for analytical cross sectional studies and systematic reviews and randomised controlled trials (Joanna Briggs Institute 2014) and CASP for systematic reviews and randomised controlled trials (Ferreira & Patino 2018).The PRISMA Flowchart (Figure 1) provide details of the records identified in each database and how these were screened for eligibility.

2.3.5 RESULTS

The structured literature review was divided in two parts; the first part presents evidence on the effectiveness of delayed cord clamping and the second part presents the implementation of delayed cord clamping.

2.3.5.1 Part I: Effectiveness of delayed cord clamping

The aim of this review was to determine the evidence associated with the practice of delayed cord clamping in preterm and term infants.

Overview of papers on delayed cord clamping

Five systematic reviews were identified during the search, which included a total of 68 randomised controlled trials (RCTs) (after removal of 21 duplicates) conducted from 1966- 2021 (Table 6 and 7). Two systematic reviews with 31 (after removal of 11 duplicates) RCTs included preterm infants between 24 and <37 weeks gestation (Fogarty et al. 2017; Rabe et al. 2012) and three systematic reviews with 37 RCTs included full term infants ≥37 weeks gestation (Hutton & Hassan 2007; McDonald & Middleton 2008; McDonald et al. 2013). The quality of the systematic reviews was assessed using the critical appraisal skills programme (CASP) tool and were each found to meet all the CASP criteria well, meaning they were high quality reviews. All the reviewed systematic studies addressed a clearly focused question, which looked at the benefits and risks of delayed versus immediate cord clamping. They looked at RCTs that focused on DCC versus ICC and they included all the most relevant studies. The quality of included studies were good and the benefits

and risks of DCC and ICC were well presented with DCC being more beneficial than ICC. These findings can be applied to the local population with regards to the benefits of DCC. The included studies were conducted in high, middle and low income countries.

The key issues identified in the systematic reviews that are of relevance for this study included the wide variation in the definitions of the length of time in which immediate cord clamping and delayed cord clamping were occuring. The length of follow up in each study was identified to examine short and long term haematological outcomes such as the impact on infant and child anaemia.

Table 6: Systematic reviews of studies conducted on preterm infants

First author, year, location of included studies.	# of studies, study designs.	Inclusion criteria.	Definition of cord clamping and timing of outcome assessment.	Primary outcomes.
Fogarty, 2017 Australia, Iran, USA, Switzerland, India, UK, Turkey, Netherlands, Thailand, South Africa and Israel	27 RCTs from 1988 to 2017	**Preterm** infants born between ≤28 and <37 weeks gestation **Total # of included infants** 2834	<30 sec/>30 sec **Timing of outcome assessments** At 30 minutes of life, 4 hours, 24 hours, 10 days, 28 days, 2 months, 6 months, 18 months, 24 months, 3 years	**Primary outcome** Reduced hospital mortality
Rabe, 2012 UK, Switzerland, South Africa, Japan, Scotland, Israel, Australia, Netherlands and USA	15 RCTs from 1988 to 2008	**Preterm** infants born between 24 and 36 weeks gestation Total **# of included infants** 738	<30 sec/30 sec-120 sec. **Timing of outcome assessments** Within 24 hours, 28 days, 6 months, 12 months	Fewer infants requiring transfusions for anaemia

Table 7: Systematic reviews of studies conducted on full term infants

First author, year, location of included studies.	# studies, study designs.	Inclusion criteria.	Definition of cord clamping and timing of outcome assessment.	Primary outcomes.
McDonald, 2013 Egypt, Sweden, Argentina, Mexico, Libya, India, Iran, Australia, Canada, UK, USA and Zambia	15 RCTs from 1966 to 2012	**Full-term** infants born ≥37 weeks of gestation Total # of included infants 3911	<60 sec or >60 sec **Timing of outcome assessments** At 6 hours of life, 24-48 hours, within the first 28 days, 2 months, 3 months, 4 months, 6 months	**Primary outcome of neonatal mortality** Higher Haemoglobin (Hb) concentration (newborn within the first 23 hours of life) Higher haematoctrit (Hct) levels; at 24 hours, and at three to five months Reduced the risk of anaemia in one trial; 272 infants at six hours Reduced risk of iron deficiency, five trials; 1152 infants at three to six months Reduced the risk of anaemia in one trial; 268 infants at 24 to 48 hours and within the first 28 days of life
McDonald 2008 Canada, Germany, UK, Sweden, USA, Argentina, Libya, Egypt, Guatemala, India, Mexico	11 RCTs from 1972 to 2007	**Full-term** infants >37 weeks of gestation Total # of included infants 2989	< 60 sec/>60 sec. Timing of outcome assessments At 6 hours of life, 24-48 hours, within the first 28 days, 2 months, 3 months, 4 months, 6 months	Outcomes not classified Delayed cord clamping was associated with higher Hb level, at 6 hours of life and at 24 to 48 hours of life Higher Hct in the delayed cord-clamping group at 24 to 48 hours Infant ferritin higher in the delayed cord-clamping group, at three months Higher ferritin, one trial at six months
Hutton, 2007 Argentina, Mexico, Libya, India, UK, Canada, USA, Zambia	11 RCTs from 1972 to 2006	**Full-term** infants born at ≥37 weeks Total # of included infants	Early cord clamping immediately after birth (in most trials)/ delayed cord clamping ≥ 120 sec	Primary outcome not classified Higher Hct, 15 trials at two to six months Increased iron (ferritin concentration) status at two to six months Increased stored iron at two to six months

Unspecified for 2 studies	1912	Timing of outcome assessments At 2-4 hours of life; 6 hours, 7 hours; 24 hours; 48 hours,5 days; 2 months; 3 months; 6 months	Reduction in the risk of anaemia at two to six months

Timing of delayed cord clamping

In all the five systematic reviews containing 31 RCTs, the definition of the timing of delayed cord clamping was highly variable (Fogarty et al. 2017; Hutton & Hassan 2007; McDonald & Middleton 2008; McDonald et al. 2013; Rabe et al. 2012). One RCT defined delayed cord clamping as clamping performed at 30 seconds, while others defined it as between 30 seconds and 120 seconds.

Benefits associated with delayed cord clamping

The benefits of delayed cord clamping were evident in all the five systematic reviews (Fogarty et al. 2017; Hutton & Hassan 2007; McDonald & Middleton 2008; McDonald et al. 2013; Rabe et al. 2012)**.** These authors focused on a number of benefits. However, for my study the benefit of interest is haematological, which was associated with the reduction of the life-time risk of anaemia by 60% (World Health Organization 2014a). Infants in the delayed cord-clamping group had higher haemoglobin (Hb) concentration and higher haematoctrit (Hct) at different time periods in all the reviews (Fogarty et al. 2017; Hutton & Hassan 2007; McDonald & Middleton 2008; McDonald et al. 2013; Rabe et al. 2012). Additionally, the systematic review by McDonald and Middleton (2013), showed that delayed cord clamping reduced the risk of iron deficiency at three to six months. Fogarty et al. (2017) found the delayed cord clamping group had a 10% reduction in the proportion of infants having a later blood transfusion within the first week of life in 13 trials including 2595 infants (Risk Ratio (RR) 0.81; 95% Confidence Interval (CI) 0.74 to 0.87). These results are in agreement with findings of the systematic review by Rabe et al (2012), which recorded fewer infants requiring transfusions for anaemia in seven trials involving 392 infants (RR 0.61; 95% CI 0.46 to 0.81) within the first 28 days of life.

The other benefit which was observed was a reduction in hospital mortality for 2834 infants born at less than 37 weeks (RR 0.68; 95% CI 0.52 to 0.90) and for 996 infants born less than or equal to 28 weeks (RR 0.70; 95% CI 0.51 to 0.95) (Fogarty et al. 2017). In the systematic review by Fogarty et al. (2017), delayed cord clamping reduced the primary outcome of hospital mortality but showed no difference in another systematic review (Rabe et al. 2012). Eleven of the 27 studies included in the review by Fogarty et al. (2017) were also included by Rabe et al. (2012). However, the inclusion of an additional 16 studies in the later review by Fogarty and colleagues (2017) identified a significant improvement in the primary outcome of hospital mortality.

Timing of outcome assessment

The length of time after birth for follow up measurements in preterm infants varied between studies from 30 minutes after birth to up to three years which makes comparing the findings challenging and precludes a meta-synthesis. Longer follow up provided evidence of the impact of delayed cord clamping on a range of longer term outcomes including infant anaemia (Fogarty et al. 2017; Rabe et al. 2012). Studies included in the systematic review by Fogarty et al. (2017) had the longest outcome assessment period ranging from 30 minutes of life, through to three years of life, whereas outcomes which were assessed in the review by Rabe et al. (2012) were from 24 hours from birth to six months of life. In these two systematic reviews that observed outcomes in preterm infants, the haematological impact of delayed cord clamping on infants was significant at 6 months and at 3 years (Fogarty et al. 2017; Rabe et al. 2012).

Timing of outcome assessment in term infants varied between two hours after birth to six months of age (Hutton & Hassan 2007; McDonald & Middleton 2008; McDonald et al. 2013). Infants in the delayed cord-clamping group had higher haemoglobin (Hb) concentration and higher haematoctrit (Hct) at different time periods in all the reviews. Additionally, the systematic review by McDonald and Middleton (2013) showed that delayed cord clamping reduced the risk of iron deficiency at three to six months.

Risks associated with delayed cord clamping

Negative outcomes associated with delayed cord clamping in both preterm and term infants include jaundice and polycythemia (Fogarty et al. 2017; Hutton & Hassan

2007; McDonald & Middleton 2008; McDonald et al. 2013; Rabe et al. 2012). A review by Hutton and Hassan (2007) showed no significant difference between the groups in the risk of jaundice at three to 14 days of life. In contrast, two reviews by McDonald and Middleton (2008 and 2013), identified more infants requiring phototherapy for jaundice in the delayed cord clamping group within the first 28 days of life compared to those in the immediate cord clamping group.

Randomised controlled trials of delayed cord clamping from LMICs

The aim of this part of the review was to review published RCTs performed in LMICs where the burden of anaemia is a major public health concern. Nine RCTs conducted in LMICs were reviewed. These RCTs were extracted from the five systematic reviews. The nine RCTs were undertaken in India (three studies) (Dipak et al. 2017; Rana 2019; Ranjit et al. 2015), Libya (one study) (Emhamed, van Rheenen & Brabin 2004), Iran (two studies) (Armanian 2017; Jahazi et al. 2008), Egypt (one study) (Al-Tawil, Abdel-Aal & Kaddah 2012), Mexico (one study) (Chaparro et al. 2006) and one study in Zambia (van Rheenen et al. 2007) . Of the nine studies, four examined delayed cord clamping with premature infants (less than 37 weeks of gestation) and five examined delayed cord clamping with full term infants (greater than 37 weeks of gestation).

Overview of the nine RCTs in LMICs

The settings for eight of the reviewed RCTs were mostly urban hospitals except for one study by van Rheenen et al. (2007), which was conducted in a rural region of the Copperbelt Province in Zambia, which is a malaria endemic area. Malaria is one of the predisposing factors to severe anaemia. Therefore, malaria is one of the confounding factors in the study of haematological outcomes of delayed cord clamping because it can influence the outcomes. Six studies looked at the Hct timing (Table 8) whereas three studies looked at Hb and ferritin levels but were not included in the table below because of being few in number and as agreed with my supervisors.

Table 8: Summary of six studies in LMICs with Hct outcomes

First author	Year	Country	Sample size by group(*DCC/ICC) and power	Hct timing	Effect and direction for Hct#
Armanian	2017	Iran	32/31 Total:63 Power: Not mentioned	4 hours	Increased Hct levels
Dipak	2017	India	Vaginal: 43/23 Caesarean: 8/4 Total: 51/27 Power: 80%	4 hours	Increased Hct levels
Rana	2017	India	50/50 Total: 100 Power: Not defined	48 hours 72 hours and at 7 days of life	Increased Hct levels
Ranjit	2015	India	Vaginal: 24/25 Caesarean: 20/25 Total: 94 Power: 90%	24 hours and 6 weeks	Increased Hct levels
Jahaz	2008	Iran	34/30 Total: 64 Power: 90%	2 hours, 18 hours and at 5 days	No significant differences in the Hct level of the neonate
Van Rheenen	2007	Zambia	46/45 Total:91 Power: 95%	Every two months until the age of 6 months	Increased Hct levels at 4 months of age Haematological effects disappeared by 6 months

*Delayed cord clamping (DCC) vs Immediate cord clamping (ICC)

Variation in delayed cord clamping timing

Timing of delayed cord clamping in seven of the nine reviewed RCTs was between 30 seconds and 180 seconds with two studies recording delayed cord clamping at

cessation of cord pulsation. These latter two studies were conducted in Zambia (van Rheenen et al. 2007) and Libya (Emhamed, van Rheenen & Brabin 2004) and included full term infants. These two studies both were conducted by the same team (van Rheenen and colleagues), which may explain the use of the same delayed cord clamping criterion, that is, cessation of cord pulsation.

Timing of outcome assessment

Despite the differences in timing of cord clamping, nine studies showed that the delayed cord clamping group recorded higher haematological outcomes at different time points in comparison with immediate cord clamping. The study by van Rheenen et al. (2007) that was undertaken in a malaria endemic area in Zambia showed no significant difference in haematological outcomes at six months between immediate cord clamping and delayed cord clamping groups. The non-significant six-months haematological outcome by Hutton et al. (2007) stands in contrast to the findings of other RCTs (Al-Tawil, Abdel-Aal & Kaddah 2012; Chaparro et al. 2006), which found a higher haematological outcomes in the delayed cord clamping cluster in comparison with the immediate cord clamping cohort.

The different outcomes were measured at four hours, 24 hours, 48 hours, seven days, six weeks, two months, four months and six months in the nine studies (Al-Tawil, Abdel-Aal & Kaddah 2012; Armanian 2017; Chaparro & Lutter 2007; Dipak et al. 2017; Emhamed, van Rheenen & Brabin 2004; Hutton & Hassan 2007; Kc et al. 2016; Rana 2020; Ranjit et al. 2015). All the nine studies reported no significant increase in polycythaemia and jaundice, which are negative outcomes associated with delayed cord clamping (Al-Tawil, Abdel-Aal & Kaddah 2012; Armanian 2017; Chaparro & Lutter 2007; Dipak et al. 2017; Emhamed, van Rheenen & Brabin 2004; Hutton & Hassan 2007; Kc et al. 2016; Rana 2020; Ranjit et al. 2015).

Understanding the outcomes

There were variations in the outcomes in all the nine RCTs because they all measured the outcomes at different time points. In a study by Armanian et al (2017), who focused on premature infants born at greater than or equal to 34 weeks gestation, the Hct outcome was measured at four hours of life and was higher for the babies in the delayed cord clamping group than it was for babies in the immediate cord clamping group (P=0.031) (Table 8). This finding of increased haematocrit is consistent with

observations by Dipak et al (2017), who assessed the haematocrit outcome at a similar time point on premature infants born between 27 weeks and 31 weeks and six days. However, there was no statistically significant difference in the need for blood transfusion between the two groups (Armanian 2017). Dipak et al (2017) did not assess the need for blood transfusion for anaemia but focused on other outcomes like mean neonatal blood pressure (measured at 12 hours of life), admission temperature, urine output (measured at 24 and 48 hours of admission) and serum bilirubin levels (measured at 72 hours of admission for detection of risks of delayed cord clamping). In my study, the focus is on haematological benefits and risks of delayed cord clamping only.

In another study by Rana and Agarwal (2017), higher haematocrits (P=0.001) were observed in the delayed cord clamping group at 48 hours and seven days of life in premature infants born at less than or equal to 34 weeks gestation. This study (2017), focused on Hct, duration of hospital stay and risks (polycythaemia and serum bilirubin at 72 hours). The length of hospital stay between the two groups (immediate vs delayed cord clamping) was not significantly different and the authors concluded that delayed cord clamping does not increase the risk of polycythaemia, hyper-bilirubinaemia and the need for phototherapy. However, the findings of Rana and Agarwal (2017) on the risks of delayed cord clamping are contrary to the findings of Ranjit et al. (2015), whose study focused on premature infants born between 30 and 36 weeks of gestation. The findings of Ranjit et al. (2015), observed that the delayed cord clamping group required longer duration of phototherapy (55.3±40.0 hours vs. 36.7±32.6 hours, P= 0.016) and increased the risk of polycythaemia. Of note is that both groups needed phototherapy in this study, the only difference was in the duration of the phototherapy treatment.

In term (≥ 37 weeks gestation) infants, five studies were reviewed that measured outcomes from two hours after birth to six months of age (Al-Tawil, Abdel-Aal & Kaddah 2012; Chaparro et al. 2006; Emhamed, van Rheenen & Brabin 2004; Jahazi et al. 2008; van Rheenen et al. 2007). Timing of the intervention was measured between 60 seconds and 180 seconds. Haematological outcomes were assessed at between two hours, 18 hours, 24 hours, two months, four months and six months of age. Four of the five studies demonstrated higher Hct levels in the delayed cord clamping group than in the immediate cord clamping group. Jahazi et al (2008) observed no significant

differences in Hct between the two groups at two and 18 hours of life (61±4.9 vs 61.6±4.5%) and 18 h of life (56.9±4.1 vs 56.2±3.9%), although there was an increase in the estimated neonatal blood volume in the delayed cord clamping group (P=<0.001). Three of the studies also measured Hb levels, which were significantly higher in the delayed cord clamping group at different time points (Al-Tawil, Abdel-Aal & Kaddah 2012; Emhamed, van Rheenen & Brabin 2004; van Rheenen et al. 2007). The other two studies did not measure Hb levels but focused on Hct level.

Three of the studies also looked at negative outcomes of delayed cord clamping, that is, polycythaemia and jaundice. With all the three studies observing no differences in the risk of jaundice and polycythaemia between immediate cord clamping and delayed cord clamping (Emhamed, van Rheenen & Brabin 2004; Jahazi et al. 2008; van Rheenen et al. 2007). These findings are similar to haematological outcomes of delayed cord clamping on premature infants and shows the importance of delayed cord clamping in improving haematocrit levels at birth, which is beneficial in the first 1000 days of life (Fogarty et al. 2017; Rabe et al. 2019). This is the more reason why delayed cord clamping should be implemented in LMICs where the burden of anaemia is higher in comparison with high-income countries.

This part of the review has provided insights into the evidence associated with the practice of delayed cord clamping and it has outlined the major risks associated with delayed cord clamping through the discussion of benefits and risks. Studies that were conducted in LMICs have been identified, including their outcomes outlining the haematological outcomes associated with the practice of delayed cord clamping. It was not possible to undertake a meta-analysis of the study findings due to the heterogeneity of the outcome measures.

The next section will provide an overview of studies that have been undertaken globally, on the implementation of delayed cord clamping.

2.3.5.2 Part II: The Implementation of delayed cord clamping

The aim of the second part was to review studies undertaken globally, on the implementation of delayed cord clamping published from 2013 to August 2021, in order to examine current practices in birth units globally, and with a focus on low and middle-income countries (LMICs).

Overview of types of studies on umbilical cord clamping practice

There were ten studies identified that met this aim (Table 9). Of the ten studies, eight were cross sectional (Afshari et al. 2014; Boere et al. 2015; Ibrahim et al. 2017; Leslie, Erickson-Owens & Park 2020; Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018; Payne, Walker & Mitchell 2021) and two were observational (Hutton, Stoll & Taha 2013; Nelin et al. 2018)

Table 9: Current umbilical cord clamping practices

First author, year	Study design	Aim	Location	Population
Payne 2021	Survey	To assess current practice of timing of cord clamping for both stable and unstable preterm infants in LMICs	Bahrain Ghana India Kenya Malawi Nigeria Pakistan Rwanda Uganda Zambia	70 (55 Obstetricians, 10 Midwives, 3 Neonatologists, 1 Paediatrician 1 General Doctor)
Leslie 2020	Cross sectional survey	To learn how midwives today manage the umbilical cord at birth	USA	5306 Midwives
Leslie 2018	Cross sectional survey	Describe current umbilical cord clamping practices by obstetricians	USA	500 Obstetricians
Madhavanprabhakaran 2018	Cross sectional survey	Investigate umbilical cord clamping practices of maternity care providers in Oman	Oman	175 (107 Obstetricians, 68 Midwives)
Nelin 2018	Observational study	Identify current umbilical cord clamping practices and factors determining the timing of clamping in a low resource setting	Nepal	138 infants

Ibrahim 2017	Cross sectional survey	Investigate current umbilical cord clamping practices of health professionals in Saudi Arabia	Saudi Arabia	157 (75 Midwives, 82Obstetricians)
Boere 2015	Cross sectional survey	Investigate if guidelines for UCC were followed and what the national practice entails	Netherlands	1120 (500 Midwives, 620 Obstetricians)
Afshari 2013	Cross sectional survey	Provide information on policies for management of third stage of labour in Iran	Iran	129 Maternity units across Iran
Hutton 2013	Observational Study	Investigate actual cord clamping time in Canada	Canada	100 (13 Midwives, 46 Obstetricians, 41 Family Physicians)
Lundberg 2013	Cross sectional survey	Investigate routines and practices for umbilical cord clamping of neonates	Norway	Maternity units (52)

Aims of included studies

Nine of the studies investigated umbilical cord clamping practices (Afshari et al. 2014; Boere et al. 2015; Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Leslie, Erickson-Owens & Park 2019; Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018; Nelin et al. 2018; Payne, Walker & Mitchell 2021). One study by Afshari focused on only on umbilical cord clamping policies (Afshari et al. 2014).

Location of included studies

Each of the studies was conducted in a different country including: Canada (Hutton, Stoll & Taha 2013; Stoll & Hutton 2012); Iran (Afshari et al. 2014); Netherlands (Boere et al. 2015)**;** Norway (Lundberg, Øian & Klingenberg 2013); Nepal (Nelin et al. 2018); Oman (Madhavanprabhakaran et al. 2018); the USA (Leslie et al. 2018);

Saudi Arabia, Bahrain, Ghana, India, Kenya, Malawi, Nigeria, Pakistan, Rwanda, Uganda and Zambia (Payne, Walker & Mitchell 2021).

Population of included studies

The participants in the reviewed studies included obstetricians (n=1600) in eight of the studies (Boere et al. 2015; Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Leslie et al. 2018; Madhavanprabhakaran et al. 2018; Payne, Walker & Mitchell 2021) and midwives (n=6861) in five of the studies practices (Afshari et al. 2014; Boere et al. 2015; Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Leslie, Erickson-Owens & Park 2019; Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018; Nelin et al. 2018; Payne, Walker & Mitchell 2021). Family physicians, general doctors, neonatologists and paediatricians (n=120) were included in studies undertaken in Canada by Hutton et al (2013), LMICs by Payne (2021) and two studies conducted in Iran and Norway focused on the staff of maternity units (n=181) (Afshari et al. 2014; Lundberg, Øian & Klingenberg 2013).

Delayed cord clamping practice in included studies

The practice of delayed cord clamping was reported to be more likely in uncomplicated vaginal term and preterm births (Boere et al. 2015; Hutton, Stoll & Taha 2013; Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018; Nelin et al. 2018; Payne, Walker & Mitchell 2021). Midwives and family physicians were more likely to practise delayed cord clamping than obstetricians (Boere et al. 2015; Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Madhavanprabhakaran et al. 2018; Payne, Walker & Mitchell 2021).

Delayed cord clamping timing in included studies

Timing of delayed cord clamping differed in all the studies and ranged from 30 seconds to the cessation of cord pulsation. In the two studies that were conducted in the USA, timing was set at between 30 seconds and more than 60 seconds in one study and at more than 60 seconds in the other (Leslie, Erickson-Owens & Park 2020; Leslie et al. 2018). The studies in Nepal, Bahrain, Ghana, India, Kenya, Malawi, Nigeria, Pakistan, Rwanda, Uganda, Zambia and Saudi Arabia had delayed cord clamping timing defined at greater than 60 seconds (Ibrahim et al. 2017; Nelin et al. 2018; Payne, Walker & Mitchell 2021). In studies that were conducted in Iran, Netherlands, Norway, Oman and Canada, timing of delayed cord clamping was defined from 120

seconds to cessation of umbilical cord pulsation (Afshari et al. 2014; Boere et al. 2015; Hutton, Stoll & Taha 2013; Madhavanprabhakaran et al. 2018).

Availability of cord clamping protocols

The following studies included cord clamping protocols, which were either immediate cord clamping or delayed cord clamping (Afshari et al. 2014; Boere et al. 2015; Ibrahim et al. 2017; Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Nelin et al. 2018; Payne, Walker & Mitchell 2021).

Quality of included studies

The quality of the included studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal checklist for analytical cross sectional studies (Joanna Briggs Institute 2014). The JBI checklist has a total of eight quality assessment parameters, which focus on the following: 1) Criteria for inclusion, 2) Description of the study subjects/setting, 3) Exposure measurement, 4) Objective standard criteria for measurements, 5) Identification of confounding factors, 6) Strategies to deal with confounding factors, 7) Reliability of measured outcomes and 8) Appropriateness of the statistical analysis. Of the eight JBI criteria, the 10 studies included in this review met six of the above highlighted parameters. The remaining two were not applicable as they were addressing confounding which is usually in experimental studies. The above six parameters evaluated the objective, inclusion, exposure, study setting, results and analysis. All the 10 studies met the six JBI criteria.

Limitations of included studies

The identified limitations were a low response rate (Leslie et al. 2018; Payne, Walker & Mitchell 2021), use of convenience sampling (Ibrahim et al. 2017; Payne, Walker & Mitchell 2021), small sample size (Nelin et al. 2018; Payne, Walker & Mitchell 2021), old studies and not all maternity units responded to all the questions, which may affect generalisability (Hutton, Stoll & Taha 2013). One study was conducted between 2006 and 2007, therefore the practice may have changed since this time (Hutton, Stoll & Taha 2013).

Key findings from the included studies

The practice of delayed cord clamping in both term and preterm infants was less than 50% among most of the clinicians (Afshari et al. 2014; Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Jelin et al. 2014; Madhavanprabhakaran et al. 2018; Nelin et al.

2018). However, in two studies conducted in Canada, 66% of midwives (N= 143) reported practising delayed cord clamping in term infants although their practice in preterm infants was only 38% of the time. In the latest study undertaken in ten LMICs, delayed cord clamping was reported in 60% of the 70 participants. In the study conducted in the Netherlands, delayed cord clamping was mainly practised with women having uncomplicated births (Boere et al. 2015). Midwives and family physicians were more likely to practise delayed cord clamping than obstetricians (Hutton, Stoll & Taha 2013).

Variations in umbilical cord clamping guidelines were identified and only a few maternity units had guidelines (Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018; Payne, Walker & Mitchell 2021). Of the nine studies, only three were conducted in LMICs (Iran, Nepal, Bahrain, Ghana, India, Kenya, Malawi, Nigeria, Pakistan, Rwanda, Uganda and Zambia), therefore there is a need for more studies in LMICs to determine their delayed cord clamping practice rates (Afshari et al. 2014; Nelin et al. 2018; Payne, Walker & Mitchell 2021). The study that was conducted in Zambia had a very small sample of two midwives and three obstetricians, hence the need for this PhD study (Payne, Walker & Mitchell 2021).

2.4 DISCUSSION

Following the establishment of the evidence of benefits of delayed cord clamping in many randomised controlled trials, there has been a strong recommendation by the World Health Organization for a shift in practice (World Health Organization 2014a). The recommended shift is from immediate cord clamping to delayed cord clamping especially in low and middle-income countries, where the burden of anaemia is very high (Fogarty et al. 2017; Hutton & Hassan 2007; McDonald et al. 2014; World Health Organization 2012a). However, uptake of the practice has been slow in many countries because of the barriers that come with the implementation of a new practice and associated risks of delayed cord clamping like polycythaemia and jaundice (Fogarty et al. 2017; Hutton & Hassan 2007; McDonald et al. 2014; Powell et al. 2015; World Health Organization 2012a). Polycythaemia and jaundice develop because of increased haemolysis from the higher haemoglobin (above 18mmols/dl) levels at birth, which exerts too much pressure on the liver (Bhagavan & Ha 2015). This is a

physiological process, which may occur with or without the practice of delayed cord clamping at birth because of the initiation of adult circulation (Bhagavan & Ha 2015). This means that the above risks are physiological and may not require treatment, therefore it can be deduced that the benefits of delayed cord clamping outweigh the risks (Fogarty et al. 2017; Hutton & Hassan 2007; Rabe et al. 2012). Therefore, the WHO calls for midwives and obstetricians to embrace delayed cord clamping as a cost-effective measure to reduce the lifetime risk of anaemia.

Despite the evidence many midwives and obstetricians persist with immediate cord clamping (Afshari et al. 2014; Boere et al. 2015; Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Nelin et al. 2018; Payne, Walker & Mitchell 2021; Stoll & Hutton 2012). This could be attributed to the absence of protocols on delayed cord clamping and previous training, which emphasised immediate clamping and cutting of the umbilical cord (Powell et al. 2015; Sellers 2018). Delayed cord clamping was more often used by midwives than obstetricians, because its use was more likely to occur during uncomplicated vaginal births, which were usually managed by midwives in all nine studies. Although a majority of participants in the studies included in this review indicated some knowledge of delayed cord clamping, their knowledge did not translate into daily practice as most of them were still practising immediate cord clamping, which could be attributed to lack of protocols on delayed cord clamping in many facilities (Powell et al. 2015). The difference between practice and knowledge levels of these practitioners may be attributed to the fact that knowledge alone does not equate to actual practice, as people may be knowledgeable enough but may not be putting their acquired information into practice (Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Powell et al. 2012). The studies have also indicated the importance of guidelines on the implementation of delayed cord clamping, because guidelines may influence change (Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Leslie et al. 2018; Nelin et al. 2018). Only three studies were conducted in LMICs where the burden of anaemia is a major public health concern.

2.5 Strengths and Limitation of the review

The strength of the review was that four (three Supervisors and the Doctoral Candidate) people looked at the eligible articles on current umbilical cord clamping practices, whose differences about whether to include articles were resolved

collectively as a team through a discussion. The limitation was that, for systematic reviews, four people examined the included studies whereas only one reviewer looked at the excluded studies who may have excluded some articles that should have been included because the panel of supervisors wanted to see the included studies only. The other limitation is that for the nine RCTs conducted in LMICs, the sample was very small for generalisation of findings.

2.6 CONCLUSION

There is a gap in the literature on what is known about current umbilical cord clamping practices especially in LMICs. In order to improve practice and adherence to guidelines, it is essential to understand what current practices are. Despite the potential benefits of delayed cord clamping in reducing anaemia, particularly in low and middle-income countries where the burden of anaemia is a public health concern, there is a paucity of literature on current delayed cord clamping practices by obstetricians and midwives. Research to establish current delayed cord clamping practices in these countries is needed to address this gap in the literature. This is the topic of my PhD.

The next chapter will present the methodology and theoretical framework of the study.

3.1 INTRODUCTION

Chapters 1 and 2 identified that, despite the evidence of the benefits of delayed cord clamping and the call for its implementation in 2013 by the WHO (World Health Organization 2013), the current practices of the timing of cord clamping in Zambia are not well understood. The overall aim was to explore umbilical cord clamping practices among midwives, obstetricians, nurses and other medical staff working in maternity care in Zambia.

This chapter explains the theoretical underpinning for the study and explains the methods used in each of the three phases. It describes the objectives, sub-objectives, data collection and data analysis approaches to address the overall aim of the study.

- **Phase 1**
    - **Objective**: To determine umbilical cord clamping practices by midwives, obstetricians, nurses and other medical staff in Zambia.
- **Phase 2**
    - **Objective**: To describe and analyse the available guidelines that inform umbilical cord clamping practice in 100 birth units across Zambia.
- **Phase 3**
    - **Objective**: To explore the motivation to undertake delayed cord clamping practices by midwives and to better understand the implementation process for new programs in maternity practice, like delayed cord clamping, from key informants from the Ministry of Health in Zambia.

This study uses a mixed methods methodology that started with quantitative data collection and analysis informing subsequent studies. Mixed methods encompass the collection of both quantitative and qualitative data to answer a specific research question (Creswell & Clark 2017). Several terms have been used before to describe this approach such as: integrating, synthesis, multimethod, mixed methodology, mixed research, qualitative and quantitative. However, the term mixed methods is now more widely accepted (Creswell & Clark 2017).

Mixed methods approaches originated from fields such as evaluation, education, management, sociology and health sciences in the late 1980s and early 1990s (Creswell & Clark 2017). Many researchers opt for a mixed methods approach to develop a better understanding of the problem under investigation, although one identified challenge of mixed methods is the time involved in analysing both qualitative and quantitative data and the process for integration (Creswell & Clark 2017). I decided to use an explanatory sequential mixed methods approach in order to better understand the topic under investigation, which is enabled by the use of different types of data to explore cord clamping practices in Zambia (Creswell & Clark 2017).

The combination of both quantitative and qualitative approaches is beneficial because the two methods complement each other (Albright, Gechter & Kempe 2013; Creswell & Clark 2017). According to Creswell and Clark (2017), the types of data collected in quantitative studies are usually closed-ended whereas more open-ended data come from qualitative research. Creswell and Clark (2017) have argued that qualitative and quantitative data collection methods have strengths and limitations. They have also argued that mixed methods can provide a richer understanding of the research problem and may help overcome limitations, which could have been seen in a single data collection study (Creswell & Clark 2017).

Mixed methods provides more insights into the topic under investigation through the integration process (Creswell & Clark 2017). Mixed methods have also been identified as important in implementation research because they provide insights into the context in which diffusion of evidence based practices occurs including the barriers and enablers to implementation (Albright, Gechter & Kempe 2013).

A mixed methods approach was especially important in my study because it helped ensure that a broader perspective to the issue could be achieved. A survey does not provide an opportunity to ask further questions on the responses, hence the need for a qualitative approach to the study (Creswell & Clark 2017). Qualitative research provided an opportunity to understand the reasons why (Creswell & Clark 2017) some midwives decided to change their practice from immediate cord clamping to delayed cord clamping when the majority of survey respondents were still practising immediate cord clamping.

Table 10 provides an overview of my PhD study and outlines the sequence of steps followed in this study (Ivankova 2006). In this study, triangulation and integration processes were undertaken after all the phases were complete.

Table 10: Sequence and procedures in my study

Phase and objectives	Design	Method
Phase 1: To determine umbilical cord clamping practices by midwives, obstetricians, nurses and other medical staff in Zambia	Quantitative survey design	Cross-sectional survey using online platform Sample: Maternity Health Care Workers (n=239)
Phase 2: To describe and analyse the available guidelines that inform umbilical cord clamping practice in 100 birth units across Zambia	Qualitative guideline review	Content analysis and an analysis using the AGREE approach Sample: Guidelines submitted by maternity units surveyed in Phase 1
Phase 3: To explore the motivation to undertake delayed cord clamping practices by midwives and to better understand the implementation process for new programs in maternity practice, like delayed cord clamping, from key informants from the Ministry of Health in Zambia	Qualitative Study	One-to-one interviews using an online platform Sample: 25 midwives from birth units where delayed cord clamping was practised. Key informants who are guideline developers and distributors from the Ministry of Health Zambia

3.2 Underpinnings and theoretical frameworks

Implementation science underpins this study. Implementation science is defined as the act of transforming research into evidence based clinical practices. In this study, implementation science was helpful as it was able to assist with the understanding of contextual barriers and facilitators to enhance innovation uptake with the innovation being delayed cord clamping (Peters et al. 2013). Implementation science also focuses on understanding ways of diffusing research evidence into practice using

implementation strategies (Peters, Tran & Adam 2013; Proctor, Powell & McMillen 2013). In doing so, it will help us to better understand the factors that influence implementation of delayed cord clamping. This study draws on theories and frameworks used in the scientific study of implementation to better understand the implementation of delayed cord clamping.

Implementation science is concerned with the effectiveness of strategies that capitalise on the application of existing knowledge about behaviour in order to improve the implementation of evidence based practices in clinical practice to improve the quality of care (Eldh et al. 2017; Peters, Tran & Adam 2013; Powell et al. 2015). Implementation strategies are ways in which research evidence can be diffused into clinical practice (Grol et al. 2013). These strategies have been grouped into three categories in this study, which will be explained in the next section with reference to my study.

Implementation strategies

The three categories of implementation strategies are (i) consistency in reporting; (ii) action involved in the implementation; and (iii) the theoretical assumptions associated with the strategy (Eldh et al. 2017; Grol & Wensing 2004; Grol et al. 2013; Leatherman et al. 2010; Powell et al. 2015; Tancred et al. 2014).

Consistency with reporting

Consistency with reporting is defined as the standardised way of implementing evidence based practices into the clinical area (Eldh et al. 2017). The use of clinical practice guidelines is one example (Grol et al. 2013). Effective use of clinical practice guidelines includes the development of educational materials that are then distributed through educational meetings or other face-to-face means (Grol et al. 2013). The process of distribution and training of staff in the new guidelines can lead to improved uniformity in the practice because practitioners have a standard document to refer to (Powell et al. 2015).

One of the aims for this thesis was to explore the availability of and to assess the quality of guidelines that inform umbilical cord clamping practices in birth units across Zambia and to determine whether having this type of guideline made a difference to practice. I was also interested in the quality and consistency of the guidelines. This was addressed in Phase 2 of the study.

Action involved in implementation research

Action involved in implementation research is the second identified discrete strategy that may facilitate diffusion of evidence based strategies into clinical practice (Powell et al. 2015). This focuses on the need for a collaborative approach to implementation and ensuring that those involved in the process are well engaged. This collaborative approach to implementation involves the actual implementers who are important for sustainability of the practice (Peters, Tran & Adam 2013).

In my thesis, the implementers are the maternity health care workers, that is, the midwives and doctors involved in the care of women during labour and birth. Understanding their perspectives, experiences and motivations is necessary to address the facilitators and barriers to implementation of the innovation.

Use of the theory

The third category of the implementation strategies is the use of theoretical assumptions in the diffusion of evidence into clinical practice to improve outcomes (Grol et al. 2013). Theoretical assumptions originated from multidisciplinary fields such as education, management and psychology. They focus on how the strategy is envisaged to produce the needed change in clinical practice in alignment with an individual, social, organisational and economic contexts (Grol & Wensing 2004; Grol et al. 2013). This means being aware of the cognitive theories as they relate to individuals involved in the implementation. Cognitive theories view the diffusion of research evidence into clinical practice as a rational process where an individual health worker evaluates the available information to make a clinical decision for change in practice (Grol et al. 2013). Therefore, it is essential to provide information that will in turn positively influence change through the provision of evidence based information for diffusion into clinical practice (Grol et al. 2013). It is the responsibility of the organisation, rather than the individual, for change to be effectively implemented (Grol et al. 2013) and understanding the process of innovation diffusion is critical. My study therefore draws on innovation diffusion theory as a means to better understand the processes behind the decision-making in relation to umbilical cord clamping and the Theoretical Domain Framework to understand the enablers to delayed cord clamping practice by midwives.

3.2.1 Innovation diffusion theory

Innovation diffusion theory (IDT) describes the process involved in the implementation of new programs by frontline workers (Rogers 2010). This theory was developed by Everett Rogers in 1962 and was put together from 508 diffusion studies. It has four main components, that is, innovation, communication channels, time, and the social system (Rogers 2004).

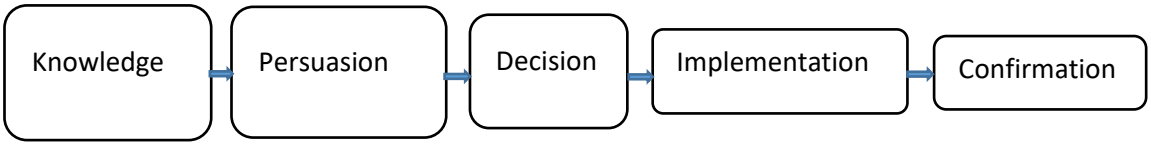
Innovation is defined as the new practice that has to be implemented. In my PhD study, the innovation was delayed cord clamping. Communication involves the sharing of information in reaching a consensus to change the practice, which can be undertaken both informally and formally through trainings and even workshops (Rogers 2010). Diffusion of new evidence based practices into clinical practice involves time in decision making to adopt the change by the adopter and the rate at which the innovation is adopted throughout the social system (Rogers 2010). The social system emphasises the importance of correlations or relationships among and between societal units, which may include individuals, groups and organisations that are working towards finding solutions to attain a common goal (Rogers 2010). The diffusion process can be affected by social norms and the amount of influence that are shared among individuals (Rogers 2010).

In IDT, the rate of diffusion can be impacted by the use of experts whose opinions are valued by others (opinion leaders) and people who may influence the behaviour of others (change agents) (Rogers 2010). It is important for innovators to identify opinion leaders and change agents in the diffusion process of the innovation who can take up the influential roles in behaviour change.

The IDT affirms that diffusion begins with few early adopters who are convinced to adopt the practice because of the benefits that comes with the innovation, which is cost effective and easy to implement (Rogers 2010). The IDT assumes that the diffusion progression increases when many frontline workers decides to adopt it then it later slows down the process when the adopter population reaches saturation (Rogers 2010). The collective adoption pattern takes an S-shaped curve and a normal distribution for the adopter (Rogers 2010). Adopters are different and have been grouped into innovators, early adopters, early majority, late majority and laggards, whose grouping is based on the time at which they adopted the new innovation (Rogers 2010).

In the IDT process, five stages have been identified (Figure 2) (Rogers 2010). These are: (1) Knowledge, which looks at the time when adopters first learnt about the innovation; (2) Persuasion: there has to be prior adopters to persuade adopters to attempt the use of the innovation; (3) Decision: have adopters been able to make a decision to either accept or reject the innovation? (4) Implementation: are the adopters able to utilize the innovation? (5) Confirmation: are the adopters able to continue using the innovation to its full potential? (Figure 2).

Figure 2: The innovation adoption process by adopters



In the IDT process, five innovation characteristics have been identified, which may have influence on the innovation adoption decisions by adopters. These are: (1) The expected benefits of an innovation relative to prior innovations (Relative advantage); (2) The extent to which the innovation fits with the adopter's work habits, beliefs, and values (Compatibility); (3) The extent to which the innovation is difficult or ease to learn and use (Complexity); (4) The extent to which the innovation can be tested on a trial basis (Trialability); (5) The extent to which the results of using the innovation can be clearly observed (Observability) (Rogers 2010).

IDT is relevant in my study. In particular, understanding the enablers of the innovation and the capacity to implement it is important. My study explores the behaviour and experiences of the different levels of adopters and experts. My study also looks at the implementation outcomes, which ultimately determine whether an innovation like delayed cord clamping is widely implemented in clinical practice.

3.2.2 Implementation outcomes

An implementation outcome is the indicator of how well a strategy is working, which includes acceptability, adoption, appropriateness, feasibility, fidelity, cost, coverage and sustainability of the strategy (Peters et al. 2013; Peters, Tran & Adam 2013). Acceptability is the perception of the intervention by the recipient; adoption is the extent to which recipients will use the intervention; appropriateness is how appropriate

the intervention is in the context of the recipients; feasibility is how possible the intervention is to implement; fidelity is whether the intervention was implemented according to the implementation protocol; implementation cost is the amount of resources needed for effective implementation; coverage is the proportion of recipients who have been reached by the intervention; and sustainability of the implementation strategies focuses on the long term use of the intervention (Peters et al. 2013).

The next section of this chapter provides an overview of the methods undertaken in the study. The detail of the methods for each of the phases is presented in the next three chapters (Chapters 4, 5 and 6).

3.3 METHODS DESIGN

This is a three-phased study. This study used a sequential explanatory design with a QUAN+ qual approach. Data collection and analysis were first done quantitatively (Phase 1), followed by collection of guidelines via emails (Phase 2), and finally a qualitative study that included one-to-one interviews with midwives and key informants from the Ministry of Health (Phase 3) (Figure 3).

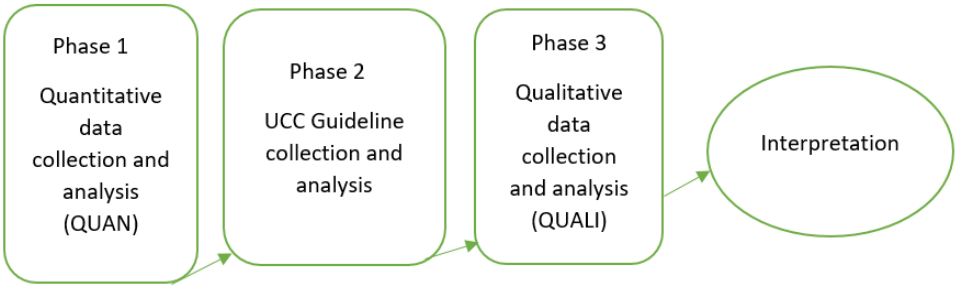
The analysis of Phase 1 provided information that informed the selection of contact people in Phase 2 and interview participants in Phase 3. Contact persons in 100 birth units across the country were emailed for collection of available guidelines that inform umbilical cord clamping practices during Phase 2. The population for one-to-one interviews in Phase 3 was birth units with more than two participants who reported practising delayed cord clamping. Key informants from the Ministry of Health, Zambia were interviewed in order to have an understanding of the implementation process that is used in Zambia. Phase 3 of the study used the Theoretical Domain Framework (TDF) to understand the enablers to delayed cord clamping practice among midwives.

The TDF looks at behaviour as a catalyst to diffusion of innovations in clinical practice (Atkins 2017). According to the TDF, there are certain factors that influence the change in behaviour, which are facilitated by determinants of current and desired behaviour. The TDF has identified important theories in the implementation of new programs, which have been grouped into 14 domains that focus on behavioural factors

by adopters in the diffusion of new programs in clinical practice. The TDF will provide the lens in which the enablers to delayed cord clamping practice will be viewed.

The methods used are shown in the Figure 3 below. The qualitative data will provide the interpretation, clarification, description, and validation of the quantitative results.

Figure 3: Sequential explanatory design of this study



3.4 CONCLUSION

This chapter has provided the methodology, an overview of implementation science in exploring and understanding the dissemination of delayed cord clamping in Zambia, and the theoretical framework underpinning the study with an overview of the methods for the three phases of the study. The next three chapters provide more detailed methods and findings for each phase of the study.

CHAPTER 4: PHASE 1: A SURVEY OF CURRENT DELAYED CORD CLAMPING PRACTICE IN ZAMBIA

4.1 INTRODUCTION

This chapter describes Phase 1 of the study, which was designed to attain the research objectives and questions stated below. This was in order to determine the current practices of midwives and obstetricians on the timing of umbilical cord clamping in Zambia and the availability of umbilical cord clamping guidelines, which was a gap identified in the literature review in Chapter 2.

Research objectives

1. To describe the current practice of umbilical cord clamping among midwives, obstetricians and other medical staff in Zambia.
2. To describe the type of guidelines on umbilical cord clamping available in Zambia.

Research questions

1. What is the current practice of umbilical cord clamping among midwives, obstetricians and medical officers in Zambia?
2. What are the available guidelines on umbilical cord clamping in Zambia?

This chapter first describes the methods used in this phase of the study. This includes the design; the participants; the instruments used and a justification for their use; the procedure used; the process of data analysis; and the results.

4.2 METHODS

An online survey was chosen to determine the current practices of midwives and obstetricians on the timing of umbilical cord clamping in Zambia. The results of previous studies in Saudi Arabia and the Netherlands indicated that the tool is reliably able to measure cord clamping practices as presented in the literature review. A survey was chosen because it provided respondents with a sense of anonymity because identifiers were switched off in REDCap, which maybe associated with an increase in the likelihood of honest answers that may answer to the set research questions and it may reach a large population (Brink, Van der Walt & Van Rensburg 2006; Creswell & Clark 2017).

4.2.1 Research design

A quantitative, cross sectional study design using an online survey was chosen to answer the research questions. The dependent variable was cord clamping practice. Independent variables were age, gender, place of work, profession, years in practice, presence of umbilical cord clamping guidelines in practice especially in relation to practice during different modes of birth and gestation (preterm or term). The null hypothesis was that the prevalence of delayed cord clamping practice by the clinicians was less than 50% basing it on the findings from the literature review on delayed cord clamping practice rate (Chapter 2).

4.2.2 Feasibility

The relevant professional associations (Midwives Association of Zambia and Zambian Association of Gynecologists and Obstetricians) were used as a method of communication with their respective members as this was an opportune way to reach midwives and obstetricians. This was a feasible way of reaching midwives and obstetricians. Most midwives and obstetricians have access to the internet. The survey was distributed and completed using an online system called Research Electronic Data Capture (REDCap). Having an online form made filling in the survey easy because it did not need to be undertaken on a computer but could also be completed using a mobile phone, which is accessible to many of the target population.

4.2.3 Research site and study population

The population for this study was practising midwives, obstetricians and other medical staff employed in maternity settings in Zambia working under the Ministry of Health Zambia (MoHZ) in 2019 and members of the professional associations (Midwives Association of Zambia (MAZ) and Zambian Association of Gynecologists and Obstetricians (ZAGO)). According to the data provided by the Presidents of the two associations, there were 360 midwives identified across the 10 provinces of Zambia who were members of the MAZ (both registered midwives (RM) and enrolled midwives (EM)) and 53 doctors identified from the ZAGO.

The target adequate response rate at 95% confidence interval was 187 for MAZ members and 47 for ZAGO which was calculated with our main target population being 53 obstetricians and 360 midwives (N=413). Since it was a population study, we did not undertake any sampling.

Selection of participants: Inclusion and exclusion criteria

The eligibility criteria were all midwives, obstetricians and other maternity care workers working in government hospitals across the 10 provinces of Zambia and members of MAZ and ZAGO. Health care workers who were not employed by the government were excluded.

4.2.4 Participant recruitment

The Association Secretary for the Midwives' Association distributed the survey to MAZ members using the Association database. The President of ZAGO sent out the survey to all obstetricians. Follow up reminders were sent every week for one month.

4.2.5 Instruments

The main data collection tool was informed by a validated pre-tested questionnaire, which was used in similar studies in the Netherlands and Saudi Arabia **(**Boere et al. 2015; Ibrahim et al. 2017). The questionnaire was slightly adapted by the research team to make it relevant for the Zambian context. The original questionnaire had 24 questions, whereas the adapted questionnaire for this study had 19 questions. Five demographic questions relevant for the Netherlands and Saudi Arabian contexts were considered not relevant for the Zambian context and were removed. The modified tool had six demographic questions, and 13 questions that focused on the current practice of umbilical cord clamping, including the availability of guidelines and protocols in birth units (Appendix B provides a copy of the questionnaire). It was estimated that the survey would take approximately 15 minutes to complete. Participants were only allowed to submit one response. The survey was developed in REDCap, which is a protected web application used for building and managing online surveys and databases.

The instrument was piloted with five postgraduate midwifery students in the Faculty of Health at UTS, who were available to assess ease of understanding of the questions and access. The pilot study also helped to estimate the time required to fill in the survey, which was 10 minutes. Completion of the survey was considered to imply consent.

4.2.6 Instrument quality: face/content validity and reliability

Face validity refers to the degree to which an instrument measures what it is supposed to measure (Parahoo 2014). The tool has already been used in Saudi Arabia and the

Netherlands with midwives and obstetricians, which meant we were confident of the level of face validity. Content validity looks at how well variables to be measured are covered by an instrument (Parahoo 2014). Reliability refers to the repeatability of a measurement which focuses on whether the same results will be found if the study was repeated (Brink, Van der Walt & Van Rensburg 2006). The results of previous studies in Saudi Arabia and the Netherlands indicate that the tool is reliably able to measure umbilical cord clamping practices. Despite the diversity in the context, we were certain that the tool was going to produce the desired results for my project.

4.2.7 Data management and storage

Data validation was undertaken through thoroughly checking of the exported file from REDCap in order to identify errors by the student. Data are collected in REDCap, and stored in an online system called STASH. This is the university's online research data management platform that helps with the management of research data throughout the life of the project. Data will be deleted after five years of finishing the project.

4.2.8 Data analysis

Data were cleaned before analysis. Responses with all data missing were deleted but those which had some questions skipped were included in the analysis. All data analyses were undertaken using the Statistical Package for Social Sciences, version 26 (SPSSv26) (George & Mallery 2016). The analyses included descriptive statistics with frequency distributions and cross tabulations to determine umbilical cord clamping practices by maternity health care providers who said they had no guidelines. Tables have been used to describe patterns in the responses. Further, cross tabulations identified umbilical cord clamping practices among practitioners who identified no set time to their umbilical cord clamping practice. Chi squared tests were conducted for categorical variables with statistical significance set at $p < 0.05$ to determine any significant differences in the population proportions and to determine if years in service influenced umbilical cord clamping practices in both term and preterm neonates. All results are in percentages.

4.2.9 Ethical approval

Permission to conduct the study was obtained from the University of Zambia Biomedical Research Ethics Committee (Reference number: 070-2019), which was followed by an application to conduct the study using health professionals from the

National Health Research Authority in Lusaka (Appendix A). Ratification of ethics was obtained from the University of Technology Sydney after receiving all the approvals from Zambia (Reference number: ETH19-3658).

The key ethical principles of autonomy, confidentiality, anonymity and justice were addressed in the design of the study.

Autonomy

Protection of the rights of the participants was a priority in this study. Research participants were informed about the purpose of the online survey through an email, which was sent out with the link to the survey. Completion of the survey implied consent.

The researcher informed participants that their participation was voluntary and that they may choose to discontinue their participation at any point should they wish to, without incurring any consequence whatsoever through an email, which was sent out with the link to the survey. This was to ensure participants' right to self-determination.

Confidentiality and anonymity

All data were stored in a password-protected computer in REDCap and only the investigator has access to the computer and no identifying names or email addresses were collected. This was achieved by switching off the automatic IP collection key for prevention of collection of IP addresses. Participants were assured that the information collected during this research was strictly confidential and their identity remained anonymous as the collected data were to be used for a PhD thesis, and possibly for publications in peer reviewed journal articles, presentation at conferences, and for dissemination at the Ministry of Health and other stakeholders in Zambia through an email, which was sent out with the link to the survey.

Research participants were informed that as the survey was being conducted in an online environment, it was important for them to understand that privacy while taking the survey was their responsibility through an email, which was sent out with the link to the survey. Anonymity and confidentiality were ensured by not using personal identifiers and the automatic IP collection key was switched off for prevention of collection of IP addresses.

Justice

All participants in the population were given an equal chance to participate because the survey was sent to everyone in the population.

4.3 RESULTS

4.3.1 Demographic description of respondents

Of the 413 (360 midwives and 53 obstetricians) eligible participants, 268 responses were received; however 29 were removed because they were completely blank. Respondents were aged between 22 and 60 years (mean 37 years). Of the 239 respondents, 159 (66.5%) were female and five participants did not identify their gender (Table 11). The majority of respondents were midwives 196 (82%), which represented a response rate of above 54%; four were obstetricians with a response rate of 8% and 11 were other medical staff. The majority of respondents were less than five years in service as it was the most common response (n=84, 35.1%).

Table 11: Demographic characteristics of respondents

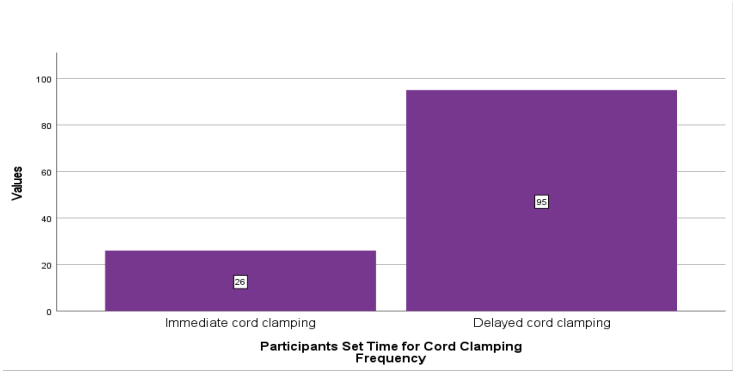
Characteristics	Frequency n=239	Percentage (%)
Gender		
Male	75	31.4
Female	159	66.5
Missing	5	2.1
Age group (years)		
Below 30 years	48	20.1
30-45 years old	144	60.3
Over 45 years old	41	17.2
Missing	6	2.5
Professional qualification		
Advanced Diploma Midwife/Diploma Nurse	124	51.9
Advanced Diploma Nurse Midwife	26	10.9
Certified Midwife	11	4.6
Enrolled Nurse Midwife	25	10.5
BSc in Midwifery	7	2.9
MSc in Midwifery	3	1.3
Total number of midwives	**196**	**82.0**
Obstetrician/ Gynaecologist	4	1.7
Medical Officer/Clinical Officer (not obstetrician/gynaecologist)	11	4.6
Total medical staff	**15**	**6.3**
Missing	28	11.7
Years in service		
Less than 5 years	84	35.1
5-10 years	73	30.5
More than 10 years	75	31.4
Missing	7	1.3

4.3.2 Current practice of umbilical cord clamping

Of the 239 respondents, 51% (n=122) reported following a set time for cord clamping for term, healthy neonates with a normal Apgar score (greater or equal to 7 at 5 minutes of age) with 46.9% (n=112) reporting no set time (n=5 missing). Of the 122 respondents, almost all (n=121) provided details of the actual time of cord clamping. The majority indicated that they delayed clamping of the cord for greater than one minute after birth (n=95/121, 78.5%) with just over one fifth (n=26, 21.5%) reporting

immediate cord clamping and two did not specify (Figure 4). Therefore, of the 239 respondents, 39.7% responded that they were practising a set time for cord clamping at birth that met the criteria for delayed cord clamping.

Figure 4: Distribution of the set time for umbilical cord clamping



Cord clamping timing during a caesarean section birth

Just over half the respondents identified immediate cord clamping as usual practice during caesarean section (n=135 (57.7%)), and 80 (34.2%) indicated a "not applicable" response because as midwives they were not responsible for cord clamping at C/S. While 19 (8.1%) did not respond to the question.

Of the 112 who said they had no set time, 94 responded to the follow up question, which asked about their umbilical cord clamping practice with 87/94 (92.5%) identifying immediate cord clamping and 7/94 (7.4%) delayed cord clamping (Table 12).

Table 12: Frequency of umbilical cord clamping practices of respondents who initially had no set time for cord clamping but later indicated timing

	Frequency (n=94)	Percent (%)
Immediate cord clamping	87	92.6
Delayed cord clamping	7	7.4
Total	94	100

Having a set time for cord clamping was not associated with increased years in service (p=0.910). Fewer 79/156 (49.4%) of respondents who had been in service for less than 10 years had a set time for cord clamping compared with 44/73 (60.3%) of those who had over 10 years in service (Table 13).

Table 13: Years in service and set time for cord clamping

		Set time cord clamping		Total n=234 (%)
		No	Yes	
Years in service	Missing	4	1	5 (2.1%)
	Less than 5 years	44	39	83 (35.5%)
	5-10 years	35	38	73 (31.2%)
	Over 10 years	29	44	73 (31.2%)
Total		112	122	234

4.3.3 Availability of umbilical cord clamping guidelines in Zambia

Of the 233 respondents to the question on whether they had an umbilical cord clamping guideline reported, just over half (n=118, 51%) said they had no guideline (Table 14). Of the 118 who said they had no guidelines, 43 (36%) said they had a set time for umbilical cord clamping and 42 (35.5%) provided their set time as either immediate cord clamping (11/42=26%) or delayed cord clamping (31/42=74%).

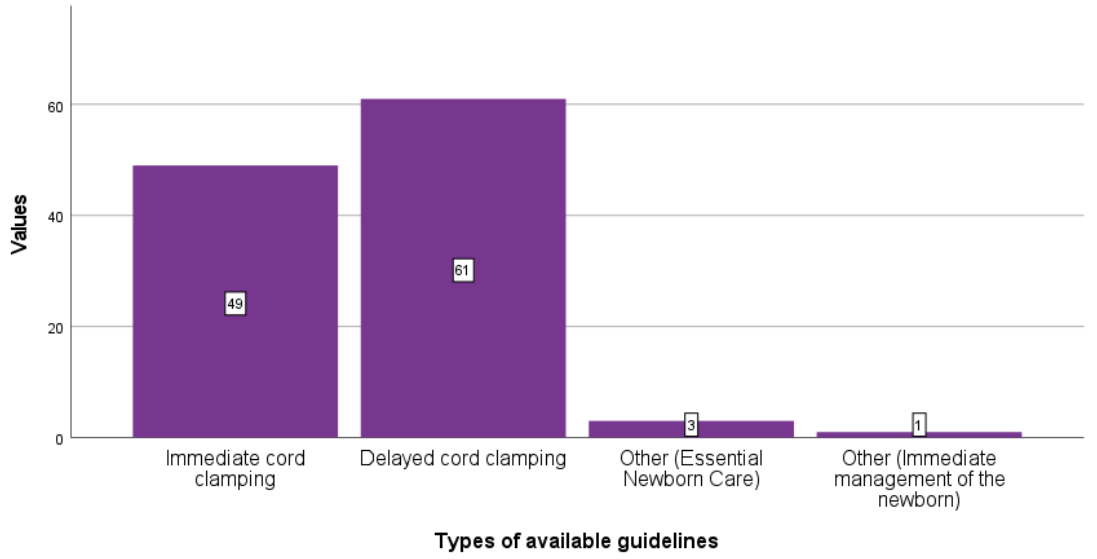
Table 14: Availability of guidelines and types

Availability of guidelines	**Frequency (n=233)**	**Percentage (%)**
Yes	115	49.4
No	118	50.6
Type of guidelines	**(n=114)**	**(%)**
Immediate cord clamping	50	43.9
Delayed cord clamping	64	56.1

Of the 115 respondents who reported having guidelines or protocols on umbilical cord clamping, 114 identified five different types of guidelines (Active management of the third stage of labour, immediate cord clamping, delayed cord clamping, clamping and cutting the cord when pulsation ceased and 'other') (Table 14). Of these 114 respondents, 64 (56.1%) reported a delayed cord clamping guideline, which included clamping the cord when pulsation has ceased and the Essential Newborn Care (ENC) guideline from the Zambian Ministry of Health that recommends delayed cord clamping of 1-3 minutes. Of those who selected 'other', this was also described as the

Essential Newborn Care guideline or "immediate management of the newborn" (Figure 5).

Figure 5: Types of available guidelines



4.3.4 Usual umbilical cord clamping practice

Table 15 denotes responses for the usual cord clamping routine in each respondent's clinical setting. Respondents could tick as many options to this question as applied, from a total of nine options. Respondents identified usual cord clamping routines were influenced by a local departmental guideline for 35.1% (n=84) respondents and/or a national guideline for 28% of respondents (n=67).

A further 71 respondents (29.7%) said they used delayed cord clamping for optimising the blood supply to the baby and 53 (22.2%) said they used it for initiation of early bonding between the mother and baby. Immediate cord clamping was said to be the routine practice by few (n=26, 10.9%) respondents, and even fewer (n=19, 7.9%) said their reason for umbilical cord clamping was that they followed what they were taught in their training. Reasons given by some respondents for practising immediate cord clamping included concern about the potential to increase the risk of polycythaemia and hyperbilirubinemia (n=45, 18.8%) and administration of uterotonic medication (oxytocin) (n=17, 7.1%). A similar number of respondents were not concerned about increased incidence of polycythaemia and hyperbilirubinemia and waited as long as possible before clamping the cord.

Table 15: Reasons for usual cord clamping practice

Reasons (multiple reasons were possible)	Frequency (n=239)	Percentage (%)
I clamp the umbilical cord according to a protocol within my practice/department	84	35.1
I find it important to wait until the pulsations have ceased in the umbilical cord to optimise blood supply.	71	29.7
I follow National Protocol/ Guidelines	67	28.0
Bonding between mother and child	53	22.2
I clamp the umbilical cord to prevent polycythaemia and hyperbilirubinaemia	45	18.8
Immediate cord clamping is my usual routine time for cord clamping.	26	10.9
I do not have a specific reason for my cord clamping routine. This is the way I was taught and I always do it like this.	19	7.9
I wait as long as possible with clamping the umbilical cord. Not worried about polycythaemia and hyperbilirubinaemia	17	7.1
For me administration of medication (e.g oxytocin) is the reason to clamp the cord.	17	7.1

4.3.5 Reasons for earlier than usual umbilical cord clamping practice

Respondents were asked about their reasons for earlier than usual cord clamping and could tick up to 13 options. As detailed in Table 16, respondents identified the main reason for clamping the cord earlier than they usually did was the baby being unwell at birth identified by a low Apgar score (n=137, 57.3%). Some respondents indicated that they always clamped the cord immediately (n=13, 5.4%) and therefore there were no occasions in which cord clamping was done earlier than their usual practice.

Table 16: Reasons for earlier than usual umbilical cord clamping practice

Reasons (multiple reasons were possible)	Frequency (n=239)	Percent (%)
The neonate has a low Apgar score	137	57.3
A short umbilical cord	86	36.0
When the placenta has detached from the uterine wall or has already been born	81	33.9
A lot of vaginal blood loss	76	31.8
Hypothermia (low temperature) of the neonate	43	18.0
Nuchal (around the neck) cord (cord clamping inside vulva)	38	15.9
When the pulsations have already ceased in the umbilical cord	37	15.5
After administration of oxytocin or other uterotonic drugs	34	14.2
To prevent polycythaemia/hyperbilirubinemia	27	11.3
Low position of the infant (e.g. birth on a birth stool)	22	9.2
Not applicable. I always clamp the cord immediately	13	5.4
Wish of the parents	7	2.9
Other	4	1.7
Other specified (maternal condition e.g. eclampsia)	1	
Other specified (tight cord around the neck)	2	
Other specified (mothers with HIV)	1	

4.3.1 Timing of cord clamping when the neonate is preterm

Of the 224 respondents, just over half (n=151, 63.2%) indicated they had no set time for cord clamping in preterm neonates following a vaginal birth; 15 (6.3%) participants did not respond to this question). Seventy-three (32.5%) stated that they used a set time, of whom 68 indicated a specific time - either delayed (n=40/68, 58.8% of those who specified) or immediate (n=27/68, 39.7%) (Table 17). Maternity health care providers were less likely to practise delayed cord clamping in preterm neonates compared with term neonates (p=0.35) (Table 18). Respondents offered multiple reasons for the set time they adopted for umbilical cord clamping when the neonate is preterm as indicated in Table 19.

Table 17: Set time cord clamping in premature births

Set time	Frequency (n=224)	Percentage (%)
No	151	67.4
Yes	73	32.5
If yes, at what time?	**(n=68)**	
Immediate cord clamping	27	39.7
Delayed cord clamping	40	58.8
Other	1	1.5

Table 18 Maternity health care providers DCC practice in preterm neonates

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	17.621[a]	16	.347
Likelihood Ratio	15.993	16	.453
Linear-by-Linear Association	.000	1	.984
N of Valid Cases	68		

a. 25 cells (92.6%) have expected count less than 5. The minimum expected count is .01.

The most common reason offered for the set time respondents used was for placental transfusion (n=65/239, 27.2%), which indicated delayed cord clamping was being used. This was similar to the finding by those who indicated their timing of umbilical cord clamping was influenced by their aim, which was to prevent polycythaemia and hyperbilirubinemia (61, 25.5%), which would require phototherapy (Table 19).

Table 19: Reason for chosen cord clamping practice when the neonate is preterm

Reasons (multiple reasons were possible)	Frequency (n=239)	Percentage (%)
For placental transfusion to occur (delayed cord clamping benefits are important)	65	27.2
I clamp the umbilical cord to prevent polycythaemia and hyperbilirubinemia	61	25.5
I clamp the umbilical cord according to a protocol within my practice/department	58	24.3
I follow National Protocol/ Guidelines	52	21.8
Bonding between mother and child	42	17.6
I find it important to wait until the pulsations have ceased in the umbilical cord to optimise blood supply.	42	17.6

I do not have a specific reason for my cord clamping routine. This is the way I was taught and I always do it like this	24	10.0
I wait as long as possible with clamping the umbilical cord. Not worried about polycythaemia and hyperbilirubinemia	17	7.1
For me administration of medication (e.g oxytocin) is the reason to clamp the cord	12	5.0
Other	5	2.1

4.4 DISCUSSION

The study aimed to determine the current umbilical cord clamping practices among midwives and obstetricians in Zambia.

Set time for umbilical cord clamping in healthy term neonates

Immediate cord clamping was the set time in many respondents and for the (40%) of the respondents who listed delayed cord clamping, it was at different time points with between two and three minutes being the preferred time in most of the respondents. Delayed cord clamping was only practised in term and healthy babies with a good Apgar score. This finding is similar to studies conducted in Australia, Nepal, Netherlands and Saudi Arabia where delayed cord clamping was practised more in uncomplicated births and in healthy neonates with a good Apgar score (Boere et al. 2015; Ibrahim et al. 2017; Nelin et al. 2018; Polglase & Stark 2018)**.** It is possible that in a complicated birth, practitioners want to remove the baby quickly to commence resuscitation and do not feel confident to practise delayed cord clamping in such situations because of the low Apgar score (Boere et al. 2015). An Apgar score was developed by Virginia Apgar in 1952, which assesses the condition of the baby at birth (Apgar 1966, 2015). It helps in identifying babies needing immediate resuscitation whose scores are determined at the 1st and 5th minutes of extra-uterine life and is used in evaluation of resuscitative interventions in babies with asphyxia, which is identified through the low Apgar score (Apgar 2015). Total points of 0-3 is defined as severe asphyxia, 4-6 is moderate asphyxia, 7 is mild asphyxia (Sellers 2018). Total scores of 8 and above indicate excellent condition (Table 20).

Table 20: Apgar score

	Sign	Score		
		0	1	2
A	Appearance (skin colour)	Cyanotic or pale all over the body	Body pink extremities blue	Completely pink
P	Pulse (heart rate)	Absent	<100bpm	>100b/m
G	Grimace response (reflex irritability)	Flaccid (no response)	Grimaces (some flexion of extremities)	Sneezes, coughs, pulls away
A	Activity (muscle tone)	Absent	Arms and legs flexed	Active movement
R	Respiration (breathing rate and effort)	Absent	Slow, irregular	Vigorous cry

Set time for preterm neonates born via spontaneous vaginal birth

In relation to cord clamping for a preterm baby, many (67.4%) respondents had no set time and for the few (32.5%) respondents who had a set time, delayed cord clamping at different intervals was their preferred time. It is worrying that many respondents had no set time, which may mean that they are still practising immediate cord clamping because of fear of the risks associated with delayed cord clamping and it was what was taught in midwifery and obstetrics for many years. However, in a study by Payne et al. (2021), it was discovered that delayed cord clamping was also practised in healthy preterm babies although the response rate to the studies conducted in LMICs for this study was low. The evidence is clear that premature babies are at increased risk of anaemia, therefore delayed cord clamping could be of significant benefit to them (Fogarty et al. 2017; Maisels & McDonagh 2008; Rabe et al. 2012).

Years in service and set time cord clamping

Only 19% of respondents who had been in service for more than 10 years had a set time for cord clamping, which could mean that they were practising immediate cord clamping. This could be attributed to how difficult it is to diffuse new evidence-based practices among practitioners who have been practising for a long time as evidenced in a study conducted in Oman (Madhavanprabhakaran et al. 2018). This study found that immediate cord clamping was the usual practice for this group despite having recent knowledge on delayed cord clamping (Madhavanprabhakaran et al. 2018).

However, this finding is in contrast with the study conducted in Saudi Arabia where delayed cord clamping was associated with increased years in service

Usual umbilical cord clamping practice

For many respondents, the usual umbilical cord clamping practice was influenced by a protocol either within the department or at national level. This finding is similar to studies conducted in Norway, the USA and Oman (Boere et al. 2015; Leslie 2015; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018). In these studies, the availability of a protocol was said to be an enabler in the diffusion of delayed cord clamping in clinical practice (Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018). In addition, studies have identified the absence of guidelines as one of the contributing factors to not implementing evidence-based practices in health care (Leslie et al. 2018; Powell et al. 2012). For implementation to be successful, policy makers have to ensure that guidelines are distributed, health care providers educated on the interpretation of guidelines and on how to use them in current practice. Having a protocol also does not necessarily mean that an intervention will be implemented in practice; an enabling environment is also necessary, which includes adequate resources and staffing levels (Turner, Griffiths & Kitson-Reynolds 2021).

Occasions for earlier cord clamping practice

A low Apgar score was the reason given by many respondents (57.3%) for immediate cord clamping. This means that neonates who were considered to have a low Apgar score had their umbilical cord clamped immediately in order to initiate resuscitation. Clearly, respondents did not wait until one or five minutes after the birth to calculate a low Apgar score before deciding on this aspect of practice. It is likely that 'low Apgar score' was used as a surrogate indicator of resuscitation needs.

This finding is similar to many studies on the topic where delayed cord clamping was only practised in healthy preterm and term infants (Boere et al. 2015; Ibrahim et al. 2017; Nelin et al. 2018; Polglase & Stark 2018). As explained earlier, delayed cord clamping has been recommended at every birth regardless of the Apgar score because it facilitates an increase in blood supply (World Health Organization 2014a) . This increase in blood supply may improve oxygen supply to the neonate thereby improving the Apgar score, the more reason why neonatal resuscitation should be undertaken with

an intact umbilical cord (Baenziger et al. 2007; Bhagavan & Ha 2015; Strauss et al. 2008).

Immediate cord clamping seems to be the preferred practice in both preterm and term neonates needing resuscitation in my study. This finding is similar to many studies on the topic where delayed cord clamping was not practised in preterm and term infants needing resuscitation (Boere et al. 2015; Ibrahim et al. 2017; Nelin et al. 2018; Polglase & Stark 2018).This is because the baby need to be moved to the resuscitation area for further management.

Umbilical cord clamping guidelines in Zambia

The majority (51%) of respondents reported having no guidelines to guide practice. The presence of a guideline has been recommended as an enabler in the diffusion of delayed cord clamping into clinical practice (Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018). The dissemination of new guidelines is usually accompanied by activities, which include the distribution of the guidelines, training of users and process evaluation to ensure that the diffusion process is implemented according to the protocol.

There were variations in the available guidelines, which included active management of the third stage of labour, immediate cord clamping, delayed cord clamping, pulsation cessation (PC) and essential newborn care (ENC). The variation in available guidelines is similar to a study by Boere et al. (2014), in which practitioners reported having different guidelines. However, it is interesting to note that among the few respondents who said they had an umbilical cord clamping guideline in Zambia, delayed cord clamping (including ENC and PC) was the most mentioned guideline. Therefore, there is need to follow up with case studies by midwives to confirm the availability and utility of guidelines.

A concerning area is that some respondents (1%) who had guidelines still reported no set time for cord clamping although the guideline had advice about cord clamping timing. This finding, while seen in only a small proportion of respondents, is still worrying because it is hoped that providers will follow guidelines, which are identified as enablers to the implementation of evidence based practices in clinical practice (Madhavanprabhakaran et al. 2018). It is, however, recognised that just having guidelines is not enough to translate into practice change (Shekelle et al. 2012). The

counter issue was also seen in the findings with some providers practising delayed cord clamping even without guidelines. This is encouraging but more research needs to be undertaken to better understand the knowledge acquisition on delayed cord clamping for this group and how they learnt how to practise without guidelines from the Ministry of Health.

4.5 STRENGTHS AND LIMITATIONS

This was the first online survey on the timing of umbilical cord clamping practices in Zambia. The survey has been able to provide a picture of current umbilical cord clamping practices by midwives and the type of available umbilical cord clamping guidelines in Zambia. This study used both quantitative and qualitative methods to explore an important area in maternity care. The sample size in this study was larger than studies undertaken in 2010 and 2021. The study by Vivio et al. (2010) had 62 participants from 13 institutions across Zambia while the Payne et al. study had 5 respondents (3 obstetricians and 2 midwives). My study included the views of 239 midwives and other maternity care providers across 101 health facilities. The health facilities were spread across the ten provinces of Zambia.

This was the first online study the researcher had conducted in Zambia and it was at a time when the country was experiencing long hours of electricity power cuts because of the low water levels in the Kariba dam, which is the country's main source of hydro-electricity. The other limitation was that it was difficulty to access email details of every midwife because not every midwife is a member of the Midwives Association of Zambia, which was our targeted approach to recruit midwives. The best way would have been to go through the Ministry of Health. The Ministry of Health Zambia uses Smart Zambia in which every employee receives an electronic payslip through the system. This was the option we initially wanted to use but because of ethics implications in which participants would have felt coerced by their employer, we decided to recruit through the professional associations. The Zambian Association of Obstetricians and Gynaecologists distributed the survey to all the obstetricians across Zambia but the response rate was very low. This is disappointing as most obstetricians are in decision-making positions hence the need to have had their voice in this survey. In the future, other ways to receive their views need to be found.

4.6 IMPLICATIONS FOR MATERNITY CARE IN ZAMBIA

Delayed cord clamping has been recommended at every birth for reduction of infant anaemia regardless of the condition and gestational age of the infant at birth (World Health Organization 2014a). However, the reported practice of delayed cord clamping in this study is far less than the WHO recommended practice at every birth(World Health Organization 2014a). This study has highlighted variations in guidelines and that some maternity healthcare providers reported practising delayed cord clamping in the absence of guidelines. Given the role of consistent, formal and informal guidelines in supporting evidence based practice (Stokes 2016), research is needed to provide a clear understanding of the utilisation of informal and formal local and formal national guidelines currently used to guide umbilical cord clamping in Zambia. Therefore, it is important to explore enablers to delayed cord clamping practice, which will inform strategies to increase this practice in birth units across Zambia. It is also important to explore and build on factors driving delayed cord clamping practice in Zambia and in particular, enablers that support delayed cord clamping in the absence of guidelines.

4.7 CONCLUSION

The findings of this survey indicated that while less than 50% of maternity health care providers are practising delayed cord clamping in Zambia, the full potential of delayed cord clamping to improve infant anaemia is not yet realised. Improving consistent implementation of delayed cord clamping has the potential for a significant impact on health outcomes. Variations in guidelines driving umbilical cord clamping practices likely undermine consistency in delayed cord clamping practices. Local examples of providers practising delayed cord clamping in the absence of guidelines provide an opportunity to identify and harness enablers to support the implementation of delayed cord clamping across Zambia. This study offers insights into the current umbilical cord clamping practices by maternity health care providers in Zambia.

The next two chapters will discuss the two follow up studies, which emanated from findings of Phase 1. Chapter 5 presents the collection of umbilical cord clamping guidelines and analysis using the AGREE II tool.

CHAPTER 5: PHASE 2: UMBILICAL CORD CLAMPING GUIDELINES IN ZAMBIA

5.1 INTRODUCTION

Many studies have been undertaken on the topic of delayed cord clamping and have identified the presence of guidelines as an enabler to the practice of delayed cord clamping (Boere et al. 2015; Ghirardello et al. 2018; Ibrahim et al. 2017; Leslie, Erickson-Owens & Park 2020; Leslie, Erickson-Owens & Park 2019; Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Madhavanprabhakaran et al. 2018; Nelin et al. 2018; Payne, Walker & Mitchell 2021; Perrone & Ghirardello 2017). However, the adoption and implementation of guidelines for delayed cord clamping in Zambia, are unknown. The Phase 1 study identified that 40% of survey respondents used delayed cord clamping in term, healthy neonates with high Apgar scores, with a delay of greater than 60 seconds or until cessation of cord pulsation.

Just under half (48%) of respondents in the Phase 1 survey indicated a range of guidelines that address cord clamping practice. These included guidelines for active management of the third stage of labour (which specifies immediate cord clamping); a delayed cord clamping guideline with timing between 1 - 3 minutes; a guideline to cut the cord following pulsation cessation, as well as a small proportion of respondents who identified the Zambian Ministry of Health guideline for Essential Newborn Care (ENC) that advises delayed cord clamping on page 11 (Ministry of Health Lusaka Zambia 2014). None of the respondents identified the WHO delayed cord clamping guideline as guiding their practice.

This phase of my PhD study aimed to examine the available guidelines that inform umbilical cord clamping practice in 100 birth units across Zambia.

Research questions

1. What are the available local maternity unit/departmental guidelines on umbilical cord clamping in birth units in Zambia?
2. What is the quality of the available delayed cord clamping guidelines?

5.2 STUDY DESIGN

A review of the available guidelines was conducted using the Appraisal of Guidelines for Research & Evaluation (AGREE) II instrument. The AGREE II tool has been widely used globally to assess the methodological rigour and transparency of guideline development that has been tested for validity and reliability (Brouwers et al. 2010; Donovan et al. 2018; Polus et al. 2012). It uses a detailed framework to assess guideline quality and it also provides a methodological strategy for developers of guidelines (Polus et al. 2012). It was used to assess WHO Guidelines in Maternal Health (Polus et al. 2012).

5.3 STUDY SITES AND SAMPLE

One hundred birth units across the ten provinces of Zambia were contacted for their available umbilical cord clamping guidelines through a WhatsApp communication group and then on email. Since Zambia consists of ten provinces, our target was ten birth units per province, which gave us 100 birth units as a representative sample. The lead midwife from each of the 100 birth units across the 10 provinces of Zambia was invited to participate in the study.

5.4 COLLECTION OF THE GUIDELINES

Each province has a 'Professional Midwifery WhatsApp group'. Each group has membership from all the birth units in the province. Invitations were sent to each of the WhatsApp groups inviting participation. Those who were interested to participate in the study were sent emails requesting an electronic copy of available guidelines in birth units. Each participant was given a $10 airtime re-imbursement after sending a copy of the available umbilical cord clamping guideline.

5.5 DATA ANALYSIS PLAN

Qualitative document analysis of submitted guidelines was conducted, to identify the types of guidelines being used in birth units across Zambia. The following information was collected: name and source of the guideline(s); whether the guidelines are evidence based; whether the guidelines recommend delayed cord clamping and whether the guidelines reference the WHO 2014 recommendations. Guidelines, which

had information on delayed cord clamping were appraised for the methodological rigour and transparency of guideline development using the AGREE II tool.

5.6 FINDINGS

A total of 100 emails were sent to lead midwives across Zambia with weekly reminders for one month. Of the 100 emails, 93 responses were received with 56 (60.2%) indicating that they had no guideline. The 37 out of 93 sent through seven different types of guidelines that inform umbilical cord clamping practice. These included Helping Babies Breathe (22), IMPAC (2), Neonatal Protocols (3), Essential Newborn Care (7), Active Management of the Third Stage of Labour (2), Nursing and Midwifery Protocols and Emergency Obstetrics and Neonatal Protocols (1). Helping Babies Breathe (22) was the most popular of the received guidelines**.** Three midwives also sent through handwritten delayed cord clamping procedures (Appendix F), which they written from their informal training. Of the submitted guidelines, three had some information on delayed cord clamping while the other four emphasised immediate cord clamping in the active management of the third stage of labour. The three guidelines, which had some information on delayed cord clamping were appraised using the AGREE II tool.

5.6.1 Guideline appraisal of submitted umbilical cord clamping documents using the AGREE II tool

Submitted umbilical cord clamping guidelines with information on delayed cord clamping were analysed by the researcher using the AGREE II tool (Tables 21-24). The AGREE II tool has six domains whose purpose is to provide a framework to assess the quality of guidelines, provide a methodological strategy for the development of guidelines and inform the structure of guidelines (Brouwers et al. 2010). The first domain is the scope and purpose, which has three items that consist of the overall aim of the guideline, the specific health questions and the target population (items 1-3) (Brouwers et al. 2010). The second domain also has three items (4-6), which involve stakeholder involvement that focuses on the extent to which the guideline was developed by the appropriate stakeholders and represents the views of its intended users (Brouwers et al. 2010). The third domain has eight items (7-14), which addresses the rigour of development that relates to the process used to gather and synthesize the evidence, the methods to formulate and update recommendations (Brouwers et al.

2010). The fourth domain has three items (15-17), which look at the clarity of presentation and involve the language, structure and format of the guideline (Brouwers et al. 2010). The fifth domain has four items (18-21) that focus on the applicability concerning the likely barriers and facilitators to implementation, strategies to improve uptake and resource implications of applying the guideline (Brouwers et al. 2010). The sixth domain has two items (22-23) that discuss the editorial independence concerned with the formulation of recommendations concerning biases and competing interests (Brouwers et al. 2010). The guideline analysis involves rating of the overall quality of the guideline and its recommendation for use in clinical practice (Brouwers et al. 2010). The AGREE II tool items are rated on a 7-point scale ranging from one, which is strongly disagree to seven, which is strongly agree (Appendix C) (Brouwers et al. 2010). A score of one was awarded if there is no information on that item in the AGREE II domain, if the concept is very poorly reported or if the criteria was not met as stated by the authors (Brouwers et al. 2010). A score of seven was given if the quality of reporting was exceptional and followed the domain items listed above (Brouwers et al. 2010). A score between two and six was assigned if the reporting of the AGREE II tool items did not meet the full criteria as stated in the domain (Brouwers et al. 2010). Assigning of the score was dependent on the completeness and quality of the reporting, which increased with the number of criteria as stated in the domain items (Brouwers et al. 2010). In this appraisal, high quality guidelines are those with an average score of greater than 65% according to the researcher. According to the agree tool II guidelines, the quality of guidelines is at the discretion of the appraiser (Brouwers et al. 2010). Table 21 will present the AGREE II Domains and Items while table 22 to 24 will present the AGREE II tool domains as presented with the three appraised guidelines.

Table 21: The AGREE II domains and Items (Brouwers et al. 2010).

AGREE II Domains and Items
Domain 1. Scope and Purpose
1. The overall objective(s) of the guideline is (are) specifically described.
2. The health question(s) covered by the guideline is (are) specifically described.
3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.
Domain 2. Stakeholder Involvement
4. The guideline development group includes individuals from all the relevant professional groups.
5. The views and preferences of the target population (patients, public, etc.) have been sought.
6. The target users of the guideline are clearly defined.
Domain 3. Rigour of Development
7. Systematic methods were used to search for evidence.
8. The criteria for selecting the evidence are clearly described.
9. The strengths and limitations of the body of evidence are clearly described.
10. The methods for formulating the recommendations are clearly described.
11. The health benefits, side effects, and risks have been considered in formulating the recommendations.
12. There is an explicit link between the recommendations and the supporting evidence.
13. The guideline has been externally reviewed by experts prior to its publication.
14. A procedure for updating the guideline is provided.
Domain 4. Clarity of Presentation
15. The recommendations are specific and unambiguous.
16. The different options for management of the condition or health issue are clearly presented.
17. Key recommendations are easily identifiable.
Domain 5. Applicability
18. The guideline describes facilitators and barriers to its application.
19. The guideline provides advice and/or tools on how the recommendations can be put into practice.
20. The potential resource implications of applying the recommendations have been considered.
21. The guideline presents monitoring and/ or auditing criteria.
Domain 6. Editorial Independence
22. The views of the funding body have not influenced the content of the guideline.
23. Competing interests of guideline development group members have been recorded and addressed.

Table 22: Essential Newborn Care - AGREE II domains, items and score

Domain 1: Scope and Purpose		
#	Item	Score
1.	The overall objective(s) of the guideline is (are) specifically described.	7
2.	The health question(s) covered by the guideline is (are) specifically described.	7
3.	The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.	7
Total		**21**
Domain 2: Stakeholder Involvement		
4.	The guideline development group includes individuals from all relevant professional groups.	7
5.	The views and preferences of the target population (patients, public, etc.) have been sought.	7
6.	The target users of the guideline are clearly defined.	7
Total		**21**
Domain 3: Rigour of Development		
7.	Systematic methods were used to search for evidence.	7
8.	The criteria for selecting the evidence are clearly described.	7
9.	The strengths and limitations of the body of evidence are clearly described.	7
10.	The methods for formulating the recommendations are clearly described.	7
11.	The health benefits, side effects, and risks have been considered in formulating the recommendations.	4
12.	There is an explicit link between the recommendations and the supporting evidence	7
13.	The guideline has been externally reviewed by experts prior to its publication.	7
14.	A procedure for updating the guideline is provided.	7
Total		**53**
Domain 4: Clarity of presentation		
15.	The recommendations are specific and unambiguous.	7
16.	The different options for management of the condition or health issue are clearly presented.	7
17.	Key recommendations are easily identifiable.	7
Total		**21**
Domain 5: Applicability		
18.	The guideline describes facilitators and barriers to its application.	1
19.	The guideline provides advice and/or tools on how the recommendations can be put into practice.	7
20.	The potential resource implications of applying the recommendations have been considered.	7
21.	The guideline presents monitoring and/or auditing criteria.	1
Total		**16**
Domain 6: Editorial Independence		
22.	The views of the funding body have not influenced the content of the guideline.	1
23.	Competing interests of guideline development group members have been recorded and addressed.	1
Total		**2**
Total Scores		134

Table 23: Helping Babies Breathe - AGREE II domains, items and score

Domain 1: Scope and Purpose		
#	Item	Score
1.	The overall objective(s) of the guideline is (are) specifically described.	7
2.	The health question(s) covered by the guideline is (are) specifically described.	7
3.	The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.	7
Total		**21**
Domain 2: Stakeholder Involvement		
4.	The guideline development group includes individuals from all relevant professional groups.	7
5.	The views and preferences of the target population (patients, public, etc.) have been sought.	7
6.	The target users of the guideline are clearly defined.	7
Total		**21**
Domain 3: Rigour of Development		
7.	Systematic methods were used to search for evidence.	7
8.	The criteria for selecting the evidence are clearly described.	7
9.	The strengths and limitations of the body of evidence are clearly described.	7
10.	The methods for formulating the recommendations are clearly described.	7
11.	The health benefits, side effects, and risks have been considered in formulating the recommendations.	6
12.	There is an explicit link between the recommendations and the supporting evidence	7
13.	The guideline has been externally reviewed by experts prior to its publication.	7
14.	A procedure for updating the guideline is provided.	7
Total		**55**
Domain 4: Clarity of presentation		
15.	The recommendations are specific and unambiguous.	7
16.	The different options for management of the condition or health issue are clearly presented.	7
17.	Key recommendations are easily identifiable.	7
Total		**21**
Domain 5: Applicability		
18.	The guideline describes facilitators and barriers to its application.	1
19.	The guideline provides advice and/or tools on how the recommendations can be put into practice.	7
20.	The potential resource implications of applying the recommendations have been considered.	7
21.	The guideline presents monitoring and/or auditing criteria.	7
Total		**22**
Domain 6: Editorial Independence		
22.	The views of the funding body have not influenced the content of the guideline.	1
23.	Competing interests of guideline development group members have been recorded and addressed.	1
Total		**2**
Total Scores		145

Table 24: Neonatal Protocols - AGREE II domains, items and score

Domain 1: Scope and Purpose		
#	Item	Score
1.	The overall objective(s) of the guideline is (are) specifically described.	7
2.	The health question(s) covered by the guideline is (are) specifically described.	7
3.	The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.	7
Total		**21**
Domain 2: Stakeholder Involvement		
4.	The guideline development group includes individuals from all relevant professional groups.	7
5.	The views and preferences of the target population (patients, public, etc.) have been sought.	7
6.	The target users of the guideline are clearly defined.	7
Total		**21**
Domain 3: Rigour of Development		
7.	Systematic methods were used to search for evidence.	4
8.	The criteria for selecting the evidence are clearly described.	7
9.	The strengths and limitations of the body of evidence are clearly described.	7
10.	The methods for formulating the recommendations are clearly described.	7
11.	The health benefits, side effects, and risks have been considered in formulating the recommendations.	3
12.	There is an explicit link between the recommendations and the supporting evidence	7
13.	The guideline has been externally reviewed by experts prior to its publication.	1
14.	A procedure for updating the guideline is provided.	7
Total		**43**
Domain 4: Clarity of presentation		
15.	The recommendations are specific and unambiguous.	7
16.	The different options for management of the condition or health issue are clearly presented.	7
17.	Key recommendations are easily identifiable.	7
Total		**21**
Domain 5: Applicability		
18.	The guideline describes facilitators and barriers to its application.	1
19.	The guideline provides advice and/or tools on how the recommendations can be put into practice.	7
20.	The potential resource implications of applying the recommendations have been considered.	5
21.	The guideline presents monitoring and/or auditing criteria.	1
Total		**14**
Domain 6: Editorial Independence		
22.	The views of the funding body have not influenced the content of the guideline.	1
23.	Competing interests of guideline development group members have been recorded and addressed.	1
Total		**2**
Total Scores		**122**

Table 25: Average scores (%) across the AGREE II domains and guideline

	AGREE II Domain						
Guideline	**Domain 1 (%)**	**Domain 2 (%)**	**Domain 3 (%)**	**Domain 4 (%)**	**Domain 5 (%)**	**Domain 6 (%)**	**Average scores**
ENC	100	100	96	0	100	50	74%
HBB	100	100	98	0	100	75	78%
Neonatal Protocols	100	100	73.6	0	100	42	69%

ENC: Essential Newborn Care
HBB: Helping Babies Breathe

5.7 SUMMARY OF THE FINDINGS

The analysis of the guidelines has given insights on the variations noted in Phase 1 of this study on available guidelines. However, the available guidelines were not specific to delayed cord clamping. Although the submitted guidelines that have been appraised using the AGREE II tool were not specific to delayed cord clamping because they had information on other newborn issues, their quality was good. Delayed cord clamping was recommended in three types of the submitted guidelines. The guidelines with the recommendation of delayed cord clamping were Essential Newborn Care (Table 22), Helping Babies Breathe (Table 23), and Neonatal Protocols (Table 24), which were appraised using the AGREE II tool. Helping Babies Breathe was the most common of the submitted guidelines. This is not surprising given the Midwives Association of Zambia has been implementing Helping Babies Breathe through the International Confederation of Midwives funded project for more than five years. It was interesting that three midwives sent through handwritten guidelines, which was encouraging because despite not having formal guidelines, they used their initiative to write the procedure for others to follow. In view of the guideline collection findings, recommendations will include the provision of a standard delayed cord clamping guideline and inclusion of process evaluation for every implemented program to ensure that what has been taught is being implemented correctly.

In this analysis, high quality guidelines are those with an average score of greater than 65% according to the researcher and all the three guidelines scored above 65%. According to the agree tool II guidelines, the quality of guidelines is at the discretion of the appraiser (Brouwers et al. 2010). Therefore, they can be recommended for use

although they are not specific to delayed cord clamping because they have information on other aspects of newborn care (Table 25).

All the three guidelines scored well on five AGREE II tool domains. However, editorial independence was not mentioned, which affected the average scores (Table 25). It is very important for guideline developers to state their competing interests. Therefore, future guideline designers could use the AGREE II tool when developing new guidelines (Brouwers et al. 2010).

5.8 CONCLUSION

The chapter has confirmed the type of documents being used as umbilical cord clamping guidelines in birth units across Zambia. It is also interesting to note that there is no delayed cord clamping specific guideline. Therefore, there is need for the Ministry of Health in Zambia to consider a delayed cord clamping focused umbilical cord clamping guideline, which may strengthen its diffusion into clinical practice. Furthermore, this analysis has revealed that the guideline formulation of these documents did not follow the AGREE II tool although this may not be the only tool or even the most relevant for all guidelines. Nonetheless, AGREE II tool has provided a framework on which to analyse these guidelines.

The next chapter presents Phase 3, a qualitative study that explored the enablers to delayed cord clamping practice by midwives in Zambia, who are the majority of maternity health care workers, and the implementation of the practice in Zambia.

CHAPTER 6: PHASE 3: AN EXPLORATORY QUALITATIVE STUDY OF THE FACTORS INFLUENCING UMBILICAL CORD CLAMPING PRACTICES BY MATERNITY HEALTH CARE PROVIDERS IN ZAMBIA

6.1 INTRODUCTION

As described in Chapter 4, Phase 1 of this PhD surveyed maternity health care workers in Zambia to identify their current umbilical cord clamping practices in Zambia. This survey identified that 95 of 239 respondents (39.7%) used delayed cord clamping when attending the births of women having term, healthy neonates who were well at the time of birth. These respondents delayed clamping and cutting the umbilical cord for greater than 60 seconds or until cessation of pulsation of the cord. Almost half of the respondents (48%) indicated that they used a number of guidelines to guide cord clamping practice and a more detailed analysis of these guidelines was presented in Chapter 5.

In the survey, 118 (49%) of respondents reported they had no guidelines at all but 31 out of 118 (26.3%) of these still said that they practised delayed cord clamping (anything from 60 seconds to the cessation of cord pulsation). It is important therefore, to identify the factors that have influenced this practice and explore why some providers had changed from immediate cord clamping to delayed cord clamping, some even in the absence of mandated guidelines. A better understanding of the enablers to the implementation of delayed cord clamping in Zambia, including the role of the Ministry of Health in producing and implementing guidelines in maternity care, is needed to increase the diffusion of delayed cord clamping into maternity practice in Zambia. Identifying the success factors for implementing delayed cord clamping in these units may provide important insights for all maternity units in Zambia and other Sub-Saharan African maternity services.

The aim of this phase of the PhD was to explore the enablers to adoption of delayed cord clamping practices by midwives and to better understand the implementation process for new programs in maternity practice, like delayed cord clamping, from key informants from the Ministry of Health in Zambia.

This chapter describes the methods used to address the aims after an amendment to the initial ethical approval was granted and the findings, which look at the diffusion of delayed cord clamping into practice.

6.2 Research Objective

To explore the enablers to undertaking delayed cord clamping practices by midwives and to better understand the implementation process for new programs in maternity practice.

Sub-objectives

3. To explore factors influencing cord clamping practices by midwives in Zambia.
4. To understand the implementation process of new programs into maternity practice from key informants from the Ministry of Health in Zambia.

6.3 Study Design

An exploratory, qualitative study was conducted. A qualitative research approach allows a rich description of participants' experiences and perspectives (Miles & Huberman 1994). It also provides in depth clarification of a particular topic (Creswell & Clark 2017). A qualitative research approach was most appropriate given this study was focused on understanding factors that facilitate implementation of evidence based practice in maternity units in Zambia. Semi structured in-depth interviews with key informants who are responsible for policy development and implementation of guidelines in Zambia and midwives who are the majority of maternity health workers were undertaken. The study drew on the Theoretical Domains Framework (TDF) as the framework to guide data analysis as a means to identify enablers to behaviour change in the implementation of delayed cord clamping in Zambia.

6.3.1 Use of the innovation diffusion theory and the theoretical domains framework in my thesis

My study has helped with determining the level at which the diffusion of delayed cord clamping in Zambia is with regards to the innovation diffusion theory staging (Rogers 2010). The innovation diffusion theory has five stages staging (Rogers 2010): stage one is knowledge, stage two is persuasion, stage three is decision making, stage four is the process of implementation and stage five is the confirmation stage. According to this mixed methods study, Zambia is at stage four because information on delayed cord clamping has been shared in order to persuade maternity health care workers to make informed decisions that has seen some change in practice from immediate cord clamping to delayed cord clamping. However, from the findings of this study, stages one to three need to be revisited in order to increase the diffusion of delayed cord clamping to every birth in Zambia. Thinking through the Theoretical Domain Framework, stage three of the innovation diffusion theory focuses on the actual decision of adopters that can be linked with the behavioural aspects to implementation, which are enablers and barriers to diffusion**.** The Theoretical Domain Framework has provided insights into the motivation to decide to practice delayed cord clamping by midwives.

6.3.2 Theoretical Domains Framework

The TDF is a theory informed approach to identifying determinants of behaviour in the diffusion of new programs (Atkins 2017). It was established by a collaboration of behavioural scientists and implementation researchers who identified relevant theories to implementation and grouped concepts into domains (Atkins 2017). This resulted in the identification and grouping of 128 explanatory constructs from 33 theories of behaviour (Francis, O'Connor & Curran 2012). The theories and constructs have been simplified into 14 overarching theoretical domains. Whilst the domains cover the physical and social environment, the majority relate to individual motivation and capability factors (Atkins 2017). An updated version of the TDF includes 14 domains covering 84 theoretical constructs. According to the TDF, there are certain factors that influence behaviour change, which are facilitated by determinants of current and desired behaviour (Atkins 2017). The TDF has identified determinants of behaviour, which have been grouped into 14 domains that focus on behavioural factors in the diffusion of new programs in clinical practice (Table 26) (Atkins 2017). The TDF has

been used in a range of studies with different objectives, including studies to identify influences on behaviours that are barriers and enablers to the implementation of evidence based practices (Atkins et al. 2017). In this study, the TDF will be used to understand the motivation to delayed cord clamping among midwives, who are the majority of maternity care workers in Zambia. Table 26 provides a glimpse of the focus of the domains in this thesis.

Table 26: Focus of domain response as applied to exploring the enablers to delayed cord clamping practice

Domain	Content definition	Focus of domain response as applied to this study
Knowledge	An awareness of something	Knowledge about delayed cord clamping
Skills	Ability or proficiency acquired through practice	Procedure of delayed cord clamping
Social/professional role and identity	Set of behaviours and qualities of an individual in social or work setting	Importance of delayed cord clamping to professional identity (e.g. is it part of my role.) Role of delayed cord clamping in relation to professional practice
Beliefs about capabilities	Views about one's ability/ talent/ capability to perform the target behaviour(s)	Capabilities of undertaking delayed cord clamping
Optimism	Confidence that things will happen for the best or that desired goals will be attained	Confidence in one's capability to perform
Beliefs about consequences	Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation	Significance of the beliefs about the outcomes of delayed cord clamping (positive and negative)
Reinforcement	Increasing the likelihood of a behaviour being performed by establishing an association between performing a behaviour and a given stimulus or cue	Sustainability of the practice. Factors that reinforce and improve the likelihood of practising delayed cord clamping
Intentions	Conscious decision to perform a behaviour or resolve to act in a certain way	Intentions to continue practising delayed cord clamping

Domain	Content definition	Focus of domain response as applied to this study
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Remembering to practise delayed cord clamping with ease at every birth. Trigger to practise delayed cord clamping
Environmental context and resources	Circumstances of a person's situation/environment that affect behaviour	Environmental and resource facilitators and barriers to practising delayed cord clamping
Social influences	Interpersonal processes that can cause individuals to change thoughts/ feelings/ behaviours	The influence of workmates on the practice of delayed cord clamping
Emotions	Complex reaction pattern by which an individual attempts to deal with a personally significant matter or event	Inner drive to practise/emotional response to practising delayed cord clamping
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions	Trigger to practise delayed cord clamping. Factors that regulate the practice of delayed cord clamping

Based on Atkins et al. (2017), the TDF domains can be understood as follows. The first TDF domain looks at an awareness of the existence of something (Knowledge), while the second domain examines the ability acquired through practice (Skills) and the third domain looks at a coherent set of behaviour and displayed personal qualities of an individual in a work setting (Social/Professional Role and Identity). The fourth domain focuses on the acceptance of truth, reality or validity about an ability, talent or capacity that a person can put to constructive use (Beliefs about Capabilities). The fifth and sixth domains look at the confidence that the desired goals will be achieved (Optimism) and the acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation (Beliefs about Consequences). Domain seven emphasises the ability of a behaviour to increase the probability of a response by arranging a dependent relationship between the response and the given stimulus (Reinforcement). The eighth, ninth and tenth domains look at the conscious decision to perform a behaviour (Intentions), the mental representation of outcomes that an individual wants to achieve (Goal) and the ability to retain information, focus on

aspects of the environment and choose between alternatives (Memory, Attention and Decision Processes). Domain eleven focuses on any circumstances of a person's environment that discourage or encourage the development of skills and abilities, independence, social competence and adaptive behaviour and thus the implementation of a target behaviour, for example delayed cord clamping (Environmental Context and Resources). Domain twelve looks at interpersonal processes that can cause individuals to change their behaviours (Social Influences). A complex reaction pattern involving experiential, behavioural and physiological elements by which the individual attempts to deal with a personally significant matter is domain thirteen (Emotion) (Atkins 2017). Finally, the last domain looks at anything aimed at changing objectively observed actions (Behavioural Regulation) (Atkins 2017).

Overall, these 14 domains provide an understanding of the behavioural aspects that influence the diffusion of evidence based practices into clinical practice (Atkins 2017). The domains have been used in previous studies that have looked at barriers and enablers to the use of new interventions in clinical practice in California, China and England (Chapman 2016; Mosavianpour et al. 2016; Roberts et al. 2017). As far as the researcher is aware, the TDF has not been used to investigate barriers and enablers to the implementation of new programs in low and middle income countries; in spite of the extensive use of the TDF in high income countries hence the need for the exploration of the enablers to the implementation of delayed cord clamping in Zambia using the TDF.

6.3.3 Using the TDF domains in this thesis

The TDF domains have been used in this thesis to analyse the data in a similar manner to that used in a study that investigated the barriers and enablers to the delivery of psychological care in the management of patients with type 2 diabetes mellitus in China (Chapman 2016). Some of the domains have been grouped together in this thesis at the reporting stage because they are interrelated. The combined domains included the following 1) Knowledge and Skills; 2) Optimism and Emotions; 3) Beliefs about consequences and social influences; 4) Intentions and reinforcement; 5) Motivation and goals. The grouping of domains resulted in the reduction of domains from 14 to 10 at the reporting stage because some domains were interrelated.

6.3.4 Research sites

Five birth units in Zambia identified in Phase 1 as having two or more respondents who said they were practising delayed cord clamping were invited to participate in the interviews. These units were selected based on survey data which indicated that at least some staff were practising delayed cord clamping. The five birth units were located in rural and urban areas. Birth units in urban areas have 50 to 100 births per day. Midwives work across three shifts, with seven midwives per shift, including morning from 7:30am to 1pm, afternoon from 1pm to 6pm and night duty from 6pm to 7:30am. Birth units in rural areas usually have 5 to 10 births per day and midwives' work schedule is different from those working in urban sites because few midwives are allocated to these areas (Table 27). However, one birth unit only had four midwives as presented in table 27 below. Some midwives are on a 24-hour on-call roster to support women requiring maternity services after hours in rural areas.

Table 27: Annual births and distribution of midwives in the sampled birth units

Birth unit	Urban/rural	Annual births	Midwife staffing
1	Rural	1680	5
2	Rural	3000	7
3	Urban	10080	32
4	Urban	4200	20
5	Rural	2300	4

6.3.5 Study Population

Two population groups were invited to participate in this study – midwives and key stakeholders from the Ministry of Health.

Midwives

Midwives from five birth units that were identified as practising delayed cord clamping in Phase 1 were invited to participate in one-to-one interviews. The study aimed to recruit at least five midwives per unit, as this is the minimum number of midwives working in birth units across Zambia, especially in rural areas however, one birth unit had four midwives only.

Key stakeholders

As explained earlier, the Ministry of Health is responsible for developing and implementing maternity service guidelines. It is the policy makers and leaders working in maternal and child health in the Ministry of Health who develop and implement these guidelines. Five out of five key stakeholders are involved in these processes at the Ministry of Health Zambia.

6.3.6 Recruitment

Midwives working in the selected birth units were invited to participate in a virtual face-to-face interview by the researcher via the professional midwives' 'WhatsApp Group' in each of the provinces where the units are located. As explained previously, the WhatsApp group is an informal platform that includes midwives from across Zambian Provinces that is used for easy communication. Midwife leaders manage the group and most birth units are included although not every midwife is a member. Midwives who showed interest in the study from the selected birth units were asked to email me. I responded by return email and shared the information sheet and the consent form. The midwives who agreed to participate then responded and a time and date for the interview was made. Participants gave verbal consent prior to the interview to ensure that participants understood and accepted the research without coercion.

The Permanent Secretary at the Ministry of Health, Zambia was contacted for the contact details of key informants in the area of maternal, newborn and child health. The Ministry of Health is responsible for the national policy and guidelines in relation to health care and it was therefore important to obtain their perspective. The key bureaucrat in the Ministry of Health, the Permanent Secretary, identified five key stakeholders working in maternal and child health who could be contacted. I was provided with their email addresses and I invited them via an email to participate in face-to-face interview but only two responded. The two individuals were provided with an information sheet describing the study and the consent form via email and verbal consent was gained prior to commencing interviews.

6.4 DATA COLLECTION PLAN AND TOOLS

The semi-structured interviews were conducted at a time that was convenient for the participants and while the participants led the interviews, the direction of the interviews was informed by the TDF (Table 26). Semi-structured interviews identified, through emergent discussion and "why" type questions (Healy, Humphreys & Kennedy 2017), perspectives of participants. This approach allowed the researcher to guide the direction of questions while at the same time enabling participants' perspectives to surface through emergent discussion (Creswell & Clark 2017). The researcher used the semi-structured questions as a guide for the conversation to explore enablers that supported midwives to practise delayed cord clamping in Zambia.

The semi-structured guides were developed based on a review of the literature (see Chapter 2) and the expertise of the research team and were informed by the Theoretical Domains Framework (Cane, O'Connor & Michie 2012). The draft data collection interview guides were pilot tested in two interviews that were conducted with a midwifery research student at UTS and a nurse midwife from South Africa. The two pilot sessions informed changes to the immediate and follow up questions, and the adjustment of the flow of questions. These pilot tests also helped me, as an interviewer, improve my interviewing style. With permission from the participants, the interviews were recorded and transcribed verbatim so I could reflect on them later and discuss with my supervisors. The transcripts were presented to the panel of supervisors who provided feedback on them, which gave insights into the interview process with midwives and key informants.

Due to the COVID-19 pandemic, I was unable to travel to Zambia to conduct the interviews. Therefore, I used the online platform Zoom to undertake the interviews. Participants were invited to connect to Zoom either through their mobile phone or a computer. Once they had had agreed to participate, I sent them a link to the zoom site where the interview would be conducted. This was password protected so that it was a private conversation. The questions used in the interviews with the midwives and their alignment to the Theoretical Domains Framework are summarised in Table 28.

Table 28: Interview questions administered to midwives and corresponding Theoretical Domains (Atkins 2017)

Domain	Content definition	Sample questions as applied to this study
Knowledge	An awareness of something.	What is your usual cord clamping practice at birth?
Skills	Ability or proficiency acquired through practice.	How would you describe the procedure of delayed cord clamping?
Social/professional role and identity	Set of behaviours and qualities of an individual in social or work setting	What are your views about the best time to clamp the cord?
Beliefs about capabilities	Views about one's ability/ talent/ capability to perform the target behaviour(s)	Are there any particular reasons that you are more or less capable about performing delayed cord clamping?
Optimism	Confidence that things will happen for the best or that desired goals will be attained	How optimistic or pessimistic are you that practising delayed cord clamping at birth holds the potential to reduce the life-time risk of anaemia?
Beliefs about consequences	Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation	Are you aware of any benefits of delayed cord clamping to the newborn baby?
Reinforcement	Increasing the likelihood of a behaviour being performed by establishing an association between performing a behaviour and a given stimulus or cue	Are you aware of any benefits of delayed cord clamping to the newborn baby? What factors influence your decision making about when to clamp the umbilical cord at birth?
Intentions	Conscious decision to perform a behaviour or resolve to act in a certain way	To what extent do you intend to (continue to) perform delayed cord clamping at every birth? What factors influence your decision making about when to clamp the umbilical cord at a birth?
Motivation and goals	Mental representation of outcomes or states that an individual wants to achieve	Do you have any specific goals for performing delayed cord clamping? What factors influence your decision making about when

Domain	Content definition	Sample questions as applied to this study
		to clamp the umbilical cord at a birth?
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	How easy or difficult is it to remember delayed cord clamping at every birth when you are conducting a delivery*? Are there triggers to prompt you to perform delayed cord clamping?
Environmental context and resources	Circumstances of a person's situation/environment that affect behaviour	What do you think makes it easy (or would make it easier) to practise delayed cord clamping in your maternity unit? To what extent does your working environment have sufficient levels of resources needed to allow performance of delayed cord clamping for 1-3 minutes after birth?
Social influences	Interpersonal processes that can cause individuals to change thoughts/ feelings/ behaviours	Are there any conflicting beliefs amongst your colleagues about delayed cord clamping? Are you aware of any benefits of delayed cord clamping to the newborn baby?
Emotions	Complex reaction pattern by which individual attempts to deal with a personally significant matter or event	How do you feel about practising delayed cord clamping?
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions	What are your views about the best time to clamp the cord? What motivates you to change practice? What will help you sustain the change? Are there factors in place that regulate the practice of delayed cord clamping?

*The term 'delivery' was used instead of birth, as this is what is well understood in this context.

The questions used in the stakeholder interviews were slightly different from the ones for the midwives as the focus was to elicit information on the implementation process of programs. Of the 14 Theoretical Domain Framework domains, I selected the 10 most relevant key domains that had relevance to policy makers. This is similar to

research conducted in Wuhan, China, where domains specific to a project were used instead of the 14 domains. The study in China aimed to explore the levels and determinants of health care workers' infection control behaviours based on the Theoretical Domains Framework, which has been shown to be effective in guiding behaviour change (Yang et al. 2021).

The ten domains selected were Knowledge, Skills, Social Influences, Reinforcement, Beliefs about consequences, Beliefs about capabilities, Social/Professional role and identity, Optimism, Behavioural regulation, Environmental context and resources (Table 29). These domains provided information on the implementation process of programs in maternal newborn and child health and generated insights on what has been done with regards to delayed cord clamping in Zambia.

The domains that were not used were more applicable to the practical aspects of delayed cord clamping than to policy makers. Emotions being a complex reaction by which an individual attempts to deal with a personally significant matter, applies to the actual practice of delayed cord clamping, which may be described by the person involved in the practice. Intentions defined as the conscious decision to perform a behaviour or resolve to act in a certain way, applies to the actual practice of delayed cord clamping, which may be described by the person involved in the practice and not policy makers. Memory, attention and decision processes, that is the ability to retain information, focus selectively on aspects of the environment and choose between alternatives, apply to the actual practice of delayed cord clamping, which may be described by the person involved in the practice and not policy makers. Motivation and Goals Mental refer to the representation of outcomes or states that an individual wants to achieve, which is better described by the person performing the action and not policy makers.

Table 29: Theoretical domains framework with sample questions for stakeholders (Atkins 2017)

Domain	Content	Sample question as applied to this study
Knowledge	An awareness of something	Has a shift in practice from immediate cord clamping to delayed cord clamping been implemented in birth units across Zambia? How is the implementation of new programs in maternity care done?
Skills	Ability or proficiency acquired through practice	Have maternity health care workers been trained on how to perform delayed cord clamping? Do we have guidelines on delayed cord clamping?
Social influences	Interpersonal processes that can cause individuals to change thoughts/ feelings/ behaviours	Are there any conflicting beliefs about delayed cord clamping practice in Zambia?
Environmental context and resources	Circumstances of a person's situation or environment that affect behaviour	To what extent does the working environment have sufficient resources to allow performance of delayed cord clamping for 1-3 minutes after birth in Zambia?
Beliefs about consequences	Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation	Are you aware of any benefits of delayed cord clamping to the newborn baby?
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions	Are there factors in place that regulate the practice of delayed cord clamping?
Optimism	Confidence that things will happen for the best or that desired goals will be attained	How optimistic or pessimistic are you that practising delayed cord clamping at birth holds the potential to reduce the life-time risk of anaemia?
Reinforcement	Increasing the likelihood of a behaviour being performed by establishing an association between performing a	Are you aware of any benefits of delayed cord clamping to the newborn baby?

Domain	Content	Sample question as applied to this study
	behaviour and a given stimulus or cue	
Social/ professional role and identity	Set of behaviours and qualities of an individual in social or work setting	What are your views about the best time to clamp the cord?
Beliefs about capabilities	Views about one's ability/ talent/ capability to perform the target behaviour(s)	Has there been training on delayed cord clamping to increase the capability of maternity care workers on how to perform delayed cord clamping?

6.4.1 Interview Procedures

As explained earlier, the one-to-one interviews were undertaken online using the Zoom platform. Permission was gained to record the interview. Participants were reminded that they were being recorded as the Zoom platform informs people at the beginning of the session. Participants were also verbally reminded at the beginning of the interview.

Midwives

The interviews started with midwives answering a series of demographic questions. They were then asked questions to ascertain the context in which they worked (for example, the number of births in their unit per shift/day, the number of midwives on each shift; other staff who might be present at births). The questions facilitated an exploration of participants' views about cord clamping practices generally, and delayed cord clamping specifically, and the factors that they believe influence umbilical cord clamping practices. The outline of the questions is presented in Table 27.

Ministry of Health stakeholders

The interviews started with the stakeholders being asked about their role and the context in which they work. Questions were slightly different from the ones used for the midwives because the aim was to explore their views about umbilical cord clamping practices generally, and the implementation of delayed cord clamping. They were asked about the factors that influence the implementation of guidelines and the

implementation process in general, of new practices in maternal, newborn and child health. The outline of the questions is presented in Table 29.

All the interviews started with an introduction from the researcher. This included that I was a midwife to ensure the participants knew that I would understand any technical or clinical terminology. Each interview took approximately 45 minutes in duration.

The interviews were audio recorded using the Zoom software and I transcribed each one verbatim into a Word document. The interviews were de-identified during this transcription process. The Word documents were reviewed for obvious mistakes that could have been made during transcription. The Word documents then were cross-checked against the interviews and any errors were corrected (Creswell & Clark 2017). The recordings were deleted after the transcription was deemed as being accurate reflections of the interview.

6.5 ETHICAL CONSIDERATIONS

Amendments to existing ethics committee approval were submitted to the University of Zambia's Biomedical Research Ethics Committee, which was followed by an amendment to conduct the study using health professionals from the National Health Research Authority in Lusaka. The initial approvals were only for the survey and so an amendment was needed to add in Phases Two and Three of the study. Ratification of the amended ethics was obtained from the University of Technology Sydney after obtaining the required approval documents from Zambia.

Each participant received a $10 for data bundle re-imbursement at the end of the interview through electronic money transfer. Participants were reassured that there were no right and wrong answers and that their names would not appear on any report or publication (Creswell & Clark 2017).

The research team had ongoing discussions about potential ethical issues that may arise during this part of the study. The ethical considerations below have been informed by Goodwin's framework (Goodwin, Mays & Pope 2006). These included being mindful of confidentiality, informed consent and the right to withdraw.

Confidentiality

Confidentiality was protected in several ways. Numbers were used to identify participants instead of names to uphold confidentiality. Data are stored on a password-protected iCloud, which is accessible to the research team. Data were de-identified but illustrative quotes have been included verbatim.

Privacy

Privacy was maintained by the researcher who held interviews in a closed room. However, maintenance of privacy by participants cannot be assured because the interviews were held on Zoom therefore, participants were asked to ensure their own privacy by ensuring that they were in their own private space. Audio files were deleted from devices once transcribed to reduce the chance that voices could be recognised.

Informed consent

Participants were informed about the research purpose and rationale of the study in the information sheet, which was sent via email before the interview. The information sheet and the consent to participate was sent via email and verbal consent was gained prior to commencing interviews.

Voluntary participation

Voluntary participation was upheld, which allows participants to withdraw from the study at any given time without any risks. Some midwives withdrew from participating before the interviews, which did not affect their relationship with the researcher.

6.6 DATA STORAGE

Transcribed data are being stored for a period of five years from the completion of the thesis in a password protected computer, which is only accessible to the researcher. The transcribed data are being used in this thesis for academic purposes and part of the data will be used for dissemination through publications, meetings and conferences.

6.7 DATA ANALYSIS

The data analysis process was informed by the Theoretical Domain Framework to understand and explore the aspects that have influenced the diffusion of delayed cord clamping among midwives in Zambia. As explained earlier, the TDF has been used in

this way in many qualitative studies. The paper by Chapman et al (2016) was used as an exemplar for my analytic process. Enablers to delayed cord clamping practice by respondents were identified in the 14 TDF domains. A content analysis was used, which allows both qualitative analysis and quantification of certain findings in order to expand on midwives' descriptions of their clinical knowledge (Cole 1988; Krippendorff 2018).

Interviews were analysed across five stages.

1) The interview transcripts were read several times and notes taken.
2) The transcripts were examined at a descriptive level to identify the enablers and barriers to delayed cord clamping practice and implementation.
3) Statements about enablers and barriers to delayed cord clamping practice and implementation were coded and tabulated using the 14 identified TDF domains.
4) Responses were divided into individual expressions and coded into the TDF domains.
5) Content analysis was conducted.

6.8 FINDINGS

6.8.1 Midwives

Twenty-five midwives participated in the study. Of these, 17 were women and eight were men (Table 30). The midwives came from five birth units located in two urban and three rural areas. Their years in service ranged between two and 15 years. The majority (n=17) of midwives were nurse midwives who undertook midwifery education after working as registered nurses. The midwives included certified midwives (n=3) and direct entry registered nurse midwives (n=5). The number of midwives in a birth unit ranged between three for rural and 32 for urban birth units.

Table 30: Demographic details of the 25 midwives

Demographic details	N=25
Gender	
• Female	17
• Male	8
Years in service (range)	2 to 15
Type of midwifery qualification	
• Nurse-midwives	17
• Certified midwives	3
• Direct entry nurse midwives	5
Area of practice	
• Urban	2
• Rural	3
Number of midwives in the Birth Unit	
• Birth Unit 1	5
• Birth Unit 2	7
• Birth Unit 3	32
• Birth Unit 4	20
• Birth Unit 5	4

Key enablers to delayed cord clamping practice together with respondents' quotes are presented within the 14 relevant domains below, which have been reduced to ten in the presentation of results because some of them were interrelated.

1. **Knowledge and Skills**

The level of knowledge regarding delayed cord clamping was high and all participants were able to explain the procedure. They knew what delayed cord clamping was and how to practise it in healthy babies. One participant said:

> *"When a baby is born, we don't clamp immediately. We wait for at least one to three minutes. That is in a baby who is stable. Because there are times when a baby is born and then after an initial assessment, you see that maybe the baby is flat, there is need for immediate resuscitation, we do not practise delayed*

cord clamping. Instead, we milk the cord and then clamp and cut" (Participant 6).

The majority (24) of the participants said that their cord clamping method was determined by the condition of the baby. They reported that delayed cord clamping was not used in babies needing resuscitation because the resuscitation became the priority. This is what a participant reported:

"Usually, our usual time for cord clamping depends on the delivery. If the baby is born without complications, we tend to take a bit of time, which is approximately one to three minutes" (Participant 1).

Another participant said:

"Normally if the baby is okay and everything is fine, I delay the clamping of the cord ... we wait until we wipe the baby, everything done, that's when now we clamp. We delay at least for two minutes or so" (Participant 5).

The benefits that come with the practice of delayed cord clamping, which includes placental transfusion, were identified as the enablers to the preferred time of cord clamping practice. In that direction, one participant said:

"I feel if you wait, at least for the three minutes the maximum blood would have gone to the baby and the baby would have received the maximum transfusion" (Participant 6).

A small number of participants (n=3) explained that their delayed cord clamping knowledge and practice was influenced by the World Health Organization's recommendation. For example:

"As for me, when I'm on duty, I usually use delayed cord clamping because it is recommended by WHO that cord clamping should be performed at least one to two, three minutes after birth"(Participant 2).

In support of the same point, another participant indicated:

"At first, it used to be immediately, as soon as the baby is born, you clamp the cord, then cut and take the baby before weighing and do the rest. But in 2019, after WHO introduced the delay method, we had an orientation since then, it is the one we've been using since" (Participant 10).

Participants were able to explain the skill of performing delayed cord clamping although their knowledge of the timing of cord clamping was not uniform. Some participants defined delayed clamping as not less than one minute while others used the 1-3 minute range. A participant reported:

> *"First of all, when a woman is fully dilated, we normally double-glove with sterile gloves. So when the baby is delivered, we usually remove one pair of gloves to maintain sterility. Then after that, we clamp through cord clamps. But then before we clamp, we usually wait. If the baby doesn't need resuscitation and the mother is not bleeding heavily, we usually delay not less than one minute earliest" (Participant 3).*

In birth units with more than one midwife on duty, midwives explained reaching out to one another with regards to the timing of cord clamping. The attending midwife was able to give a signal for someone to note the time of the birth as this helped them in timing the clamping of the cord. They knew that they needed assistance to do the timing accurately. A participant said that:

> *"The procedure for delayed cord clamping starts the moment you deliver the baby onto the mother's abdomen, if you're the one delivering you shout the time of delivery, then someone will tell you as you continue wiping the baby and keeping the baby warm, then you tell them to note if it's one minute to three minutes after delivery, then you can clamp and you're good to go" (Participant 6).*

Three midwives knew the importance of delayed cord clamping practice in babies needing resuscitation, which helps in improving the oxygenation that may further improve the asphyxia. One of these participants said:

> *"Delayed cord clamping because there are those babies that may have asphyxia at birth. We would want to delay so that maybe they can get the oxygen from the mother. So that's why delaying in clamping is the best" (Participant 8).*

Participants knew that the guidelines were important in their delayed cord clamping practice. Where they were present, guidelines were identified as an enabler to delayed cord clamping practice. Specific guidelines were not available in two of the sampled

birth units although midwives seemed to know that the practice was beneficial. A participant observed:

> *"And from my own observation delayed cord clamping is something which is a good practice and I think it would help us a lot if we had guidelines. When you're doing delivery for example, if midwives that are training in schools can be taught delayed cord clamping as they're doing the delivery" (Participant 11).*

This participant knew about delayed cord clamping practice and all its benefits to the baby as they had learned this during midwifery training. This knowledge from midwifery school made it easy to embrace it in practice because it was the only method taught. This participant indicated:

> *"I learnt about delayed cord clamping in training. It was the only method that I learnt and since then I have been practising delayed cord clamping. I finished the registered nurse midwife training in 2016 (Participant 11)".*

In summary, the levels of knowledge and skill in relation to delayed cord clamping was high amongst this group of midwives despite not always having the specific guidelines.

2. Social/professional role and identity

The domain of social/professional role and identity looks at a coherent set of behaviour and displayed personal qualities of an individual in a work setting (Atkins 2017). The practice of umbilical cord clamping is a key part of the professional role of midwives and undertaken by all midwives at essentially every birth. Making the decisions about timing of cord clamping is part of the identity of the midwife as it is that cadre who usually makes this decision.

All 25 midwives clearly explained their cord clamping practice with ease because the practice is imbedded in their management of the third stage of labour. In addition, participants said immediate cord clamping provided little time to transition from one activity to the other during the process of birth whereas delayed cord clamping has been identified to offer more time to conduct procedures that follow the birth of the baby like wiping the baby. One participant reported:

"What I can say is, really, from the time I personally started practising delayed cord clamping, it gives me time not to panic to do a lot of things that you have to do on the newborn baby. Because before that it was like a must that you have to cut the cord immediately, regardless of how the baby is at birth, whether the baby is not crying or baby's able to cry. However, for now it gives me time to focus on the wellbeing of the baby and try to resuscitate the baby, ensure the baby is breathing well, and that is when I will calmly get my clamps and cut the cord. So it is really gives me enough time to do other things. It's beneficial in a way that it gives you that ample time and it gives you time to work on the newborn baby" (Participant 1).

Another participant said:

Practising delayed cord clamping is easy and similar to what I used to do before when I was practising immediate cord clamping. The only difference is that I just do the procedures that follows the complete delivery of the baby like wiping of the baby, showing the sex to the mother and placing the baby onto the mother's abdomen slowly (Participant 8).

3. Beliefs about capabilities

This domain looks at an acceptance of the truth, reality or validity about an ability or talent that a person can put to constructive use (Atkins 2017). All the midwives reported practising delayed cord clamping with ease although there were variations in the timing as already discussed. Midwives understood that umbilical cord clamping practice was within their capabilities and the decision regarding timing was theirs to make. They recognised that confidence and capability were usually gained with clinical practice; the more one practises, the more capable one becomes at the procedure. Participants said:

"When you're used to something, you know, if it just flows, the procedure just flows when you know what to do, it becomes part of you. You do not have to think about it, you know. If you usually do it, it will just flow on. So it becomes easier for you because you usually do it and it does not require any special resources" (Participant 2).

"Since I have been practising delayed cord clamping from the time I was a student, it is the method that I know and it is easy to remember" (Participant 14).

"Immediately after orientation to delayed cord clamping the change was easy because the procedure is similar to immediate cord clamping. The only difference is that we do not rush into clamping but take some time by doing other things" (Participant 19).

4. Optimism and Emotion

Optimism looks at how confident adopters are at reaching the desired goal while emotion looks at a complex reaction, which ignites individuals to deal with an important issue (Atkins 2017). All the midwives recognised the haematological benefits that come with the practice of delayed cord clamping from the observed benefits that has been seen in babies post delayed cord clamping and they are able to practice the procedure with confidence. Emotional factors that influence the practice of delayed cord clamping were identified throughout the interviews as most midwives provided information that were linked to the emotional effect of the practice of delayed cord clamping for the midwife. A participant reported:

> "*Well, my experience has been that most of the children or the babies whom I deliver by delayed cord clamping don't usually come back to the facility with illnesses compared with others who have their cords clamped immediately. You know others usually come back with their babies suffering from illnesses for those who have not had delayed cord clamping that's one thing I have observed. Maybe it's because of the higher stem cells of haemoglobin, which they usually get from delayed cord clamping. And if you see the cord in delayed cord clamping it usually looks white because most of the blood has gone to the baby but with immediate cord clamping, the cord looks reddish meaning the blood has not gone to, to baby" (Participant 2).*

Midwives talked about the practical observations of a gush of blood that is seen in immediate cord clamping. This shows that if placental transfusion has not occurred there is a lot of blood moving from the placenta to the baby hence the need to allow the transfer of blood from the placenta to the baby before cutting the cord. One participant revealed:

"Just after delivery of the baby, if you can get hold the umbilical cord, you will realize that there's still pulsations and very strong ones for that matter. So meaning, the blood is being transferred from the placenta to the baby. So that pulsation is there, which is so strong and then you'll notice, okay, this placenta seems to be very functional to the baby and then you even see it, if you would do immediate cord clamping. According to my observation, you'll find that there will be this gush of blood which comes with force showing that this blood was in transit going into the baby, which was just disrupted. So basically I believe, yes delayed cord clamping has good effects on the baby" (Participant 4).

In support, another participant said:

"So the blood can still go to the baby and still supply the baby with the few other requirements, especially the oxygen aspects, because that's when the baby is learning how to breathe on their own outside the uterus" (Participant 12).

Some midwives have witnessed the improvement that happens with the use of placental transfusion in asphyxiated babies and this was an enabler to continue the practice. As more blood moves from the placenta to the newborn baby, there is an improvement in the condition of an asphyxiated baby as more oxygen gets to vital organs. One participant said the following:

"I think I will give this scenario. I was happy with the outcome of a baby who was born asphyxiated because we delayed clamping the cord. The baby was still receiving blood. And we know that blood has oxygen, and then the baby cried after some time. So the outcome became good after delayed cord clamping. And the other benefits, I know some benefits, it reduces the chances of the baby having blood transfusion because the babies will receive a lot of blood from the placenta. You know, when we rush to clamp, you'll find that the baby has not received that blood, which was there in the umbilical cord. So we more like deprived the baby of that blood. So if we delay, you find that the baby will receive that blood and I think it will help the cardiovascular system of the baby, which will stabilize the baby than rushing to clamp and cut the cord" (Participant 6).

The feeling that comes with seeing a happy mother and a healthy baby is what motivated some midwives to practise delayed cord clamping. There is inner satisfaction that comes with witnessing to the joy that comes at seeing a well mother and baby at the end of the birthing process. One participant made the following statement:

> *"The motto which said, 'No baby or mother should die on the table of giving birth.' That makes me so happy and feel fulfilled when I see a mother come to deliver and leave with a live baby. That joy the mother gets gives me joy as well. I find happiness in seeing the mothers happy and satisfied with our services" (Participant 15).*

5. Beliefs about consequences and Social influences

Beliefs about consequences focus on understanding the acceptance of the truth, reality or validity about outcomes of behaviour in a given situation; the social influences domain looks at interpersonal relationships that can cause individuals to change their behaviour (Atkins 2017). Participants identified the connectivity of beliefs about consequences and social influences as barriers that influence their practice. Some of their colleagues were sceptical about performing delayed cord clamping because of the risks and myths that surround the practice. This means that the social pressures to conform with others was high. Although implementation of change was not easy at first because it was met with a lot of questions, as midwives wanted to know the reason for the shift in practice. Given the benefits that come with delayed cord clamping practice, it was eventually accepted. This is what a participant reported:

> *"I think the positive response that we have received from the staff working on the labour ward helped a lot with changing the practice. And of course at first everyone was asking questions like 'Why are we changing the practice?' But when they heard the reason why everyone was, 'Oh, okay, then it's fine. We can do it.' And that's how everyone made change to say, 'there's no problem about it. We can adopt it'" (Participant 5).*

Another participant who weighed up the benefits and the consequences to the baby said:

> *"I think because of the ward meetings, people are coming to accept it. Although sometimes, they'll say there are risks of delayed cord clamping like the baby*

may develop jaundice because the liver becomes overwhelmed because of the blood. But otherwise, I usually weigh the benefits. Probably the baby will benefit more from delayed cord clamping. Very few will have jaundice" (Participant 3).

Being used to the old way of practice and not wanting to let go of the old practice in embracing the new evidence based practice was identified as a barrier to change. One participant made the following statement:

"Well, we've tried to talk to other midwives who are not practising delayed cord clamping on the importance of delayed cord clamping, but others still think that it is not important for them, because they are used to the old way of doing it. We have tried to educate them on the importance of delayed cord clamping but they don't use it and they don't see it to be important because they're still using the old way. So, I don't know" (Participant 2).

Other identified barriers to delayed cord clamping practice were the myths that surround the procedure especially in rural areas where people hold on to traditional social practices that are transferred from one generation to another. One participant said:

"There have been these conflicting ideas about the practice of delayed cord clamping. Ideally, when you look at it there are just these fears attached, us who are in the villages and the like, sometimes we tend to be taken away by myths. There are quite a lot of myths attached around delivery. Okay. So, like one from the village I'm coming from. They say something like when you delay, because they are majority of the people that I had found who are no longer practising were traditional birth attendants. They believe to say when you cut the umbilical cord early, it will facilitate the fast growth of the baby. Like if you delay, you will delay some milestones, something like that. Okay, maybe when you delay then others believe that when the placenta is out, it's dead. So, whatsoever blood that is coming from it to the baby may have no effect, yeah" (Participant 20).

Reduction in the need for blood transfusion is among the identified positive consequences of delayed cord clamping because midwives look forward to seeing a

well-baby with less hospitalisation, which is a fulfilling experience for both the family and the midwife. This is what one participant said:

> *"I think it's good for better establishment of the red blood cells. Also, if the baby has got a good haemoglobin, they will not need any blood transfusion, there will be decreased need for blood transfusion" (Participant 3).*

6. Intentions and Reinforcement

Intention and reinforcement relate to sustaining the practice. Midwives often intend to do the new practice, in this case delayed cord clamping, but without ongoing reinforcement, they will revert back to the old way, that is immediate cord clamping. There are a number of factors that support intention and reinforcement including perceived benefits. The identified benefits to the newborn baby were related to the haematological benefits that come with the practice.

Understanding the benefits really helped sustain the practice. One participant said:

> *"I think looking at the benefits, they are the ones which makes me delay in cord clamping because I think most of the babies, those who, let's say, were born before they arrived at the hospital, most of them, you'll see that maybe when they come for postnatal review, they normally don't put on weight so easily compared with those who had delayed cord clamping done at the facility. Maybe the cord wasn't handled very nicely. Most of the time, they would have infection, which would lead even to a reduction in haemoglobin. But for me, what I've seen, almost all the babies that have used this practice, they are doing fine. We've never transfused blood. They're doing fine, increasing weight nicely. I never had all those complications. It is the reason why I will continue practising delayed cord clamping" (Participant 3).*

7. Motivation and Goals

The motivation to change the practice from immediate to delayed cord clamping was underpinned by the knowledge that the delayed cord clamping has benefits to the baby. The number of babies needing blood transfusion was observed to have reduced in some institutions. This made moving to a system where delayed cord clamping was usual practice easy and it was a goal for many midwives in this study. Reasons that were cited included observed reduction in blood transfusion, improved oxygenation and

calmness that comes with the practice of delayed cord clamping instead of rushing to clamp and cut the cord. One participant said:

> *"The benefits were well presented. They told us that the benefits of delayed cord clamping is that the child will be able to have extra blood amounting to somewhere around 40 to 50 Millilitres per kilogram. And then, it will prevent this baby from having anaemia in the first year of life and other related conditions. And the baby will also have higher haemoglobin concentration. I can remember that and it is the reason why I practise" (Participant 2).*

Training was mentioned as a motivation that supported some midwives to change their practice. The content of the training emphasised the benefits that come with the practice, which was the reason why some participants decided to shift their practice. This is one participant's view:

> *"After learning and I came to think of it, I think it was making sense, because the old practice that we were using before, we were rushing. I saw that there was nothing wrong in us delaying it, because it was beneficial to the baby rather than rushing in clamping the cord. So, that's the only thing that was interesting to me. And I just thought of its benefits and agreed to embrace it, since it is bringing a positive change in the lives of babies according to what we've heard" (Participant 5).*

Similarly, a participant attended a workshop where delayed cord clamping was mentioned although its implementation was not emphasised. The participant was further involved in an informal discussion and finally was motivated to adopt the practice because many people had spoken about it and she had read about it on the midwifery App. The midwifery App is a tool that many midwives use when caring for pregnant women. The participant was also motivated to be a change agent in ensuring that students were being taught the evidence based practice of delayed cord clamping in the birth unit. They said:

> *"We went to a workshop on EmONC but that was a long time. Then they didn't really implement it, but they were just talking about it. Then now, when I went to hospital where we usually take referrals, I found a midwife and a gynaecologist talking about it. So I got interested. Then another gynaecologist came from the hospital, then they told us about an app. There is an app for*

most of the midwifery contents, but they are summarised. In case you are alone, you need this and that. So I saw it there, then I read about it. Then during our meetings, the doctor mentioned it and the nursing officer mentioned it too. So I was like, Oh, okay. That's why now, everyone has started. Though it took time for us to start practising this, but then eventually, we got used to it because now, we have students also. So when the students come and then you're not practising this, what are they going to take? And then they are the same people that will be deployed in the rural areas where you go and get patients. So, if they don't learn, if I'm not practising and they don't know anything they will not know when they start practising. So, it has made us also to be practising because of these students that we receive, if they don't learn it from us, they won't learn anywhere else" (Participant 11).

In the past, immediate cord clamping was advocated for the active management of the third stage of labour in midwifery training for prevention of hypothermia and mother to child transmission of human immunodeficiency virus (HIV) in LMICs. With the coming of delayed cord clamping and its benefits to the newborn baby, there has been a shift in practice, which is the reason several midwives gave for the motivation to change the practice from immediate cord clamping to delayed cord clamping. One participant revealed:

"Okay, when I was in training, I was told initially that we should practise immediate cord clamping after delivery. The reason why that was established is because there were all these fears. Maybe the mother may bleed to death - all those kind of things. But then after they established some benefits, especially when it comes to how much blood that the baby is going to get, the percentage of blood the baby needs from the placenta and all those health benefits that will go to the baby, including the immune aspect. So, I felt personally that that's the best way and that's the best gift you can give to these babies. Just give them as much blood as they need from the placenta before it is discarded" (Participant 14).

8. Memory, attention and decision processes

The domain of memory, attention and decision processes looks at the ability to retain information when making decisions (Atkins 2017). Delayed cord clamping requires midwives to remember to do it – remember to wait, which may have been against their

automatic reflex, which is to clamp and cut the cord as soon as possible. However, many participants said it was easy to remember because it allowed them to do follow up procedure after birth slowly compared to before when they were clamping and cutting immediately after birth. The name itself is a reminder to delay and not rush to clamp and cut the cord. Making the decision to wait was explained by the participants in the study as they practised delayed cord clamping. Participants said remembering to practise delayed cord clamping was not too difficult but it did require attention to detail, that is, noting the time of the birth. This is what one participant reported:

> *"So immediately the baby is born, you wipe the baby, you can even as well be careful and even maybe put some socks on. If you have the wrapper, you can even wrap the baby. After you, you give the woman oxytocin, at complete delivery. You can then start counting the three minutes. You have to wait, you don't have to clamp immediately wait, at least one to two minutes that's when you can clamp the cord and cut" (Participant 2).*

The timing of cord clamping seemed to vary. One midwife mentioned not less than 40 seconds as their cord clamping timing and when asked if that was delayed cord clamping the response was "yes". However, not having a wall clock could have affected the decision at which cord clamping was performed. Attention to the exact timing was not always possible as not all units had an easily seen wall clock in their birthing area. One participant said:

> "*So, of course, before you do the clamping and the like, you have to make sure the baby is kept warm. So, you have to cover the baby. As you're covering the baby and wiping dry the baby, seconds are ticking, your target should be at least not to clamp the cord in less than 40 seconds. Okay. So then after you are certain that the 40 seconds have gone as you're keeping yourself busy trying to make sure you wipe the baby, just remove anything that can attract hypothermia" (Participant 4).*

9. Behavioural regulation

Behavioral regulation refers to practices put in place that encourage and enable the new practice to be implemented (Atkins 2017). In the case of delayed cord clamping, midwives found other activities to do in the few minutes that they were waiting. This is important as historically, clamping and cutting the cord was done very quickly, straight after the baby was born, so finding things to do to resist this practice was

needed. Preparation of baby layette and talking with the woman and allaying her anxieties were practices put in place to delay the clamping. One participant explained:

> *As we wait for the three to five minutes, we put the baby layette in order and talk to the mother to encourage the mother so that she doesn't realize that time we are spending to wait for transfusion to occur" (Participant 12).*

The comfort of the woman was a concern for some midwives as they waited for placental transfusion to occur. They also needed to ensure that the woman was in the best position and that the cord was visible and long enough to enable movement of the baby. One participant indicated:

> *"We make sure the woman is comfortable, once the membranes rupture, at least you change where they are sleeping so that you have at least a safe and clean delivery. So, before the baby is born, you prepare all the things. The cord clamp is usually in the sterile pack. So, you double-glove and after the baby is born, you delay the clamping and the baby is placed on the abdomen, that is if the cord is long enough. But, if the cord is short, we just usually put in between the thighs of the woman because it can snap. If the cord is long, you put the baby on the mother's abdomen for bonding (Participant 17).*

Prevention of hypothermia for the baby was important as delayed cord clamping meant the baby could be exposed to the cold air for a longer period of time. All participants said that they dried the baby to prevent hypothermia and early initiation of bonding by placing the baby onto the mother's abdomen for skin to skin contact. One participant said:

> *"Okay, after the baby is born, on the mother's abdomen. Then you wipe the baby dry. As you are wiping dry, of course we need to assess to make sure that everything is okay and the baby is breathing and there are no secretions, everything is fine. Then you can just leave the baby on the mother's abdomen for bonding and for prevention of hypothermia through skin-to-skin interactions between the mother and the baby. Then later on, after cleaning, making sure that you are done with everything, that's when you now can clamp" (Participant 5).*

10. Environmental context and resources

Environmental context and resources look at any circumstance of a person's environment that either discourages or encourages the development of skills, abilities and adaptive behaviour (Atkins 2017). The environmental context and the available resources usually impact on the ability of a practice to be put in place. This did not seem to be the case with the delayed cord clamping because the procedure requires no special place but the mastery of how to perform it. One participant said:

> *"When you're used to something, it just flows, the procedure just flows when you know what to do. You do not have to think about it, you know. If you usually do it, it will just flow on. So, it becomes easier for you because you usually do it. It does not require any special environment" (Participant 2).*

Nonetheless, the environment in the birthing room was cited as a barrier to delayed cord clamping practice for babies needing resuscitation because of the need to move the baby to another area for resuscitation. One participant said:

> *"Probably because of the same things that I've explained. It is just that at our facility now we do not have a good resuscitaire equipment for resuscitation. We wish in the near days to come we might have, probably, a good resuscitaire, which we do not have at our hospital currently. So, in most cases, probably with those babies that are not breathing well, they are the ones where we really rush to try and ensure the baby is well. But it's quite a good practice because even when you are working, in most of the times when we are short of staffing, it gives you time when you are working alone to be able to attend to the mother and the baby very well without panic" (Participant 1).*

The midwife to woman ratios were, however, part of the context that the midwives worked in and were seen as a barrier to quality of care. Usually, one midwife was allocated more than two birthing women at a time and by the end of a shift, the midwife would have attended to approximately five to ten women in a space of 6 hours for a day shift and 13 hours for a night duty[1]. A participant said the following in support.

> *"So basically, it's not conducive in the sense that manpower is not really there because sometimes we work alone and you have to do everything alone, if we*

[1] In Zambia, shifts are divided into morning 7:30am to 1pm, afternoon 1pm to 6pm and night duty, which starts from 6pm to 7:30pm.

can have more than two midwives per delivery, we can say that the environment is conducive but for now it is not" (Participant 4).

6.8.2 Summary of key points from the interviews

Midwives identified benefits that come with the practice of delayed cord clamping to the baby as enablers to the implementation of delayed cord clamping. It was interesting to learn that implementation of new programs into midwifery care is not very easy because of slow adopters who do not usually adopt to change with ease. It was also interesting to learn that midwives working in rural areas where the number of midwives is usually less than 10 seemed to have an easier experience of implementing new practices in comparison to those working in urban areas where the number of midwives in a birth unit is more than 20. Some participants were taught delayed cord clamping in their midwifery training, which made it easier for them to embrace it in their clinical practice as midwives. The practice of delayed cord clamping was not a preferred method in babies needing resuscitation among all the 25 interviewed midwives and the environment was not conducive for few midwives, although it did not matter among several respondents. Although one person mentioned that results of delayed cord clamping have been noted at their health facility, which is more than 60kms to the nearest referral facility and they have no stationed ambulance making the practice beneficial to the newborn.

6.8.3 Key informants from the Ministry of Health

Key informants from the Ministry of Health Zambia were interviewed. They identified the benefits associated with the practice of delayed cord clamping as enablers to its practice and they gave insights into the implementation of innovations in Zambia. The TDF domains that were relevant to stakeholders are discussed below and some of them have been combined because they are interrelated.

1. Knowledge and Beliefs about consequences

The participants had knowledge about delayed cord clamping and its benefits to the newborn baby. As indicated in the responses below.

Delayed cord clamping is a practice that has been recommended and the Ministry of Health Zambia placed it in the essential newborn document in 2014 and the emergency obstetric, maternal and neonatal care document in 2016. It plays a role in improving the welfare of newborn babies when practised.

A lot has been said about the benefits of delayed cord clamping as it gives the newborn baby more bloods thereby improving life in the first 1000 days.

2. Skills and Behavioural regulation

The key informants provided insights on the implementation of delayed cord clamping and the availability of guidelines in birth units across Zambia. The two participants said:

I may not have preview information on the practice in every birth unit because we have not conducted an evaluation.

So far there is no specific guideline on delayed cord clamping. As I said earlier, delayed cord clamping was inserted in the Essential Newborn Care and the EmONC documents.

We also asked participants about the process of implementation of new programs in maternity care. Both participants provided a clear explanation of how programs are implemented in maternity care. They both gave a similar description of the implementation process as follows:

Usually, a stakeholder meeting is convened to look at what needs to be done as we work on implementing the new program. Thereafter, regular meetings are held in which we look at the guidelines to be released and each stakeholder is usually assigned work to do in line with the activity. This is followed by the production of copies to be disseminated and the Minister usually rolls the new guidelines out before they can be released for use in all health institutions. Guidelines are then distributed and trainings are held in facilities before the actual roll out at facility level. We then offer supportive supervision to facilities across the country to ensure that implementation is being done as stipulated in the guidelines.

We also wanted to find out if delayed cord clamping has been implemented in the above manner. One participant said:

Delayed cord clamping was not disseminated using the above process. As said earlier it was embedded in the ENC and EmONC documents, which were distributed to facilities.

We also wanted to find out if there have been targeted activities that may have been considered to influence the practice of delayed cord clamping like embedding it in the summary of labour and baby notes. One participant said

> *Since no monitoring and evaluation of the implementation of delayed cord clamping has been done, no preview information is available on this one.*

We further wanted to find out if there are any particular reasons why delayed cord clamping has not been rolled out following the discussed implementation plan in all birth units across Zambia. One participant said.

> *There are no reasons that I know of. It was expected that after ENC and EmONC trainings, many maternity care workers would have adopted delayed cord clamping because trainings have been conducted across Zambia, which involve midwives and obstetricians.*

Participants provided insights on the implementation of programs in maternal. newborn and child health. One participant said:

> *The best way is to have a clear implementation plan. The process starts with the planning phase in which stakeholders are invited. Then once the guidelines have been developed, a meeting is held with stakeholders before rolling out. After that, dissemination meetings are held with the users and the change is implemented. Usually, we provide technical support to ensure that the end users are practising according to what has been provided in the guidelines. Although this has not been done with regards to delayed cord clamping.*

With regards to training on how to perform delayed cord clamping, which is related to the belief about the capabilities domain of the TDF that focuses on the abilities of adopters in practising delayed cord clamping (Atkins 2017). They both said many EmONC and ENC trainings have been conducted. One participant said:

> *I may not be sure if all the maternity health care workers have been trained because we have not yet conducted an evaluation of the practice.*

3. Optimism and Reinforcement

Optimism and reinforcement focus on the confidence in reaching the desired goals through the practice of delayed cord clamping. Both key informants were optimistic

about the haematological effects of delayed cord clamping and were looking forward to a future in which it will be the standard practice in Zambia.

4. Social influences, Social/professional role and identity

Concerning the perceived risks and of the practice of delayed cord clamping, they both said the benefits outweighed the risks. Therefore, delayed cord clamping should be embraced by all maternity care workers. One participant said:

> *Just the issue of jaundice and polycythaemia from my knowledge but the benefits to the newborn baby outweighs the risks.*

5. Beliefs about Capabilities

We wanted to know if there has been training on delayed cord clamping to increase the capability of maternity care workers on how to perform delayed cord clamping. The key informants said they are optimistic that most maternity care workers were trained through emergency obstetrics and neonatal care and essential newborn care trainings, which have imbedded the component of delayed cord clamping in the orientation. One participant said:

> *As said earlier delayed cord clamping has been included in the emergency obstetrics and neonatal care and essential newborn care trainings, which have been undertaken throughout Zambia for a long time now.*

6. Environmental context and resources

We further wanted to explore if the birth units had sufficient levels of the resources needed to allow performance of delayed cord clamping. They both cited provision of guidelines in every birth unit as the needed resource. The first participant said:

> *As for the resources, I do not think there are any needed for the implementation of delayed cord clamping besides guidelines.*

The second participant said, *there are no resources needed. They just have to embed it in the third stage of labour practice.*

6.8.4 Summary of face-to-face interviews with key informants

Interviews were held with Ministry of Health policy makers who are involved with guideline development and implementation in Maternal and Child Health across Zambia. The process of implementing an innovation like delayed cord clamping was

explained to involve stakeholders from the planning through to dissemination. This process was followed by rolling out the innovation or intervention in an identified district with the full involvement of all stakeholders. Training was then conducted with end-users in each province and district before the actual implementation in health facilities. After the implementation of the new program, follow up is usually undertaken to ensure end-users are implementing the new program as stipulated in the guideline. However, with regards to the implementation of delayed cord clamping, this process has not yet taken place because delayed cord clamping was embedded in the 2014 ENC and 2016 EmONC documents. Therefore, it will be recommended in the policy brief for the Ministry of Health Zambia to reconsider implementing delayed cord clamping in similar ways to which other programs have been received, like the maternal and newborn referral guidelines.

6.9 CONCLUSION

The chapter presented the findings from Phase three including the research design and findings that have emerged from the project. The findings have provided insights into the motivation to delayed cord clamping practices by midwives whose major motivation was underpinned in the ten identified TDF domains. It has also explored the implementation process that is involved in the diffusion of evidence based practices in maternal, newborn and child health from insights provided by the key informants from the Ministry of Health in Zambia. The insights from this study will formulate strategies to increase the diffusion of delayed cord clamping in birth units across Zambia that will be written in a policy brief for the Ministry of Health Zambia.

The next chapter will present the discussion chapter, which will integrate all the findings from this three-phase study.

7.1 INTRODUCTION

Umbilical cord clamping practices are integral to the immediate care of the newborn and have implications for the short, medium and long-term health of the baby. This study has looked at the issue of umbilical cord clamping practices in Zambia from three perspectives with a particular focus on delayed cord clamping. Firstly, it examined umbilical cord clamping practices by maternity health care workers in Zambia. Secondly, it reviewed the relevant available guidelines in birth units across Zambia. Thirdly, it explored the motivation to practise delayed cord clamping from the perspective of midwives and the Zambian perspective of the implementation of programs in maternal, newborn and child health.

This chapter presents the summary of the results, integrates the findings and outlines the implications for maternity care provision in Zambia and LMICs in general. The chapter also describes the strengths and limitations of the study. Finally, a list of recommendations for government, health service managers, educators and clinicians is provided.

7.2 SUMMARY OF THE RESULTS

The objective of Phase 1 was to determine the current umbilical cord clamping practices among maternity health care providers and to identify guidelines being used to guide umbilical cord clamping practices in Zambia. A survey was distributed to maternity care providers in Zambia and 239 responses were analysed. There were three main findings. The first one was that less than 50% of survey respondents were practising delayed cord clamping at the birth of a healthy and term neonate. The second one was that more than 50% of respondents were working in settings with no formal guidelines on delayed cord clamping to inform the practice. Interestingly, some participants still practised delayed cord clamping in the absence of formal guidelines. The third one was that less than one-fifth (17%) of respondents practised delayed cord clamping in preterm neonates and no respondents identified that delayed cord clamping was practised at the time of caesarean section.

Phase 2 described and analysed the guidelines that clinicians were reported to be using to inform umbilical cord clamping practice in 100 birth units across Zambia. A total

of 93 email responses were received with 56 (60.2%) indicating that they had no guideline. The 37 midwives sent through seven different types of guidelines that inform umbilical cord clamping practice with Helping Babies Breathe (22) being the most common guideline, which was received. Three sent through handwritten delayed cord clamping procedures. Of the submitted guidelines, three had some information on delayed cord clamping while the other four emphasised immediate cord clamping as part of the active management of the third stage of labour. The AGREE II tool was used to assess the three guidelines that had information on delayed cord clamping. All the three guidelines scored well on five AGREE II tool domains. However, editorial independence was not mentioned, which affected the average scores.

The aim of Phase 3 was to explore the factors that influenced delayed cord clamping by midwives and to understand the implementation process of new programs in maternity care. Interviews with 25 midwives and Ministry of Health staff working in maternal, newborn and child health department were conducted. An adapted TDF was used for the analysis. The motivation to delayed cord clamping practice was embedded in the benefits that come with the practice, which are entrenched in the 14 domains for midwives and ten TDF domains for key informants. Key informants provided insights into the implementation process, which followed a similar pattern to that described in the consolidated framework for implementation research. The implementation process starts with planning, engaging, executing, and ends with reflecting and evaluating, which involves supportive supervision during the process of innovation diffusion (Damschroder et al. 2009). The innovation diffusion theory provided insights into the current happenings in the implementation of delayed cord clamping.

7.3 INTEGRATING THE FINDINGS: UNDERSTANDING CORD CLAMPING PRACTICES IN ZAMBIA

Encouragingly, delayed cord clamping was practised in Zambia, especially for term and healthy babies, although not universally. Both the survey and the interviews showed a high level of knowledge about the benefits and value of delayed cord clamping. This finding is similar to many studies that have been undertaken on delayed cord clamping in which the practice was undertaken in term and health newborn babies (Bates et al. 2019; Manley 2017; Payne, Walker & Mitchell 2021).

An area still to address is delayed cord clamping for babies who are unwell and needing resuscitation. Resuscitation causes some level of panic in some midwives and there is usually an impetus to move the baby quickly to a resuscitation area, thus requiring the cord to be clamped and cut. Although studies have indicated that resuscitation can be undertaken on the bedside of the mother with the cord attached to the placenta, many midwives have not accepted this (Andersson et al. 2019; Fulton, Stoll & Thordarson 2016; Katheria et al. 2018). Resuscitation with an intact cord has been associated with improvements in the oxygen saturation and Apgar score in both preterm and term newborn babies (Andersson et al. 2019; Hutchon, Pratesi & Katheria 2021). This will take time to implement in many LMICs including Zambia (based on the findings of this thesis). Many low resource settings may not have the needed resources that make resuscitation at the bedside possible. For example, some birth spaces may not have the resuscitaire equipment near the delivery bed hence the need to move the baby to a place where a resuscitaire can be found, which may be in a different room. However, conversations on the resources needed to enhance the practice of resuscitation at the bedside should be strengthened to improve the capacity to provide delayed cord clamping. Successful bedside resuscitation requires the following equipment (Hutchon, Pratesi & Katheria 2021):

- A stable flat soft, but firm surface on which to place safely the neonate during resuscitation;
- Warming equipment to prevent hypothermia (For preterm babies, placing them in a polythene bag while under the radiant heater may help with maintaining their body temperature);
- Good lighting; all the equipment to provide positive pressure ventilation with positive end expiratory pressure immediately and easily, which are adjustable;
- A suction apparatus in good working condition; monitoring equipment and a trolley within reach.

  It is important for low resource countries to work on implementing provision of these requirements for resuscitation at the bedside in the future.

Another area where variation was found in both the survey and the interviews was in the timing of delayed cord clamping. Some participants defined delayed cord clamping as being undertaken at 40 seconds while others used 60 to 180 seconds. Other studies have also shown variations. For example, in studies conducted in Iran, Netherlands,

Norway, Oman and Canada, timing of delayed cord clamping was defined from 120 seconds to cessation of umbilical cord pulsation (Afshari et al. 2014; Boere et al. 2015; Hutton, Stoll & Taha 2013; Madhavanprabhakaran et al. 2018). Studies in Nepal and Saudi Arabia had delayed cord clamping timing defined as greater than 60 seconds (Ibrahim et al. 2017; Nelin et al. 2018). In two studies conducted in the USA, timing was set at 30 seconds to greater than 60 seconds in one study and at greater than 60 seconds in the other study (Leslie, Erickson-Owens & Park 2019; Leslie et al. 2018). The WHO defines delayed cord clamping as clamping between 60 seconds and 120 seconds but my study and the research of others shows that this is not followed universally (World Health Organization 2014a).

My study found that a uniform guideline that informs the practice of umbilical cord clamping was not found. This could be the reason for the variations in practice that are seen across the country. It is clear that guidelines in themselves may not result in the implementation of the innovation. However, having guidelines may be an enabler to the implementation of evidence-based **practices** (Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Leslie et al. 2018)**.** More work needs to be done in Zambia to develop a national guideline, but more importantly, to work out ways to disseminate and implement this in practice.

It is encouraging to see that there have been changes in the practice of health care providers in Zambia towards delayed cord clamping. In 2008, 90% of 62 midwives from five district hospitals and eight health centres supported immediate cord clamping (Vivio et al. 2010), in comparison to the current study when delayed cord clamping was seen in about 40% of 239 respondents and immediate cord clamping at 60%. A potential explanation for a shift towards delayed cord clamping could be the 2013 recommendation by the WHO and the inclusion of delayed cord clamping in a section of the 2014 Zambian Ministry of Health (Ministry of Health Lusaka Zambia 2014; World Health Organization 2013). The Ministry of Health has also embedded delayed cord clamping in the Essential Newborn Care guideline and it is included in emergency obstetric and newborn care training (Ministry of Health Lusaka Zambia 2014). While some guidelines do exist in Zambia to support delayed cord clamping, it is interesting that the majority of respondents in my study stated that they did not have guidelines to inform umbilical cord clamping practice, with only a small proportion indicating that their usual practice was influenced by a guideline. This study also found

variations in the available guidelines that inform delayed cord clamping practice across Zambia. Such variation in available formal guidelines is not exclusive to Zambia, as similar findings have been reported in other studies, for example from Netherlands and Oman (Boere et al. 2015; Madhavanprabhakaran et al. 2018). Given the lack of embedded and well known formal guidelines to improve the uptake of delayed cord clamping in clinical practice, it is not surprising to find that immediate cord clamping was still so widely used as this is what was taught in midwifery education according to the majority of interview participants and from my personal experience. It is surprising that, despite the absence of consistent formal guidelines, some maternity health care providers in Zambia choose to practise delayed cord clamping. Guidelines have been identified as enablers to delayed cord clamping practice in other countries (Afshari et al. 2014; Boere et al. 2015; Ibrahim et al. 2017; Leslie et al. 2018; Lundberg, Øian & Klingenberg 2013; Perrone & Ghirardello 2017) but clearly for some in Zambia this was not necessarily the case.

My study identified the guidelines that recommended delayed cord clamping. The guideline from the program helping Babies Breathe was the most popular of the submitted guidelines from birth units across Zambia. This is probably because the Midwives Association of Zambia has been implementing Helping Babies Breathe, which is funded by the International Confederation of Midwives, for more than five years (Callister 2014; Riley et al. 2019). The Helping Babies Breathe program was developed in order to teach clinicians the skill of newborn resuscitation within the first minute of life, which is known as the Golden Minute (Callister 2014; Riley et al. 2019).

While many midwives did not have formal guidelines, three sent me handwritten documents that they used to guide their practice. These informal guidelines were based on information shared via dissemination meetings. This shows that they must have received the information through other sources and used their initiative to write down the procedure. According to Rogers (2010), these midwives who sent through handwritten informal guidelines are in the category of early adopters. Early adopters can be easily moved into implementing a practice immediately after learning (Rogers 2010). With guidelines, the process of diffusion may be made easier for such early adopters hence the need for the Ministry of Health Zambia to strongly revisit the implementation process of delayed cord clamping.

7.4 DRIVERS THAT ENABLE A SHIFT TO DELAYED CORD CLAMPING PRACTICE

In both the survey and the interviews, a key driver to change from immediate cord clamping to delayed cord clamping practice was attributed to knowledge of the benefits that come with increased placental transfusion. In trying to understand enablers using the frame of reference adapted from the Theoretical Domain Framework, which focuses on the behavioural aspects of implementation, benefits are significant in driving the agenda of change, which were unpacked in the interviews. Midwives and other providers understood the importance of on the benefits of placental transfusion and were optimistic that this practice will reduce the risk of anaemia. Placental transfusion has many proven benefits to the newborn baby, which include more oxygen, more red blood cells, more platelets, more white blood cells and better neurological outcomes (Fogarty et al. 2017). Studies have also shown a reduced need for blood transfusion and a reduction in the rates of necrotising entero-colitis (McDonald et al. 2014). Although participants in this study knew the benefits of delayed cord clamping, there was a condition attached to the practice, which was determined by the initial assessment that is performed when the birth of the baby is complete. The condition attached to midwives being able to practise delayed cord clamping practice was that the baby was born at term and healthy. Studies in Australia, Nepal, the Netherlands and Saudi Arabia demonstrated that delayed cord clamping was also practised more in uncomplicated births and on healthy neonates (Boere et al. 2015; Ibrahim et al. 2017; Polglase & Stark 2018). It seems that more work needs to be done to identify when delayed cord clamping should and should not be practised.

Practising delayed cord clamping slows down the procedures associated with the birth and can provide midwives with more time to do the necessary actions. As an example, delaying clamping of cord provides midwives with time to help ensure the woman is comfortable by removing the any wet linen used during birth and promoting respectful maternity care (Mgawadere & Shuaibu 2021). Delaying the cord clamping gives midwives time to talk with the woman while drying the baby, identifying of the gender with the mother, initiating skin to skin contact by placing the baby on the mother's chest for early bonding and initiation of breastfeeding.

Many participants in this study also reported that mastering the act of delayed cord clamping is easy because it can easily be infused into the active management of the

third stage of labour. This process is similar to how mastery of immediate cord clamping was diffused into the third stage of labour because it was taught in obstetric and midwifery education. The insertion of delayed cord clamping where immediate cord clamping was embedded during training could result in the change in practice (Vivio et al. 2010).

This issue of guidelines has already been mentioned in this chapter. Having a formal guideline to support the practice may be important but was not always the case. However, in the face-to-face interview many midwives who did have a guideline recommending delayed cord clamping attributed their practice to the presence of this document. In addition, it is important to ensure that the content, usability and applicability of guidelines are appropriate and relevant to ensure successful implementation (Gagliardi et al. 2011; Isik 2019). Content refers to the intervention to be implemented; usability refers to how easy the guideline is to use in practice; applicability refers to how applicable the intervention is in the context where it is to be applied (Gagliardi et al. 2011). Other studies have shown that having a guideline was an enabler to the practice of delayed cord clamping (Afshari et al. 2014; Blouin et al. 2009; Boere et al. 2015) highlighting the need for a widely used national guideline in Zambia.

Delayed cord clamping can be seen as an innovation that requires support to become embedded in practice. Recipients of an innovation should be motivated with sufficient level of skills, knowledge and authority to enable diffusion into clinical practice through supportive leadership, supervision and the provision of resources as needed (Harvey & Kitson 2015a). The analysis of the interviews with key informants from the Ministry of Health in Zambia identified supportive supervision as one way to ensure an innovation is being facilitated as planned. Facilitation is the process of enabling implementation through the interactions between the recipient of the innovation and the context of introducing the innovation (Harvey & Kitson 2015b). The interactions provide an opportunity that influences the required behaviour in the diffusion of the innovation as described in the Theoretical Domain Framework.

Another driver for change was having work colleagues who were spearheading the change. Some participants in Phase 3 of this study mentioned that they have had colleagues who have taken up the orientation role after attending a workshop where delayed cord clamping was recommended. This is similar to studies that have

investigated the use of champions in the implementation of new evidence based programs (Brunkert, Simon & Zúñiga 2021; Bunce et al. 2020; Gams et al. 2017; Miech et al. 2018; Wood et al. 2020). Having champions for an innovation is an enabler to the implementation of evidence based practices because they have been identified as facilitators to overcoming organisational barriers (Gams et al. 2017; Wood et al. 2020). Champions provide leadership in ensuring that the practice is being implemented by all and they can also undertake audit reviews for continuous quality improvement (Bunce et al. 2020). However, of note was the ease of implementing delayed cord clamping among a small group of midwives in birth units situated in rural areas with compared to those in urban areas where the number of midwives is more than 20 because of the diversity that comes with a big group. Therefore, champions may find it easy to implement evidence based practices among smaller groups than bigger groups hence strategies need to be outlined on how to overcome this challenge.

Ward meetings were also identified as enablers among midwives who were interviewed in Phase 3 of this study because concerns were discussed and the way forward was outlined. This was seen in birth units where acceptance of delayed cord clamping was a challenge at the beginning but with constant monthly ward meetings the evidence-based practice was accepted by most practitioners, which created one component of the enabling environment. According to the International Confederation of Midwives, an enabling environment for midwives is defined as the atmosphere that supports the infrastructure, profession and system-level integration needed for midwives to effectively practise their full scope of work (International Confederation of Midwives 2021).

The working environment can be a driver for change. In my study, the environment was both an enabler and a barrier. Some participants in the face-to-face interviews said there was no special environment needed for the practice of delayed cord clamping while all of them said they did not practise delayed cord clamping in babies needing resuscitation because of the need to move the baby to the designated space for resuscitation. As explained earlier in this chapter, this finding is similar to other studies in which delayed cord clamping was not practised in babies needing resuscitation (Boere et al. 2015; Devin & Larkin 2018; Ibrahim et al. 2017; Uduwana & Nemerofsky 2021).

7.4.1 Applying the Innovation Diffusion Theory in this thesis

Translating evidence into practice in any context is challenging and my study has shown that even a simple innovation, like delayed cord clamping, can be difficult to diffuse into practice. The Innovation Diffusion Theory (Rogers 2010) provides some insights that may assist with improving the diffusion of delayed cord clamping in Zambia. This next section explains this further through exploring an integration of the findings.

The Innovation Diffusion Theory describes the process involved in the implementation of new programs by frontline workers (Rogers 2010). This theory was developed by Everett Rogers in 1962 and based on 508 diffusion studies. It has four main components, that is, innovation, communication channels, time, and social system (Rogers 2004).

Innovation Diffusion Theory recognises that the rate of diffusion is impacted by the use of experts whose opinions are valued by others (opinion leaders) and people who may influence the behaviour of others (change agents) (Rogers 2010). It is important for innovators to identify opinion leaders and change agents in the diffusion process of an innovation who can take up the influential roles in behaviour change. In my study, some face-to-face participants identified the role of opinion leaders by people who attended a workshop where delayed cord clamping was recommended through sharing of benefits in influencing change. Some face-to-face participants also mentioned the role of change agents in their birth units who have been influencing them to embrace delayed cord clamping in the best interests of babies. The Innovation Diffusion Theory affirms that diffusion begins with a few early adopters who are convinced to adopt the practice because of the benefits that comes with the innovation, which is cost effective and easy to implement (Rogers 2010). My study identified a number of early adopters, in particular, those midwives who were practising delayed cord clamping despite not having formal institutional guidelines directing their practice. These people are important, as it is their influence and enthusiasm that are likely to drive grass-roots change.

The Innovation Diffusion Theory assumes that the diffusion progression picks up when a lot of frontline workers decide to adopt it, then it later slows down the process when the adopter population assumes saturation (Rogers 2010). The collective

adoption pattern takes the S- shaped curve and a normal distribution for the adopter (Rogers 2010). Adopters are different and have been grouped into innovators, early adopters, early majority, late majority and laggards, based on the time at which they adopted the new innovation (Rogers 2010). In my study, the practice of delayed cord clamping seems to be in the early adopters phase and in order to move out of the early adopters phase, more strategies are needed, which have been discussed in the recommendations section of this thesis.

The Innovation Diffusion Theory has five stages and these are useful to explore when considering the findings of my study. The first stage is knowledge. My findings showed that the overall level of knowledge was high and maternity care providers obtained knowledge through both formal and informal ways of learning. Some maternity care providers also gained knowledge through guidelines although these were not universally available. The knowledge deficits centred on variations in the delayed cord clamping practice especially the timing and in the value of the practice in newborns needing resuscitation. There are opportunities to improve on the level of knowledge through education sessions in which the innovation can be described and its advantages and disadvantages discussed.

The second stage of the Innovation Diffusion Theory is persuasion. Persuasion refers to the need for prior adopters to persuade early adopters to attempt the use of the innovation. In the persuasion phase, guidelines are very important but my study revealed that not all birth units had guidelines that may have affected this phase to some extent. Nevertheless, findings of Phase 3 of my study showed that many midwives interviewed were persuaded to practise delayed cord clamping by someone who had knowledge that it would improve haematological outcomes for babies. This was facilitated through the sharing of benefits that come with the practice of delayed cord clamping in the reduction of the lifetime risk of anaemia by 60%. The WHO guidelines seem to have provided a level of persuasion as have the guidelines from the Ministry of Health in Zambia and the International Confederation of Midwives.

The third stage of the Innovation Diffusion Theory is the process of decision-making. Decision-making refers to adopters' choice in accepting or rejecting the innovation. My findings showed that the individual decision to practise delayed cord clamping was multifaceted because the practice was mainly done in term and health babies although few face-to-face interview participants mentioned that they have been practising it

even in babies needing resuscitation. The survey also revealed that some participants have accepted the practice of delayed cord clamping, which was affirmed in face-to-face interviews.

The fourth stage of the theory is actually the process of implementation. In the Innovation Diffusion Theory, implementation means the utilisation of the innovation by adopters. In my study, implementation occurred, sometimes despite no guidelines, in varied ways and only for well and healthy term babies. This is important and means that there is a foundation on which a further study can be built. Making the process of implementation easy is important and that includes the need to adapt the environment to make sure that midwives can practise delayed cord clamping. The challenges in this area relate to the need to move the baby in order to undertake neonatal resuscitation as described by many respondents. It seems clear that in many contexts in Zambia, the implementation has been achieved but it needs strengthening and further embedding in the health system.

The final stage of the Innovation Diffusion Theory is the confirmation stage. This means that the innovation has reached its full potential and that adopters are able to continue using the innovation. By the time the health system and the individuals reach this stage, the innovation is embedded, part of usual practice and well diffused. My study has confirmed that this stage has not been reached in Zambia. This is evident from findings of Phase 1 of this study, which indicated that many maternity care workers have not yet embraced the practice of delayed cord clamping at birth regardless of the gestation age and the condition of the baby. More strategies need to be implemented in order to reach the confirmation stage and this finding provides an opportunity for future research.

7.5 THE RELEVANCE OF MY FINDINGS FOR MATERNITY CARE IN ZAMBIA

While my study has identified some encouraging progress in the shift to delayed cord clamping, it is clear that more strategies are needed to increase its diffusion as stated in the recommendations in this study. The first strategy is looking at education for both pre-service and in-service orientation into delayed cord clamping practices at birth. Once learners are taught about delayed cord clamping during the socialization into practice, studies have shown that it is easy to implement in clinical practice. The second strategy is provision of an enabling environment, which includes staffing levels

because numbers matter in quality improvement (Turner, Griffiths & Kitson-Reynolds 2021). The third strategy is looking at the leadership as it is important to see leaders as catalysts of change in the diffusion of evidence based practices. Identification of leaders who are passionate about influencing change in maternal, newborn and child health could help with increasing the diffusion of delayed cord clamping in birth units across Zambia. These leaders can be the role models for the desired change and can also work on establishing delayed cord clamping champions who can work as liaison officers between birth units in the implementation of this innovation. The fourth strategy is the introduction of local quality improvement projects in the implementation plan of delayed cord clamping, which may include local audits conducted by maternity care workers. This is because during the process of auditing, learning of what is to be done may influence change in clinical practice through the process of feedback to practitioners. The fifth strategy is the development of guidelines, which are specific to delayed cord clamping by the Ministry of Health Zambia. A specific guideline on delayed cord clamping may harmonise the practice and may increase the diffusion at every birth (Hutton, Stoll & Taha 2013; Ibrahim et al. 2017; Leslie et al. 2018; Payne, Walker & Mitchell 2021). This is because at the implementation of new guidelines, training is usually conducted in setting out the idea to be implemented, which in turn may result in the acceptance of the innovation by adopters.

7.6 THE RELEVANCE OF MY FINDINGS FOR MATERNITY CARE IN LMICS

The findings from my study are directly relevant to the Zambian context although they may have relevance and applicability in other LMICs. As explained in Chapter 2, similar studies have been conducted in other LMICs including Bahrain, Ghana, India, Iran, Kenya, Malawi, Nigeria, Pakistan, Rwanda and Uganda (Afshari et al. 2014; Payne, Walker & Mitchell 2021). These studies found that despite the benefits of delayed cord clamping, its diffusion in clinical practice was variable within these countries. The practice of delayed cord clamping was mainly seen in term and healthy babies. These studies identified the lack of guidelines and re-education of maternity care workers on the innovation, which slows the diffusion process because even those who are aware of the updated endorsements fail to implement it due to lack of a standard guideline (Payne, Walker & Mitchell 2021). The practice of delayed cord

clamping seemed to be challenging in babies needing resuscitation and during caesarean section both in this study and in many studies in LMICs as discussed in chapter 2 of this study. These findings indicate the need to conduct research into implementation of delayed cord clamping at birth especially in LMICs where anaemia is a major public health concern.

Low and middle income countries should focus on provider-focused strategies, including the provision of a delayed cord clamping guideline and facility-focused strategies such as the importance of the enabling environment, for the promotion of delayed cord clamping. An enabling environment has been described as one that values and respects midwives and women (International Confederation of Midwives 2021). It provides the opportunity for midwives to practise with full autonomy through the provision of continuous education, adequate human resources, equipment and timely consultation when needed (International Confederation of Midwives 2021). We all know that human and material resources are inadequate in LMICs. The insights that were shared by participants has hinted at a very important aspect in the delivery of maternity health services in Zambia. Some participants mentioned the issue of not having adequate resources to enhance the practice of delayed cord clamping like non-availability of resuscitaire equipment in the birthing space, which prompts them to clamp and cut the cord immediately in babies needing resuscitation. Resuscitation takes the priority place especially if the midwife has to shift to some other space for resuscitation. Therefore, it is important to develop strategies that will bridge the gap between what is being practised and the desired practice. The desired practice is to be able to resuscitate the newborn at the bedside with an intact cord instead of rushing to clamp and cut the cord. A plan-do-study-act model of quality improvement can be implemented with consideration of the recommended strategies that require a multi-step approach (Anton, Jordan & Rabe 2019; Imamura et al. 2017). In the plan-do-study-act approach to the implementation plan, the development of a protocol should be a priority. The protocol should have a clear definition of timings and the procedure for delayed cord clamping, whose implementation should follow the recommended process that starts with the involvement of a multi-disciplinary team for planning and training through to implementation. The practice of delayed cord clamping should be regularly evaluated through continuous quality improvement practices and audit reviews to be

undertaken by practitioners (Anton, Jordan & Rabe 2019). Another desired practice is to ensure that numbers of maternity care workers are closer to the global recommendation of two midwives to one woman in labour (Turner, Griffiths & Kitson-Reynolds 2021). Another desired practice is to ensure that midwifery competences are well defined (International Confederation of Midwives 2021). It is also important for LMICs to conduct more studies on implementation science in order to have an understanding of what may work well in the diffusion of the innovation.

7.7 STRENGTHS

This study used both quantitative and qualitative methods to explore an important area in maternity care. The sample size in this study was larger in comparison to an earlier study undertaken in 2010 about active management of the third stage of labour that also identified high rates of immediate cord clamping practice. The study by Vivio et al (2010) had 62 participants from 13 institutions across Zambia. Overall, my study included the views of 239 midwives and other maternity care providers across 101 health facilities. The health facilities were spread across the ten provinces of Zambia. The study has also provided a deep understanding of the experiences and the motivation to delayed cord clamping practice of midwives in five maternity units and an analysis of guidelines using an established methodology.

7.8 LIMITATIONS

My study, like all studies, has limitations. The study sample may not represent the views of the all the midwives, obstetricians and other maternity care workers working in birth units across Zambia. There were 239 survey respondents for the survey in Phase 1, which targeted midwives and obstetricians. There were more than 5000 registered midwives and 53 obstetricians at the time of the survey in Zambia but a small number of obstetricians responded giving a low response rate. This may have been due to a number of factors that could not be controlled by the researcher and highlight the challenges in doing surveys, including the fact that not all midwives and obstetricians are members of professional associations. Nevertheless**,** reminders were sent by responsible officers from the professional association to the membership on a weekly basis in order to capture majority of members for the survey.

The study was conducted at a time when the country was experiencing long hours of electricity power cuts, which may have impacted the ability of respondents to access and submit electronic survey responses. I endeavored to reach all maternity care staff through membership distribution lists managed by the two professional associations but not all midwives and obstetricians are members of the professional organisation or access the relevant WhatsApp groups. I was in Australia when the survey was distributed which reduced my capacity to actively encourage my colleagues to participate. If I had been in Zambia during this time, it may have been easier to explain the purpose of the study and to motivate people to complete the survey.

When I originally designed the study, I had planned to be in Zambia to conduct the interviews. With the COVID-19 pandemic, this was not possible and so all interviews moved to an online platform. Not all midwives were comfortable with this and it is possible that they responded differently using Zoom compared to face-to-face interviews. In the interviews, participants may have also been giving answers that they felt I wanted to hear, which are right but may be different from their actual practice and I had no control over this. However, this was unlikely because I have gained some amount of trust among midwives in Zambia. I strongly feel that participants were free and honest in their conversations with me. Nevertheless, an observational study of the actual practice of delayed cord clamping would have been carried out if it was not for COVID-19, which meant I was unable to travel back home at that stage in the study.

I had hoped to interview all the five key informants from the Ministry of Health but I was only able to include two individuals. However, the conversations I had with the two were enough to give me a picture of the process of implementation in Zambia, therefore the three would not have added any new information. The interviews were held at a time when the country was experiencing the second wave of COVID-19 infections, which meant the three individuals were completely caught up with work and could not schedule an interview.

I am quite well known in Zambian maternity circles and my enthusiasm for delayed cord clamping is evident. It is possible that respondents in the interviews told me what I wanted to hear. It is also possible that I only recruited those who were positive towards delayed cord clamping rather than those who were skeptical of this practice. My position in the research does need to be considered and my well known views may have impacted on the information I was given. However, this was unlikely because of

my personality, which is known to many as an approachable and open person who is a change agent. Outside the research, many midwives find it easy to confide in me on many issues.

Phase 2 of the study was to review the available guidelines. Many of the guidelines I received were not specific to delayed cord clamping. The few that were relevant provided limited information and only had a statement or more embedded in the documents that addressed other newborn issues like essential newborn care. This made reviewing these guidelines challenging. In addition, the AGREE II tool is one way to assess guidelines but given these were often local guidelines rather than national evidence based guidelines, it may have not been the best tool. Nonetheless, the tool provided a framework with which to reflect upon the different guidelines.

7.9 Reflecting on my own role and conducting this study during the COVID-19 pandemic

As someone who is passionate about maternal, newborn and child health, I am well known in the Zambia for this enthusiasm. As explained earlier, in 2016, I went across Zambia conducting educational sessions on delayed cord clamping. The education session had more than 500 participants who included a majority of nursing and midwifery students, practising nurse midwives and midwifery educators. Many midwives in Zambia therefore know that I am committed to promoting delayed cord clamping.

I undertook this doctoral project because I am very passionate about delayed cord clamping. Since I learnt about the benefits of delayed cord clamping, all I have been thinking about is how we can influence the practice so that we can reduce the lifetime risk of anaemia by 60%. Having worked as a midwife in low and middle resource countries of Zambia and South Africa, I can attest to the magnitude of anaemia among women of childbearing age, who are mostly diagnosed at their first antenatal visit because pregnancy exaggerates minor symptoms, but it could be that they have had anaemia since childhood. This anaemia in pregnancy is very difficult to treat and the probability of having premature labour and even post-partum haemorrhage (PPH) are very high. When an anaemic woman in labour has a PPH the chances of dying increases and also her chance of developing other severe complications such as disseminated intravascular coagulation (DIC), are very high.

In the recent past, I lost a friend from complications of anaemia. She went into premature labour and an emergency caesarean section was conducted because there was a problem with oxygen supply to the unborn baby. Unfortunately, she died of a severe complication of prolonged anaemia, which has been described above as DIC and sadly the baby died few minutes later because of lack of oxygen to vital organs. This was a young lady who was fine before getting her first pregnancy. She was diagnosed with anaemia at her first antenatal visit and treatment was commenced. It is difficult to correct prolonged anaemia. It could be that she had anaemia since childhood. This is just one of the many untold stories of how terrible prolonged anaemia is and explains my commitment to addressing this challenge in my country.

It is stories such as these that prompted me to embark on influencing the change in umbilical cord clamping practice at birth from immediate cord clamping to the recommended delayed cord clamping for reduction in the lifetime risk of anaemia. I embarked on this research study with my own point of view, having come across the benefits of delayed cord clamping in comparison with immediate cord clamping. Having read the literature, my hypothesis for Phase 1 of the study was that the practice of delayed cord clamping was less than 50%, which has been proven by the findings of the survey. In the face-to-face interviews on Zoom, participants may have heard about my presentation, which was shared among many midwives in 2016, which could have influenced their responses to the conversation on delayed cord clamping. However, as someone who has a great sense of emotional intelligence, I strongly felt the honesty in their conversations as they spoke about the practice of delayed cord clamping. I have a personality that makes connecting with new people very easy; this could have contributed to the flow of the conversation and, reflecting back, participants shared their experiences without fear or intimidation. I provided an active listening ear, which is very important in communication.

Reflecting back on this academic journey, which I started in 2018 with the aim of determining cord-clamping practices by midwives and obstetricians in Zambia, I can attest to the importance of communication during the academic journey. Phase 1 data collection was completed in November 2019; this analysis informed Phases 2 and 3, which was in March 2020. At around that time, the COVID-19 pandemic was announced by WHO, which saw the closing of borders for international travel. This meant I needed to redesign much of my study, as I was unable to travel home. I came

up with two studies, the first one aimed at collecting the available guidelines using email addresses to validate the results of Phase 1. The second one aimed at exploring the motivation to delayed cord clamping practice among a few survey respondents who said it was their usual practice. The qualitative study was designed to be face-to-face but now needed to be online and this was a challenge for me and the participants. In Australia, COVID-19 brought a lot of changes, which included limited access to the university and stay-at-home orders that meant studying was undertaken at home. This was very different to the usual life that I am used to, just like many other people. I am one person who likes feeling like a student by spending much of the time at the University whenever I am studying. I had to adjust to this new normal of studying at home, which I am now used to although I miss face-to-face interactions with other students because Zoom interactions are very different from actual face-to-face because it does not provide the actual bonding that is shared in face-to-face interactions.

7.10 RECOMMENDATIONS: STRATEGIES TO INCREASE THE DIFFUSION OF DELAYED CORD CLAMPING IN BIRTH UNITS ACROSS ZAMBIA.

This next section provides a number of recommendations that should be considered by the Ministry of Health Zambia and the General Nursing and Midwifery Council of Zambia (GNMCZ). I have focused on the GNMCZ because midwives are the majority of maternity care workers in comparisons with obstetricians.

7.10.1 Education providers

1. *Embed delayed cord clamping in the teaching and practice of active management of the third stage of labour*

The active management of labour is taught to maternity care providers and so provides a unique opportunity to address change. It is recommended that delayed cord clamping be taught in active management of the third stage of labour (AMTSL). The AMTSL of labour is recommended to reduce PPH by reducing uterine atony, the major contributing factor to PPH by shortening the duration of the third stage of labour (World Health Organization 2012b). The most recent guidance from the WHO on AMTSL includes the statement "Delay clamping the cord for at least 1-3 minutes to reduce rates of infant anaemia" (World Health Organization 2012b). This is very

useful to have such a clear statement and now important for Zambia to integrate this aspect of AMTSL in the teaching of midwives and obstetricians.

2. *Include delayed cord clamping in midwifery education as an objective structured clinical exam (OSCE) procedure*

Teaching students about delayed cord clamping and having it examinable as an objective structured clinical exam (OSCE) may increase its diffusion. Research has shown an OSCE exam can support the diffusion of clinical procedures (Yesodharan & Valsaraj 2020). Midwifery students often undertake such assessments, and it would be valuable for learning if delayed cord clamping was a defined skill assessed in this way.

3. *Include delayed cord clamping in midwifery and obstetric training*

The inclusion of delayed cord clamping in midwifery and obstetric training may help the implementation of this as usual practice across Zambia. It is important for Zambia to embrace interdisciplinary learning, which involves doctors and midwives learning together, which may in turn standardise the practice of delayed cord clamping.

7.10.2 Ministry of Health Zambia and Local Health Facility recommendations

4. *Establish local champions to promote delayed cord clamping in every birth unit*

Each birth unit in Zambia should identify a number of 'delayed cord clamping champions'. They would form teams and meet regularly to discuss the progress of diffusing delayed cord clamping in their birth units. Champions could be identified through expression of interest for midwives. The identified champions would be trained in delayed cord clamping and their terms of references would be discussed at a national event, which would be held in one of the identified Provinces. Their main role would be to ensure midwives in their birth unit learn about delayed cord clamping and start to implement it.

5. *Work with the Ministry of Health in Zambia to develop national guidelines to support delayed cord clamping guidelines*

The Ministry of Health in Zambia should consider developing a national guideline on delayed cord clamping. In support of this, I will develop a policy brief for the Ministry of Health that will provide an overview of the findings of my study. This will also highlight the importance of having guidelines specific to delayed cord clamping and a way forward on how to increase the diffusion of delayed cord clamping into maternity care.

A national working group could be established, which would comprise all stakeholders to review the evidence and the global recommendations and come up with new strategies to enhance the diffusion of delayed cord clamping into practice. The process would involve stakeholder meetings and training of end users. A summarized protocol and procedure may help with the diffusion of delayed cord clamping in every birth unit across Zambia through the process of guideline dissemination, which would involve training users to facilitate guideline implementation (Vogel et al. 2016).

6. *Embed delayed cord clamping in the maternity case record in Zambia*

Documentation is part of the professional, ethical and legal obligations, which should be undertaken in maternity care by midwives, obstetricians and other maternity care workers (Kerkin, Lennox & Patterson 2018). It is the professional role of maternity health care workers to effectively and thoroughly document the care rendered to women and the decisions that have been made within maternity care (Kerkin, Lennox & Patterson 2018).

Zambia uses maternity case records in the care of women during birth. It would be useful for delayed cord clamping to be included in the document with the timing at which the cord was clamped and cut. This would act as a good reminder but also could be part of the process evaluation and audit reviews. This may enhance the diffusion of delayed cord clamping into maternity care. Orientation should be undertaken in every birth unit to ensure that information is uniformly transferred. After orientation, ways to evaluate the practice of delayed cord clamping should be outlined and followed for continuous quality improvement.

7. *Process evaluation of delayed cord clamping*

The Ministry of Health Zambia and other stakeholders should ensure that process evaluation is undertaken few months after implementation of delayed cord clamping to examine if the innovation is being implemented as planned. Process evaluation focuses on the implementation of an innovation by assessing how activities of the program are being implemented, which should be in line with the stipulated steps (Moore et al. 2015). It is important to undertake this type of evaluation because it provides understandings on how the program is being implemented. The checks and balances that come with process evaluation are able to redirect the implementation process if implementation is not following the intended plan.

8. *Discuss delayed cord clamping with women during antenatal care*

Increasing the demand for delayed cord clamping through providing pregnant women with information on the benefits of delayed cord clamping and its practice during antenatal care may be a useful strategy to adopt. Usual antenatal care involves health education, health promotion, risk identification, prevention and management of pregnancy related illnesses (World Health Organization 2016). The period of preparation maybe used to provide women with information about delayed cord clamping, so that they may be able to ask for this at the time of birth. Even if they are unable to advocate for delayed cord clamping themselves at this time, at least they will have a better understanding of why the cord clamping is being delayed and may accept this practice more readily.

Antenatal clinic interactions have been linked with positive influences on the utilisation of maternal, newborn and child health services through education that occurs during the sessions (Ensor et al. 2014). For example, antenatal women are taught the importance of danger signs in pregnancy and once they experience any danger signs, they present to the health facility for further management.

9. *Strengthen the audit review meetings to ensure continuous quality improvement*

The use of audits in quality improvement has been identified as one way of improving the practice. Usually an audit review is accompanied by feedback, which in turn results in the embracing of the desired change (Ivers et al. 2012). Audit reviews can be used

as a strategy to improve clinical practice by either independent use or as a subdivision of a multidimensional quality improvement plan (Ivers et al. 2012). Adopters may be stimulated to amend their practice when feedback is given from the audit review indicating that their clinical practice is varying from the anticipated target (Ivers et al. 2012). The inclusion of audit reviews in the implementation plan for delayed cord clamping, which should be executed by midwives on a rotation basis, may provide the understanding of what is expected of them in when practising delayed cord clamping.

Established champions could develop a monthly evaluation tool, which they would use to evaluate maternity case records on the use of delayed cord clamping by midwives and feedback given for continuous quality improvement. Different midwives would be involved in the audit process of the practice each month.

10. Establish quality improvement projects to support the diffusion of delayed cord clamping

Quality improvement projects in health facilities may help strengthen the diffusion of delayed cord clamping. This can start with the setting of standards for quality assurance followed by quality control to ensure that the standards are being adhered to; if they are not being followed, continuous quality improvement strategies should be established.

11. Use the defined implementation process when implementing new programs

It is strongly recommended that all new programs be implemented following a known process, which starts with planning, engaging, executing, reflecting and evaluating. Following the process is likely to increase the diffusion of the new innovation because of activities that accompany the process. More studies are also needed to help understand the behavioural aspects to implementation of new programs in Zambia.

7.11 CONCLUSION

The thesis has provided an understanding into the current umbilical cord clamping practices by maternity health workers in Zambia. It was a three-phased study, which first determined umbilical cord clamping practices by midwives, obstetricians, nurses and other medical staff in Zambia. The findings of Phase 1 informed the two phases that followed. The study design, which was used, was mixed methods, which complemented each other in exploring cord clamping practices by maternity health

workers in Zambia. The second phase described and analyzed the available guidelines that inform umbilical cord clamping practices in birth units across Zambia. The last phase explored the motivation to delayed cord clamping practice by midwives and the implementation process for new programs in maternity practice by key informants from the Ministry of Health in Zambia. In this study delayed cord clamping was identified as a challenge especially with few guidelines and a lack of dissemination. Immediate cord clamping was still prevalent. In order to bring about change, adopters need information to make an informed decision to embrace the new practice. There is a need for a national guideline on delayed cord clamping, which should be developed and disseminated through information sharing. Informal and formal information sharing about delayed cord clamping by prior adopters may result in practice change. The motivation to delayed cord clamping practice by midwives was imbedded in the benefits that come with the practice to the newborn baby.

8. REFERENCES

Afshari, P., Medforth, J., Aarabi, M., Abedi, P. & Soltani, H. 2014, 'Management of third stage labour following vaginal birth in Iran: A survey of current policies', *Midwifery*, vol. 30, no. 1, pp. 65-71.

Al-Tawil, M.M., Abdel-Aal, M.R. & Kaddah, M.A. 2012, 'A randomized controlled trial on delayed cord clamping and iron status at 3-5 months in term neonates held at the level of maternal pelvis', *Journal of Neonatal -- Perinatal Medicine*, vol. 5, no. 4, pp. 319-26.

Aladangady, N., McHugh, S., Aitchison, T.C., Wardrop, C.A.J. & Holland, B.M. 2006, 'Infants' blood volume in a controlled trial of placental transfusion at preterm delivery', *Pediatrics*, vol. 117, no. 1, pp. 93-8.

Albright, K., Gechter, K. & Kempe, A. 2013, 'Importance of mixed methods in pragmatic trials and dissemination and implementation research', *Academic Pediatrics,*, vol. 13, no. 5, pp. 400-7.

Andersson, O., Rana, N., Ewald, U., Målqvist, M., Stripple, G., Basnet, O., Subedi, K. & Kc, A. 2019, 'Intact cord resuscitation versus early cord clamping in the treatment of depressed newborn infants during the first 10 minutes of birth (Nepcord III)–a randomized clinical trial', *Maternal Health, Neonatology and Perinatology*, vol. 5, no. 1, pp. 1-11.

Anton, O., Jordan, H. & Rabe, H. 2019, 'Strategies for implementing placental transfusion at birth: a systematic review', *Birth*, vol. 46, no. 3, pp. 411-27.

Apgar, V. 1966, 'The newborn (Apgar) scoring system: reflections and advice', *Pediatric Clinics of North America*, vol. 13, no. 3, pp. 645-50.

Apgar, V. 2015, 'A proposal for a new method of evaluation of the newborn infant', *Anesthesia & Analgesia*, vol. 120, no. 5, pp. 1056-9.

Armanian, A.M., Ghasemi Tehrani, H., Ansari, M. and Ghaemi, S., 2017, 'Is" Delayed Umbilical Cord Clamping" Beneficial for Premature Newborns?', *International Journal of Pediatrics*, vol. 5, no. 5, pp. 4909-18.

Atkins, L., Francis, J., Islam, R., O'Connor, D., Patey, A., Ivers, N., Foy, R., Duncan, E.M., Colquhoun, H., Grimshaw, J.M. and Lawton, R., 2017, 'A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems', *Implementation Science*, vol. 12, no. 1, pp. 1-18.

Backes, C.H., Rivera, B., Haque, U., Copeland, K., Hutchon, D. & Smith, C.V. 2014, 'Placental transfusion strategies in extremely preterm infants: The next piece of the puzzle', *Journal of Neonatal -- Perinatal Medicine*, vol. 7, no. 4, pp. 257-67.

Baenziger, O., Stolkin, F., Keel, M., von Siebenthal, K., Fauchere, J.C., Kundu, S.D., Dietz, V., Bucher, H.U. & Wolf, M. 2007, 'The influence of the timing of cord clamping on postnatal cerebral oxygenation in preterm neonates: a randomized, controlled trial', *Pediatrics,*, vol. 119, no. 3, pp. 455-9.

Bates, S.E., Isaac, T.C., Marion, R.L., Norman, V., Gumley, J.S. & Sullivan, C.D. 2019, 'Delayed cord clamping with stabilisation at all preterm births–feasibility and efficacy of a low cost technique', *European Journal of Obstetrics & Gynecology and Reproductive Biology*, vol. 236, pp. 109-15.

Beard, J.L. 2008, 'Why Iron Deficiency Is Important in Infant Development', *The Journal of Nutrition*, vol. 138, no. 12, pp. 2534-6.

Benoist, B.d., McLean, E., Egll, I. & Cogswell, M. 2008, 'Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia'.

Bhagavan, N. & Ha, C.-E. 2015, *Essentials of Medical Biochemistry: With Clinical Cases*, Academic Press, San Diego.

Blouin, B., Joseph, S.A., Casapia, M., Penny, M.E., Creed-Kanashiro, H.M. & Gyorkos, T.W. 2009, 'Current practice in umbilical cord clamping in an area of high infant anemia

prevalence in the Peruvian Amazon', *Tropical Medicine & International Health*, vol. 14, pp. 145-.

Blouin, B., Penny, M.E., Maheu-Giroux, M., Casapia, M., Aguilar, E., Silva, H., Creed-Kanashiro, H.M., Joseph, S.A., Gagnon, A., Rahme, E. & Gyorkos, T.W. 2013, 'Timing of umbilical cord-clamping and infant anaemia: the role of maternal anaemia', *Paediats and International Child Health*, vol. 33, no. 2, pp. 79-85.

Boere, I., Smit, M., Roest, A.A., Lopriore, E., van Lith, J.M. & te Pas, A.B. 2015, 'Current practice of cord clamping in the Netherlands: A questionnaire study', *Neonatology*, vol. 107, no. 1, pp. 50-5.

Bradley, J., Leibold, E.A., Harris, Z.L., Wobken, J.D., Clarke, S., Zumbrennen, K.B., Eisenstein, R.S. & Georgieff, M.K. 2004, 'Influence of gestational age and fetal iron status on IRP activity and iron transporter protein expression in third-trimester human placenta', *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, vol. 287, no. 4, pp. R894-R901.

Brink, H., Van der Walt, C. & Van Rensburg, G. 2006, *Fundamentals of research methodology for health care professionals*, Juta and Company Ltd.

Brouwers, M.C., Kho, M.E., Browman, G.P., Burgers, J.S., Cluzeau, F., Feder, G., Fervers, B., Graham, I.D., Hanna, S.E. & Makarski, J. 2010, 'Development of the AGREE II, part 2: assessment of validity of items and tools to support application', *Canadian Medical Association Journal,*, vol. 182, no. 10, pp. E472-E8.

Brunkert, T., Simon, M. & Zúñiga, F. 2021, 'Use of Pain Management Champions to Enhance Guideline Implementation by Care Workers in Nursing Homes', *Worldviews on Evidence-Based Nursing*, vol. 18, no. 2, pp. 138-46.

Bryar, R. & Sinclair, M. 2011, *Theory for midwifery practice*, vol. Second Edition, Macmillan International Higher Education, New York.

Bunce, A.E., Gruß, I., Davis, J.V., Cowburn, S., Cohen, D., Oakley, J. & Gold, R. 2020, 'Lessons learned about the effective operationalization of champions as an implementation strategy: results from a qualitative process evaluation of a pragmatic trial', *Implementation Science*, vol. 15, no. 1, pp. 1-12.

Callister, L.C. 2014, 'The golden minute: helping babies breathe', *The American Journal of Maternal/Child Nursing*, vol. 39, no. 4, p. 271.

Cane, J., O'Connor, D. & Michie, S. 2012, 'Validation of the theoretical domains framework for use in behaviour change and implementation research', *Implementation science*, vol. 7, no. 1, p. 37.

Central Statistical Office & Zambia, M.o.H. 2018, *Zambia Demographic Health Survey*, Lusaka2021, <https://dhsprogram.com/publications/publication-fr304-dhs-final-reports.cfm>.

Chaparro, C. & Lutter, C. 2007, 'Beyond survival: integrated delivery care practices for long-term maternal and infant nutrition, health and development', *Washington DC: Pan American Health Organization*.

Chaparro, C.M. 2011, 'Timing of umbilical cord clamping: Effect on iron endowment of the newborn and later iron status', *Nutrition Reviews*, vol. 69, no. SUPPL. 1, pp. S30-S6.

Chaparro, C.M., Neufeld, L.M., Tena Alavez, G., Eguia-Liz Cedillo, R. & Dewey, K.G. 2006, 'Effect of timing of umbilical cord clamping on iron status in Mexican infants: a randomised controlled trial', *Lancet*, vol. 367, no. 9527, pp. 1997-2004.

Chapman, A., Yang, H., Thomas, S.A., Searle, K. and Browning, C., 2016, 'Barriers and enablers to the delivery of psychological care in the management of patients with type 2 diabetes mellitus in China: a qualitative study using the theoretical domains framework', *BMC Health Services Research,*, vol. 16, no. 1, pp. 1-10.

Chapter 16: Neonatal care 2015, 'Chapter 16: Neonatal care', *Oxford Handbook of Children's and Young People's Nursing, Oxford*, Oxford University Press, Oxford, pp. 539-673.

Cole, F.L. 1988, 'Content analysis: process and application', *Clinical Nurse Specialist,* , vol. 2, no. 1, pp. 53-7.

Creswell, J.W. & Clark, V.L.P. 2017, *Designing and conducting mixed methods research*, Sage Publications, London, United Kingdom.

Damschroder, L.J., Aron, D.C., Keith, R.E., Kirsh, S.R., Alexander, J.A. & Lowery, J.C. 2009, 'Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science', *Implementation Science*, vol. 4, no. 1, p. 50.

Devin, J. & Larkin, P. 2018, 'Delayed cord clamping in term neonates: Attitudes and practices of midwives in Irish hospitals', *International Journal of Childbirth*, vol. 8, no. 1, pp. 4-17.

Dewey, K.G. & Chaparro, C.M. 2007, 'Session 4: Mineral metabolism and body composition Iron status of breast-fed infants: Symposium on 'Nutrition in early life: new horizons in a new century'', *Proceedings of the Nutrition Society*, vol. 66, no. 3, pp. 412-22.

Dipak, N.K., Nanavat, R.N., Kabra, N.K., Srinivasan, A. & Ananthan, A. 2017, 'Effect of Delayed Cord Clamping on Hematocrit, and Thermal and Hemodynamic Stability in Preterm Neonates: A Randomized Controlled Trial', *Indian Pediatrics*, vol. 54, no. 2, pp. 112-5.

Donovan, G., Parkin, L., Brierley-Jones, L. & Wilkes, S. 2018, 'Unlicensed medicines use: a UK guideline analysis using AGREE II', *International Journal of Pharmacy Practice*, vol. 26, no. 6, pp. 515-25.

Duley, L. & Batey, N. 2013, 'Optimal timing of umbilical cord clamping for term and preterm babies', *Early Human Development*, vol. 89, no. 11, pp. 905-8.

Eldh, A.C., Almost, J., DeCorby-Watson, K., Gifford, W., Harvey, G., Hasson, H., Kenny, D., Moodie, S., Wallin, L. & Yost, J. 2017, 'Clinical interventions, implementation interventions, and the potential greyness in between-a discussion paper', *BMC Health Services Research*, vol. 17, no. 1, p. 16.

Emhamed, M.O., van Rheenen, P. & Brabin, B.J. 2004, 'The early effects of delayed cord clamping in term infants born to Libyan mothers', *Tropical Doctor*, vol. 34, no. 4, pp. 218-22.

Ensor, T., Quigley, P., Green, C., Razak Badru, A., Kaluba, D. & Siziya, S. 2014, 'Knowledgeable antenatal care as a pathway to skilled delivery: modelling the interactions between use of services and knowledge in Zambia', *Health Policy and Planning*, vol. 29, no. 5, pp. 580-8.

Ersdal, H.L., Singhal, N., Msemo, G., Ashish, K., Data, S., Moyo, N.T., Evans, C.L., Smith, J., Perlman, J.M. & Niermeyer, S. 2017, 'Successful implementation of Helping Babies Survive and Helping Mothers Survive programs—An Utstein formula for newborn and maternal survival', *PloS one*, vol. 12, no. 6, p. e0178073.

Fasawe, O., Avila, C., Shaffer, N., Schouten, E., Chimbwandira, F., Hoos, D., Nakakeeto, O. & De Lay, P. 2013, 'Cost-effectiveness analysis of Option B+ for HIV prevention and treatment of mothers and children in Malawi', *PloS one*, vol. 8, no. 3, p. e57778.

Ferreira, J.C. & Patino, C.M. 2018, 'Critical appraisal of the literature. Why do we care?', *Jornal Brasileiro de Pneumologia*, vol. 44, pp. 448-.

Fogarty, M., Osborn, D.A., Askie, L., Seidler, A.L., Hunter, K., Lui, K., Simes, J. & Tarnow-Mordi, W. 2017, 'Delayed vs early umbilical cord clamping for preterm infants: a systematic review and meta-analysis', *American Journal of Obstetrics and Gynecology*.

Francis, J.J., O'Connor, D. & Curran, J. 2012, 'Theories of behaviour change synthesised into a set of theoretical groupings: introducing a thematic series on the theoretical domains framework', *Implementation Science*, vol. 7, no. 1, pp. 1-9.

Fulton, C., Stoll, K. & Thordarson, D. 2016, 'Bedside resuscitation of newborns with an intact umbilical cord: Experiences of midwives from British Columbia', *Journal of Midwifery*, vol. 34, pp. 42-6.

Gagliardi, A.R., Brouwers, M.C., Palda, V.A., Lemieux-Charles, L. & Grimshaw, J.M. 2011, 'How can we improve guideline use? A conceptual framework of implementability', *Implementation Science*, vol. 6, no. 1, p. 26.

Gams, R.L., Popp, K.K., Cramer, J., George, T.N., Rauk, P.N., Sommerness, S.A. & Sublette, J.A. 2017, 'How to engage your team to implement delayed cord clamping', *Nursing for Women's Health*, vol. 21, no. 6, pp. 489-98.

George, D. & Mallery, P. 2016, *IBM SPSS statistics 23 step by step: A simple guide and reference*, Routledge, New York.

Ghavam, S., Batra, D., Mercer, J., Kugelman, A., Hosono, S., Oh, W., Rabe, H. & Kirpalani, H. 2014, 'Effects of placental transfusion in extremely low birthweight infants: meta-analysis of long-and short-term outcomes', *Transfusion*, vol. 54, no. 4, pp. 1192-8.

Ghirardello, S., Di Tommaso, M., Fiocchi, S., Locatelli, A., Perrone, B., Pratesi, S. & Saracco, P. 2018, 'Italian recommendations for placental transfusion strategies', *Frontiers in Pediatrics, *, vol. 6, p. 372.

Goodwin, D., Mays, N. & Pope, C. 2006, *Ethical Issues: Qualitative Research in Health Care 3rd Edition*, Blackwell Publishing, Lancaster, United Kingdom.

Grol, R. & Wensing, M. 2004, 'What drives change? Barriers to and incentives for achieving evidence-based practice', *Medical Journal of Australia*, vol. 180, no. 6 Suppl, p. S57.

Grol, R., Wensing, M., Eccles, M. & Davis, D. 2013, *Improving patient care: the implementation of change in health care*, John Wiley & Sons, West Sussex, United Kingdom.

Harvey, G. & Kitson, A. 2015a, *Implementing evidence-based practice in healthcare: a facilitation guide*, Routledge, New York.

Harvey, G. & Kitson, A. 2015b, 'PARIHS revisited: from heuristic to integrated framework for the successful implementation of knowledge into practice', *Implementation science*, vol. 11, no. 1, p. 33.

Healy, S., Humphreys, E. & Kennedy, C. 2017, 'A qualitative exploration of how midwives' and obstetricians' perception of risk affects care practices for low-risk women and normal birth', *Women and Birth,*, vol. 30, no. 5, pp. 367-75.

Hutchon, D., Pratesi, S. & Katheria, A. 2021, 'How to provide motherside neonatal resuscitation with intact placental circulation?', *Children, *, vol. 8, no. 4, p. 291.

Hutton, E.K. & Hassan, E.S. 2007, 'Late vs early clamping of the umbilical cord in full-term neonates: systematic review and meta-analysis of controlled trials', *Journal of acquired immune deficiency syndromes (1999)*, vol. 297, no. 11, pp. 1241-52.

Hutton, E.K., Stoll, K. & Taha, N. 2013, 'An Observational Study of Umbilical Cord Clamping Practices of Maternity Care Providers in a Tertiary Care Center', *Birth*, vol. 40, no. 1, pp. 39-45.

Ibrahim, N.O., Sukkarieh, H.H., Bustami, R.T., Alshammari, E.A., Alasmari, L.Y. & Al-Kadria, H.M. 2017, 'Current umbilical cord clamping practices and attitudes of obstetricians and midwives toward delayed cord clamping in Saudi Arabia', *Annals of Saudi Medicine*, vol. 37, no. 3, pp. 216-24.

Imamura, M., Kanguru, L., Penfold, S., Stokes, T., Camosso-Stefinovic, J., Shaw, B. & Hussein, J. 2017, 'A systematic review of implementation strategies to deliver guidelines on obstetric care practice in low-and middle-income countries', *International Journal of Gynecology & Obstetrics* vol. 136, no. 1, pp. 19-28.

International Confederation of Midwives 2021, *Building the Enabling Environment for Midwives: a call to actions for policy makers,The Hague: ICM*, International Confederation of Midwives, , Hague2021, <https://www.internationalmidwives.org/our-work/other-resources/icm-enabling-environment-policy-brief-(2021).>.

Isik, G.U. 2019, 'Opinions of Nurses and Midwives on the Implementation of Clinical Practice Guidelines', *International Journal of Caring Sciences*, vol. 12, no. 3, pp. 1487-96.

Ivankova, N.V., Creswell, J.W. and Stick, S.L., 2006, 'Using mixed-methods sequential explanatory design: From theory to practice', *Field methods,*, vol. 18, no. 1, pp. 3-20.

Ivers, N., Jamtvedt, G., Flottorp, S., Young, J.M., Odgaard-Jensen, J., French, S.D., O'Brien, M.A., Johansen, M., Grimshaw, J. & Oxman, A.D. 2012, 'Audit and feedback: effects on professional practice and healthcare outcomes', *Cochrane Database of Systematic Reviews*, no. 6.

Jahazi, A., Kordi, M., Mirbehbahani, N. & Mazloom, S. 2008, 'The effect of early and late umbilical cord clamping on neonatal hematocrit', *Journal of Perinatology*, vol. 28, no. 8, p. 523.

Jelin, A.C., Kuppermann, M., Erickson, K., Clyman, R. & Schulkin, J. 2014, 'Obstetricians' attitudes and beliefs regarding umbilical cord clamping', *Journal of Maternal-Fetal & Neonatal Medicine*, vol. 27, no. 14, pp. 1457-61.

Joanna Briggs Institute 2014, 'Joanna Briggs Institute reviewers' manual: 2014 edition', *Australia: The Joanna Briggs Institute*.

Katheria, A.C., Lakshminrusimha, S., Rabe, H., McAdams, R. & Mercer, J.S. 2017, 'Placental transfusion: a review', *Journal of Perinatology*, vol. 37, no. 2, pp. 105-11.

Katheria, A.C., Sorkhi, S.R., Hassen, K., Faksh, A., Ghorishi, Z. & Poeltler, D. 2018, 'Acceptability of bedside resuscitation with intact umbilical cord to clinicians and patients' families in the United States', *Frontiers in Pediatrics*, vol. 6, p. 100.

Kc, A., Malqvist, M., Rana, N., Ranneberg, L.J. & Andersson, O. 2016, 'Effect of timing of umbilical cord clamping on anaemia at 8 and 12 months and later neurodevelopment in late pre-term and term infants; a facility-based, randomized-controlled trial in Nepal', *BMC Pediatrics*, vol. 16, p. 35.

Kerkin, B., Lennox, S. & Patterson, J. 2018, 'Making midwifery work visible: The multiple purposes of documentation', *Women and Birth,*, vol. 31, no. 3, pp. 232-9.

Khan, A., Nasrullah, F.D. & Jaleel, R. 2016, 'Frequency and risk factors of low birth weight in term pregnancy', *Pakistan Journal of Medical Sciences*, vol. 32, no. 1, p. 138.

Krippendorff, K. 2018, *Content analysis: An introduction to its methodology*, Sage publications, Pennsylvania.

Leatherman, S., Ferris, T.G., Berwick, D., Omaswa, F. & Crisp, N. 2010, 'The role of quality improvement in strengthening health systems in developing countries', *International Journal for Quality in Health Care*, vol. 22, no. 4, pp. 237-43.

Leslie, M.S. 2015, 'Perspectives on implementing delayed cord clamping', *Nursing for Women's Health*

vol. 19, no. 2, pp. 164-76.

Leslie, M.S., Erickson-Owens, D. & Park, J. 2020, 'Umbilical Cord Practices of Members of the American College of Nurse-Midwives', *Journal of Midwifery & Women's Health*.

Leslie, M.S., Erickson-Owens, D. & Park, J. 2019, 'Umbilical Cord Practices of Members of the American College of Nurse-Midwives', *Journal of Midwifery & Women's Health,* , vol. 64, no. 5, pp. 676-.

Leslie, M.S., Greene, J., Schulkin, J. & Jelin, A.C. 2018, 'Umbilical cord clamping practices of U.S. obstetricians', *Journal of Neonatal-Perinatal Medicine*, vol. 11, no. 1, pp. 51-60.

Levy, T. & Blickstein, I. 2006, 'Timing of cord clamping revisited', *Journal of Perinatal Medicine*, vol. 34, no. 4, pp. 293-7.

Linderkamp, O. 1982, 'Placental transfusion: determinants and effects', *Clinics in Perinatology*, vol. 9, no. 3, pp. 559-92.

Linderkamp, O. 1987, 'Blood rheology in the newborn infant', *Bailliere's Clinical Haematology*, vol. 1, no. 3, pp. 801-25.

Lozoff, B., Beard, J., Connor, J., Felt, B., Georgieff, M. & Schallert, T. 2006, 'Long-lasting neural and behavioral effects of iron deficiency in infancy', *Nutrition Reviews*, vol. 64, no. suppl_2, pp. S34-S43.

Lozoff, B. & Georgieff, M.K. 2006, 'Iron deficiency and brain development', *Seminars in Pediatric Neurology*, vol. 13, no. 3, pp. 158-65.
Lubeya, M.K. & Vwalika, B. 2017, 'Anaemia in pregnancy among pregnant women in Lusaka District, Zambia', *Medical Journal of Zambia*, vol. 44, no. 4, pp. 238-43.
Lundberg, C., Øian, P. & Klingenberg, C. 2013, 'Umbilical cord clamping at birth--practice in Norwegian maternity wards', *Tidsskrift for Den norske legeforening*, vol. 133, no. 22, pp. 2369-73.
Madhavanprabhakaran, G., Wittmann, A., Vaidyanathan, G., Aldughaishi, T. & Shaji Thomas, D. 2018, 'Knowledge and Practice of Umbilical Cord Clamping among Maternity Care Providers', *Journal of Midwifery and Reproductive Health*, vol. 6, no. 3, pp. 1311-8.
Maimbolwa, M.C. 2004, *Maternity care in Zambia: With special reference to social support*, Institutionen för folkhälsovetenskap/Department of Public Health Sciences, Sweden.
Maisels, M.J. & McDonagh, A.F. 2008, 'Phototherapy for neonatal jaundice', *New England Journal of Medicine*, vol. 358, no. 9, pp. 920-8.
Manley, B.J., Owen, L.S., Hooper, S.B., Jacobs, S.E., Cheong, J.L., Doyle, L.W. and Davis, P.G. 2017, 'Towards evidence-based resuscitation of the newborn infant', *The Lancet*, vol. 389, no. 10079, pp. 1639-48.
McDonald, S.J. & Middleton, P. 2008, 'Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes', *Cochrane Database Systematic Reviews*, no. 2, p. Cd004074.
McDonald, S.J., Middleton, P., Dowswell, T. & Morris, P.S. 2013, 'Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes', *The Cochrane Database Of Systematic Reviews*, no. 7, p. CD004074.
McDonald, S.J., Middleton, P., Dowswell, T. & Morris, P.S. 2014, 'Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes', *Evidence-Based Child Health: A Cochrane Review Journal*, vol. 9, no. 2, pp. 303-97.
Mgawadere, F. & Shuaibu, U. 2021, 'Enablers and Barriers to Respectful Maternity Care in Low and Middle-Income Countries: A Literature Review of Qualitative Research', *International Journal of Clinical Medicine*, vol. 12, no. 5, pp. 224-49.
Miech, E.J., Rattray, N.A., Flanagan, M.E., Damschroder, L., Schmid, A.A. & Damush, T.M. 2018, 'Inside help: an integrative review of champions in healthcare-related implementation', *SAGE open medicine*, vol. 6, p. 2050312118773261.
Miles, M.B. & Huberman, A.M. 1994, *Qualitative data analysis: An expanded sourcebook*, Sage, London, United Kingdom.
Ministry of Health Lusaka Zambia 2014, *Essential Newborn Care,*, 11, Lusaka, viewed 29 November 2021, <https://www.moh.gov.zm/?wpfb_dl=104>.
Moore, G.F., Audrey, S., Barker, M., Bond, L., Bonell, C., Hardeman, W., Moore, L., O'Cathain, A., Tinati, T. & Wight, D. 2015, 'Process evaluation of complex interventions: Medical Research Council guidance', *British Medical Journal*, vol. 350, p. h1258.
Mosavianpour, M., Sarmast, H.H., Kissoon, N. & Collet, J.P. 2016, 'Theoretical domains framework to assess barriers to change for planning health care quality interventions: a systematic literature review', *Journal of Multidisciplinary Healthcare,* , vol. 9, p. 303.
Mwamba, B. 2015, 'Implementation of Delayed Cord Clamping in Seven Midwifery Training Schools of Zambia', *Newborn and Infant Nursing Reviews*, vol. 15, no. 4, pp. 163-4.
Nelin, V., Ashish, K., Andersson, O., Rana, N. & Målqvist, M. 2018, 'Factors associated with timing of umbilical cord clamping in tertiary hospital of Nepal', *Biomedical Central Research Notes*, vol. 11, no. 1, p. 89.
Onwuegbuzie, J, A. & Frels, R. 2016, *Seven steps to a comprehensive literature review: A multimodal and cultural approach*, London, United Kingdom.
Parahoo, K. 2014, *Nursing research: principles, process and issues*, Macmillan International Higher Education, England, United Kingdom.

Payne, L., Walker, K.F. & Mitchell, E.J. 2021, 'Timing of umbilical cord clamping for preterm infants in low-and-middle-income countries: a survey of current practice', *European Journal of Obstetrics & Gynecology and Reproductive Biology*.

Perrone, B. & Ghirardello, S. 2017, 'Placental Transfusion Strategies in Italy: A Nationwide Survey of Tertiary-Care Delivery Wards', *American Journal of Perinatology*, vol. 34, no. 07, pp. 722-8.

Peters, D.H., Adam, T., Alonge, O., Agyepong, I.A. & Tran, N. 2013, 'Implementation research: what it is and how to do it', *British Medical Journal*, vol. 347, p. f6753.

Peters, D.H., Tran, N.T. & Adam, T. 2013, *Implementation research in health: a practical guide*, World Health Organization, Geneva.

Polglase, G.R. & Stark, M. 2018, 'Cord clamping in term and pre-term infants: how should clinicians proceed?', *The Medical Journal of Australia*, vol. 208, no. 8, pp. 330-1.

Polus, S., Lerberg, P., Vogel, J., Watananirun, K., Souza, J.P., Mathai, M. & Gülmezoglu, A.M. 2012, 'Appraisal of WHO guidelines in maternal health using the AGREE II assessment tool', *PloS One*.

Powell, B.J., McMillen, J.C., Proctor, E.K., Carpenter, C.R., Griffey, R.T., Bunger, A.C., Glass, J.E. & York, J.L. 2012, 'A compilation of strategies for implementing clinical innovations in health and mental health', *Medical Care Research and Review*, vol. 69, no. 2, pp. 123-57.

Powell, B.J., Waltz, T.J., Chinman, M.J., Damschroder, L.J., Smith, J.L., Matthieu, M.M., Proctor, E.K. & Kirchner, J.E. 2015, 'A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project', *Implementation Science*, vol. 10, no. 1, p. 21.

Prendiville, W., Elbourne, D. & McDonald, S. 2000, 'Active versus expectant management in the third stage of labour', *Cochrane Database of Systematic Reviews,*, vol. 3, no. 3.

Proctor, E.K., Powell, B.J. & McMillen, J.C. 2013, 'Implementation strategies: recommendations for specifying and reporting', *Implementation Science*, vol. 8, no. 1, p. 139.

Rabe, H., Diaz-Rossello, J.L., Duley, L. & Dowswell, T. 2012, 'Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes', *The Cochrane Database of Systematic Reviews*, no. 8, p. CD003248.

Rabe, H., Gyte, G.M.L., Diaz-Rossello, J.L. & Duley, L. 2019, 'Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes', *Cochrane Database of Systematic Reviews*, no. 9.

Rana, N., Brunell, O. and Målqvist, M., 2019, 'Implementing delayed umbilical cord clamping in Nepal—Delivery care staff's perceptions and attitudes towards changes in practice', *PloS one,* , vol. 14, no. 6, p. p.e0218031.

Rana, N., Ranneberg, L.J., Målqvist, M., Kc, A. and Andersson, O., 2020, 'Delayed cord clamping was not associated with an increased risk of hyperbilirubinaemia on the day of birth or jaundice in the first 4 weeks', *Acta Paediatrica,*, vol. 109, no. 1, pp. 71-7.

Ranjit, T., Nesargi, S., Rao, P.N., Sahoo, J.P., Ashok, C., Chandrakala, B.S. & Bhat, S. 2015, 'Effect of early versus delayed cord clamping on hematological status of preterm infants at 6 wk of age', *The Indian Journal of Pediatrics,*, vol. 82, no. 1, pp. 29-34.

Riley, C., Spies, L.A., Prater, L. & Garner, S.L. 2019, 'Improving neonatal outcomes through global professional development', *Advances In Neonatal Care: Official Journal of The National Association of Neonatal Nurses,*, vol. 19, no. 1, pp. 56-64.

Roberts, N., Hooper, G., Lorencatto, F., Storr, W. & Spivey, M. 2017, 'Barriers and facilitators towards implementing the Sepsis Six care bundle (BLISS-1): a mixed methods investigation using the theoretical domains framework', *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine,* , vol. 25, no. 1, pp. 1-18.

Rogers, E.M. 2004, 'A prospective and retrospective look at the diffusion model', *Journal of Health Communication,*, vol. 9, no. S1, pp. 13-9.

Rogers, E.M. 2010, *Diffusion of innovations*, Simon and Schuster, New York.

Sellers, P.M. 2018, *Sellers' midwifery*, Juta and Company,, Cape Town,South Africa,.

Shekelle, P., Woolf, S., Grimshaw, J.M., Schünemann, H.J. & Eccles, M.P. 2012, 'Developing clinical practice guidelines: reviewing, reporting, and publishing guidelines; updating guidelines; and the emerging issues of enhancing guideline implementability and accounting for comorbid conditions in guideline development', *Implementation Science*, vol. 7, no. 1, pp. 1-7.

Stevens, G.A., Finucane, M.M., De-Regil, L.M., Paciorek, C.J., Flaxman, S.R., Branca, F., Peña-Rosas, J.P., Bhutta, Z.A., Ezzati, M. and Nutrition Impact Model Study Group, 2013, 'Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data', *The Lancet Global Health*, vol. 1, no. 1, pp. e16-e25.

Stokes, T., Shaw, E.J., Camosso-Stefinovic, J., Imamura, M., Kanguru, L. and Hussein, J., 2016, 'Barriers and enablers to guideline implementation strategies to improve obstetric care practice in low-and middle-income countries: a systematic review of qualitative evidence', *Implementation Science,*, vol. 11, no. 1-10, p. 144.

Stoll, K. & Hutton, E. 2012, 'A survey of umbilical cord clamping practices and attitudes of Canadian maternity care providers', *Canadian Journal of Midwifery Research*

Practice,, vol. 11, no. 3, pp. 18-29.

Strauss, R.G., Mock, D.M., Johnson, K.J., Cress, G.A., Burmeister, L.F., Zimmerman, M.B., Bell, E.F. & Rijhsinghani, A. 2008, 'A randomized clinical trial comparing immediate versus delayed clamping of the umbilical cord in preterm infants: short-term clinical and laboratory endpoints', *Transfusion*, vol. 48, no. 4, pp. 658-65.

Tancred, T., Mandu, R., Hanson, C., Okuga, M., Manzi, F., Peterson, S., Schellenberg, J., Waiswa, P., Marchant, T., Team, a.E.S., Baker, U., Balidawa, H., Byaruhanga, R., N.,, Jaribu, J., ., Kajjo, D., Kalungi, J., Majura, A., ., Mussa , A., Okong , P., Sedekia , Y. & Tomson G 2014, 'How people-centred health systems can reach the grassroots: experiences implementing community-level quality improvement in rural Tanzania and Uganda', *Health Policy and Planning*, vol. 33, no. 1, pp. e1-e13.

Turner, L., Griffiths, P. & Kitson-Reynolds, E. 2021, 'Midwifery and nurse staffing of inpatient maternity services–a systematic scoping review of associations with outcomes and quality of care', *Midwifery*, vol. 103, p. 103118.

Uduwana, S.R. & Nemerofsky, S.L. 2021, 'A Questionnaire Assessing Utilization of Delayed Cord Clamping', *American Journal of Perinatology,*.

Vain, N.E., Satragno, D.S., Gorenstein, A.N., Gordillo, J.E., Berazategui, J.P., Alda, M.G. & Prudent, L.M. 2014, 'Effect of gravity on volume of placental transfusion: a multicentre, randomised, non-inferiority trial', *The Lancet*, vol. 384, no. 9939, pp. 235-40.

van Rheenen, P., de Moor, L., Eschbach, S., de Grooth, H. & Brabin, B. 2007, 'Delayed cord clamping and haemoglobin levels in infancy: a randomised controlled trial in term babies', *Tropical Medicine & International Health,*, vol. 12, no. 5, pp. 603-16.

Vivio, D., Fullerton, J.T., Forman, R., Mbewe, R.K., Musumali, M. & Chewe, P.M. 2010, 'Integration of the practice of active management of the third stage of labor within training and service implementation programming in Zambia', *The Journal of Midwifery & Women's Health*, vol. 55, no. 5, pp. 447-54.

Vogel, J.P., Moore, J.E., Timmings, C., Khan, S., Khan, D.N., Defar, A., Hadush, A., Minwyelet Terefe, M., Teshome, L., Ba-Thike, K. & Than, K.K. 2016, 'Barriers, facilitators and priorities for implementation of WHO maternal and perinatal health guidelines in

four lower-income countries: a GREAT network research activity', *PLoS One*, vol. 11, no. 11, p. e0160020.

Wood, K., Giannopoulos, V., Louie, E., Baillie, A., Uribe, G., Lee, K.S., Haber, P.S. & Morley, K.C. 2020, 'The role of clinical champions in facilitating the use of evidence-based practice in drug and alcohol and mental health settings: A systematic review', *mplementation Research and Practice*, vol. 1, p. 2633489520959072.

World Health Organization 2012a, *Maternal, newborn, child and adolescent health approved by the WHO Guidelines Review Committee*, World Health Organization, Geneva.

World Health Organization 2012b, *WHO recommendations for the prevention and treatment of postpartum haemorrhage*, World Health Organization, Geneva.

World Health Organization 2013, *Guidelines on maternal, newborn, child and adolescent health approved by the WHO Guidelines Review Committee: recommendations on maternal and perinatal health.* , World Health Organization, Geneva, <https://www.who.int/publications/i/item/WHO-MCA-17.10>.

World Health Organization 2014a, 'Delayed clamping of the umbilical cord to reduce infant anaemia', *World Health Organization International,*.

World Health Organization 2014b, 'Global Nutrition Targets 2025: Low birth weight policy brief', *World Health Organization International,*.

World Health Organization 2014c, *Guideline: delayed umbilical cord clamping for improved maternal and infant health and nutrition outcomes*, World Health Organization, Geneva.

World Health Organization 2014d, *Optimal timing of cord clamping for the prevention of iron deficiency anaemia in infants. The WHO Reproductive Health Library*, World Health Organization, Geneva, <https://www.who.int/elena/titles/full_recommendations/cord_clamping/en/>.

World Health Organization 2015, *The global prevalence of anaemia in 2011*, World Health Organization, Geneva, <https://apps.who.int/iris/bitstream/handle/10665/177094/9789241564960_eng.pdf>.

World Health Organization 2016, *WHO recommendations on antenatal care for a positive pregnancy experience*, World Health Organization, Geneva.

Yang, Q., Wang, X., Zhou, Q., Tan, L., Zhang, X. & Lai, X. 2021, 'Healthcare workers' behaviors on infection prevention and control and their determinants during the COVID-19 pandemic: a cross-sectional study based on the theoretical domains framework in Wuhan, China', *Archives of Public Health,*, vol. 79, no. 1, pp. 1-10.

Yao, A. & Lind, J. 1974, 'Blood flow in the umbilical vessels during the third stage of labor', *Neonatology,*, vol. 25, no. 3-4, pp. 186-93.

Yao, A., Moinian, M. & Lind, J. 1969, 'Distribution of blood between infant and placenta after birth', *The Lancet*, vol. 294, no. 7626, pp. 871-3.

Yesodharan, D.K. & Valsaraj, B.P. 2020, 'OSCE (Objective Structured Clinical Examination) In Psychiatric Mental Health Nursing: Faculty Reflections)', *Journal of Critical Reviews,*, vol. 7, no. 19, pp. 9376-82.

Zambia Demographic Health Survey 2014, *Health Survey 2013–2014. Maryland: Central Statistical Office, Ministry of Health and ICF International; 2015*, Lusaka, <https://dhsprogram.com/publications/publication-fr304-dhs-final-reports.cfm>.

9. APPENDICES

a. APPENDIX A

Ethics Approval

UNIVERSITY OF ZAMBIA BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067 Ridgeway Campus

Telegrams: UNZA, LUSAKA P.O. Box 50110

Telex: UNZALU ZA 44370 Lusaka, Zambia

Fax: + 260-1-250753 E-mail: unzarec@unza.zm

Federal Assurance No. FWA00000338 IRB00001131 of IORG0000774

17th July, 2019.

Ms. Bupe Mwamba, University of Technology, Sydney, Australia.

Dear Ms. Mwamba,

REF. No. 070-2019

RE: "A DESCRIPTIVE STUDY OF UMBILICAL CORD CLAMPING PRACTICES BY MIDWIVES, OBSTETRICIANS AND MEDICIAL OFFICERS THROUGHOUT ZAMBIA: A NATIONAL SURVEY" (Ref. No. 070-2019)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 16th July, 2019. The proposal is **approved**. The approval is based on the following documents that were submitted for review:

a) **Study proposal**

b) **Questionnaires**

c) **Participant Consent Form**

APPROVAL NUMBER : REF. 070-2019

This number should be used on all correspondence, consent forms and documents as appropriate.

- **APPROVAL DATE : 17th July 2019**
- **TYPE OF APPROVAL : Standard**
- **EXPIRATION DATE OF APPROVAL : 16th July 2020**

  After this date, this project may only continue upon renewal. For purposes of renewal, a progress report on a standard form obtainable from the UNZABREC Offices should be submitted one month before the expiration date for continuing review.

- **SERIOUS ADVERSE EVENT REPORTING**: All SAEs and any other serious challenges/problems having to do with participant welfare, participant safety and study integrity must be reported to UNZABREC within 3 working days using standard forms obtainable from UNZABREC.
- **MODIFICATIONS**: Prior UNZABREC approval using standard forms obtainable from the UNZABREC Offices is required before implementing any changes in the Protocol (including changes in the consent documents).
- **TERMINATION OF STUDY**: On termination of a study, a report must be submitted to the UNZABREC using standard forms obtainable from the UNZABREC Offices.
- **NHRA:** Where appropriate, apply in writing to the National Heath Research Authority for permission before you embark on the study.
- **QUESTIONS**: Please contact the UNZABREC on Telephone No.256067 or by e-mail on unzarec@unza.zm.
- **OTHER**: Please be reminded to send in copies of your research findings/results for our records. You're also required to submit electronic copies of your publications in peer-reviewed journals that may

  emanate from this study. Use the online portal: unza.rhinno.net for further submissions.

Yours sincerely,

Production Note:
Signature removed
prior to publication.

Sody Mweetwa Munsaka, BSc., MSc., PhD

CHAIRPERSON

Tel: +260977925304

E-mail: s.munsaka@unza.zm

NATIONAL HEALTH RESEARCH AUTHORITY
Paediatric Centre of Excellence, University Teaching Hospital, P.O. Box 30075, LUSAKA
Tell: +260211 250309 | Email: nhrasec@gmail.com | www.nhra.org.zm

Ref No:..... **Date: 9th August, 2019**

The Principal Investigator
Ms. Bupe Mwamba
University of Technology
[redacted]
AUSTRALIA

Dear Ms. Mwamba,

Re: Request for Authority to Conduct Research

The National Health Research Authority is in receipt of your request for authority to conduct research titled **"A descriptive study of umbilical cord clamping practices by midwives, obstetricians and other medical staff in Zambia."** I wish to inform you that following submission of your request to the Authority, our review of the same and in view of the ethical clearance, this study has been **approved** on condition that:

1. The relevant Provincial and District Medical Officers where the study is being conducted are fully appraised;
2. Progress updates are provided to NHRA quarterly from the date of commencement of the study;
3. The final study report is cleared by the NHRA before any publication or dissemination within or outside the country;
4. After clearance for publication or dissemination by the NHRA, the final study report is shared with all relevant Provincial and District Directors of Health where the study was being conducted, University leadership, and all key respondents.

Yours sincerely,

Production Note:
Signature removed
prior to publication.

Dr. Godfrey Biemba
Director/CEO
National Health Research Authority

UNIVERSITY OF ZAMBIA BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067 Ridgeway Campus

Telegrams: UNZA, LUSAKA P.O. Box 50110

Telex: UNZALU ZA 44370 Lusaka, Zambia

Fax: + 260-1-250753 E-mail: unzarec@unza.zm

Federal Assurance No. FWA00000338 IRB00001131 of IORG0000774

10th August 2020.

Yours Ref: 070-2019.

Ms. Bupe Mwamba, University of Technology, Sydney, Australia.

Dear Ms. Mwamba,

RE: AMENDMENT TO THE PROTOCOL FOR THE STUDY ENTITLED: "A DESCRIPTIVE STUDY OF UMBILICAL CORD CLAMPING PRACTICES BY MIDWIVES, OBSTETRICIANS AND MEDICIAL OFFICERS THROUGHOUT ZAMBIA: A NATIONAL SURVEY" (REF. NO. 070-2019)

We acknowledge receipt of your request for amendment to the aforementioned protocol. The study amendment were reviewed and approved as follows:

1. Record of interviews on audio and transcribed verbatim where the transcripts will be de-identified during transcription and the recorded information deleted after transcription.
2. Change of title to an exploratory qualitative study of umbilical cord clamping practices by maternity health care providers in Zambia.

Yours sincerely,

Production Note:
Signature removed
prior to publication.

Dr. Victor Chisha Zulu **VICE-CHAIRPERSON**

NATIONAL HEALTH RESEARCH AUTHORITY
Paediatric Centre of Excellence, University Teaching Hospital, P.O. Box 30075, LUSAKA
Tell: +260211 250309 | Email: znhrasec@gmail.com | www.nhra.org.zm

Date: 13th August, 2020

The Principal Investigator,
Ms. Bupe Mwamba,
University of Technology,
Sydney, Australia.

Dear Ms. Mwamba

Re: Amendment to the Study Protocol entitled "An exploratory qualitative study of umbilical cord clamping practices by Maternity Health Care providers in Zambia"

Reference is made to the above subject matter.

The National Health Research Authority is in receipt of your submission of letter Amendment, dated 12 August 2020 for approval.

The following amendments were reviewed and approved as follows:

1. Record of interviews on audio and transcribed verbatim where the transcripts will be de-identified during transcription and the recorded information deleted after transcription.
2. Change of title to an exploratory qualitative study of umbilical cord clamping practices by maternity health care providers in Zambia.

Yours sincerely,

Production Note:
Signature removed
prior to publication.

Prof. Godfrey Biemba
Director/CEO
National Health Research Authority

b. Appendix B

Questionnaire

Link to the online survey

Umbilical cord clamping practices by midwives, obstetricians and other medical staff in Zambia

A survey of umbilical cord clamping practices

Thank you for agreeing to participate in an online survey to explore umbilical cord clamping practices in Zambia. It should take approximately 15 minutes of your time to complete. Questions will require either a tick box response or a few words to be entered where indicated.

Question 1:

a. What is the name of the city in which you work?

_____

b. What is the name of your place of practice? _____

c. How many years have you been practicing as a midwife/obstetrician/other medical staff? _____

d. What is your gender?

□ Male

□ Female

e. How old are you? _____

Question 2:

I work in a maternity service as a/an:

(*Please tick one box*)

□ Advanced Diploma Midwife/Diploma Nursing

□ Advanced Diploma Nurse Midwife

□ Enrolled Midwife

□ Certified Midwife

□ BSc Midwifery

□ MSc Midwife

□ PhD Midwife

□ Obstetrician/ Gynaecologist

□ Medical Officer (not obstetrician/gynaecologist)

Question 3:

Are there any guidelines/protocols for the time of cord clamping in the practice/department in which you work? (*Please tick one box*)

□ No

□ Yes

If you answered **YES,** what are these guidelines: (*please tick **as many as** apply*)

□ Active management of the 3rd stage of labour

□ Immediate cord clamping (ICC)

□ Delayed cord clamping (DCC)

□ Pulsation Ceased (PC)

□ Other - please specify ……..

Question 4:

Do you have **a set time** when clamping the cord (for neonates who are **term and healthy** with a high Apgar score)? *(Please tick one box)*

□ Yes, *go to question 4a*

□ No, *go to question 4b*

Question 4a:

If you answered **YES**, please indicate how many minutes after birth (*Please tick one box*)

□ 0-30 seconds after birth

□ 30 seconds-1 minute after birth

□ 1-2 minutes after birth

□ 2-3 minutes after birth

□ 4 – 10 minutes after birth

□ > 10 minutes after birth

□ I do not have a set time. I wait until the pulsations have ceased in the umbilical cord.

□ I do not have a set time. I wait until the placenta comes loose from the uterine wall.

□ Other.....

Question 4b:

If you answered **NO**, please indicate when you clamp the cord (for neonates who are **term and healthy** with a high Apgar score) (*Please tick one box*)

□ 0-30 seconds after birth

□ 30 seconds-1 minutes after birth

□ 1-2 minutes after birth

□ 2-3 minutes after birth

□ 4 – 10 minutes after birth

□ > 10 minutes after birth

□ I do not have a set time. I wait until the pulsations have ceased in the umbilical cord.

□ I do not have a set time. I wait until the placenta comes loose from the uterine wall.

□ Other.....

Question 5:

Which statement is applicable for your usual cord clamping routine? (*Please tick as many boxes as apply*)

□ I do not have a specific reason for my cord clamping routine. This is the way I was taught to do it. I always do it like this.

□ I clamp the umbilical cord according to a protocol within my practice/department.

□ I clamp the umbilical cord to prevent polycythaemia and hyperbilirubinemia.

□ I wait as long as possible with clamping the umbilical cord; I am not worried about polycythaemia and hyperbilirubinemia.

□ I find it important to wait until the pulsations have ceased in the umbilical cord to optimize the blood supply to the neonate.

□ For me the administration of medication (e.g. oxytocin during Active management of third stage of labour) is a reason to clamp the cord.

□ Immediate cord clamping (ICC)

□ Bonding between mother/child

□ National protocol/guideline followed

□ Other…….

Question 6:

On which occasions would you clamp the cord **earlier** than you are used to? (*Please tick as many boxes as apply*)

□ Not applicable. I always clamp the cord immediately

□ The neonate has a low Apgar score

□ A lot of vaginal blood loss

□ A short umbilical cord

□ Hypothermia (low temperature) of the neonate

□ Nuchal cord (cord clamping inside the vulva)

□ Wish of the parents

□ When the pulsations have already ceased.

□ When the placenta has detached from the uterine wall or has already been born.

□ After administration of oxytocin or other uterotonic drugs

□ Low position of the infant (e.g. birth on a birth stool)

□ To prevent polycythaemia/hyperbilirubinemia

□ Other…….…….....

Question 7:

On which occasions would you clamp the cord **later** than you are used to? (*Please tick as many boxes as apply*)

□ Wish of the parents

□ The umbilical cord is still pulsating at the time where I usually clamp the umbilical cord.

□ The placenta is still attached to the uterine wall

□ The mother is breastfeeding

□ No vaginal blood loss

□ Not applicable

□ Other please specify…….…….……

Question 8:

Do you have **a set time** during a vaginal delivery for clamping the cord, if the neonate is **preterm**? (*Please tick one box*)

□ Yes, *go to question 8a*

□ No, *go to question 8b*

Question 8a:

If **YES,** please report when? (*Please tick one box*)

□ 0-30 seconds after birth

□ 30 seconds-1 minutes after birth

□ 1-2 minutes after birth

□ 2-3 minutes after birth

□ 4 – 10 minutes after birth

□ > 10 minutes after birth

□ I do not have a set time. I wait until the pulsations have ceased in the umbilical cord.

□ I do not have a set time. I wait until the placenta comes loose from the uterine wall.

□ Other.....

Question 8b: If you do not have a set time, when do you clamp the cord if the neonate is **preterm**? (*Please tick one box*)

□ 0-30 seconds after birth

□ 30 seconds-1 minute after birth

□ 1-2 minutes after birth

□ 2-3 minutes after birth

□ 4 – 10 minutes after birth

□ > 10 minutes after birth

□ I do not have a set time. I wait until the pulsations have ceased in the umbilical cord.

□ I do not have a set time. I wait until the placenta comes loose from the uterine wall.

□ Condition of the child

□ Gestational age

□ Other.....

Question 9:

What is the reason for clamping the cord at this time when the neonate is preterm? (*Please tick as many boxes as apply*)

□ I do not have a specific reason for my cord clamping routine. This is the way I was taught to do it. I always do it like this.

□ I clamp the umbilical cord according to a protocol within my practice/department.

□ I clamp the umbilical cord to prevent polycythaemia and hyperbilirubinemia.

□ I wait as long as possible with clamping the umbilical cord; I am not worried about polycythaemia and hyperbilirubinemia.

□ I find it important to wait until the pulsations have ceased in the umbilical cord to optimize the blood supply to the neonate.

□ For me the administration of medication (e.g. oxytocin during AMTSL) is a reason to clamp the cord.

□ For placental transfusion to occur (delayed cord clamping benefits are important)

□ To initiate early bonding between mother and child

□ I Follow National protocol/guidelines on umbilical cord clamping

□ 1Other…….

Question 10:

What cord clamping time do you use during a caesarean section? (*Please tick one box*)

□ I clamp the cord at the same time as during a vaginal delivery

□ I clamp the cord as soon as possible

□ Not applicable (as I am a midwife and am not responsible for cord clamping at caesarean section)

We thank you for answering this questionnaire.

c. Appendix C

Scoring for three guidelines using the AGREE II tool

Rating of the AGREE II items on the 7-point scale

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Grading of the scores

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

Maximum possible score = 7 (strongly agree) x 3 (items) x 1 (appraiser) = 21
Minimum possible score = 1 (strongly disagree) x 3 (items) x 1 (appraiser) = 3

ESSENTIAL NEWBORN CARE

Domain 1: Scope and Purpose

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{21 - 3}{21 - 3} = \frac{18}{18} \times 100$$

$$=100\%$$

Domain 2: Stakeholder Involvement

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{21 - 3}{21 - 3} = \frac{18}{18} \times 100$$

$$=100\%$$

Domain 3: Rigour of Development

Maximum Possible Score= 56

Minimum Possible Score= 8

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{54 - 8}{56 - 8} = \frac{46}{48} \times 100$$

$$=96.4\ \%$$

$$=96\%$$

Domain 4: Clarity of presentation

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{21 - 3}{21 - 3} = \frac{18}{18} \times 100$$

=100%

Domain 5: Applicability

Maximum Possible Score= 28

Minimum Possible Score= 4

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{16 - 4}{28 - 4} = \frac{12}{24} \times 100$$

=50 %

Domain 6: Editorial Independence

Maximum Possible Score= 14

Minimum Possible Score= 2

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{2 - 2}{14 - 2} = \frac{0}{12} \times 100$$

=0%

HELPING BABIES BREATHE

Domain 1: Scope and Purpose

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{21 - 3}{21 - 3} = \frac{18}{18} \times 100 = 100\%$$

Domain 2: Stakeholder Involvement

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{21 - 3}{21 - 3} = \frac{18}{18} \times 100 = 100\%$$

Domain 3: Rigour of Development

Maximum Possible Score= 56

Minimum Possible Score= 8

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

55 — 8

56 — 8

=47 × 100

48

=97.9%

=98%

Domain 4: Clarity of presentation

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

Obtained Score — Minimum possible score

Maximum possible Score — Minimum possible score

21 — 3

21 — 3

=18 × 100

18

=100%

Domain 5: Applicability

Maximum Possible Score= 28

Minimum Possible Score= 4

Scoring

Obtained Score — Minimum possible score

Maximum possible Score — Minimum possible score

22 — 4

28 — 4

=18 × 100

24

=75%

Domain 6: Editorial Independence

Maximum Possible Score= 14

Minimum Possible Score= 2

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{2 - 2}{14 - 2}$$

$$= \frac{0}{12} \times 100$$

$$= 0\%$$

NEONATAL PROTOCOLS

Domain 1: Scope and Purpose

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{21 - 3}{21 - 3}$$

$$= \frac{18}{18} \times 100$$

$$= 100\%$$

Domain 2: Stakeholder Involvement

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{21 - 3}{21 - 3} = \frac{18}{18} \times 100$$

$$=100\%$$

Domain 3: Rigour of Development

Maximum Possible Score= 56

Minimum Possible Score= 8

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{43 - 8}{56 - 8} = \frac{35}{48} \times 100$$

$$=72.9\ \%$$

$$=73\%$$

Domain 4: Clarity of presentation

Maximum Possible Score= 21

Minimum Possible Score= 3

Scoring

$$\frac{\text{Obtained Score} - \text{Minimum possible score}}{\text{Maximum possible Score} - \text{Minimum possible score}}$$

$$\frac{21 - 3}{21 - 3} = \frac{18}{18} \times 100$$

18

=100%

Domain 5: Applicability

Maximum Possible Score= 28

Minimum Possible Score= 4

Scoring

Obtained Score— Minimum possible score

Maximum possible Score— Minimum possible score

14 — 4

28 — 4

=10 × 100

24

=41.6 %

=42%

Domain 6: Editorial Independence

Maximum Possible Score= 14

Minimum Possible Score= 2

Scoring

Obtained Score— Minimum possible score

Maximum possible Score— Minimum possible score

2 — 2

14 — 2

=0 × 100

12

=0%

d. APPENDIX D

Supporting Documents

Research Integrity Certificates

Certificate of Completion for Module 1 – FORUMUTS22 4/18/18, 11:40 AM

UTS

Graduate Research School

Research Integrity for Students

Certificate of Completion

This is to certify that

Bupe Mwamba

has successfully completed

Module 1: Research Integrity and Code of Conduct

Production Note:
Signature removed
prior to publication.

Professor Lori Lockyer,
Dean, Graduate Research School

University of Technology Sydney

Date: *18/04/2018*

https://online.uts.edu.au/webapps/gu-certofcomp-bb_bb60/index.jsp?course_id=_28251_1&content_id=_1460705_1 Page 1 of 2

Research Integrity for Students

Certificate of Completion

This is to certify that

Bupe Mwamba

has successfully completed

Module 2: Plagiarism and Misconduct
Module 3: Risk Assessment
Module 4: Risk Management and Health & Safety
Module 5: Project Management

Production Note:
Signature removed
prior to publication.

Professor Lori Lockyer,
Dean, Graduate Research School

University of Technology Sydney

Date: *07/03/2019*

Conference Presentations

32nd ICM Triennial Congress
Indonesia 21-25 June 2020
Midwives of the World: delivering the future

Dear Ms. Bupe Mwamba,

Congratulations! We are pleased to inform you that your abstract ICMBALI-0215 *A descriptive study of umbilical cord clamping practices by midwives, obstetricians and other medical officers working in birth units across Zambia* has been accepted as a **Three-minute research or practice innovation** presentation at the **32nd ICM Triennial Congress**, which is being held in Bali, Indonesia, 21 – 25 June 2020.

The aim of these sessions is to provide the audience with an opportunity to experience a very short presentation that is delivered in an engaging way. It is important that you condense your ideas and focus sharply on your main message.

We stress that you will have **no longer than 3-minutes to do this presentation**.

We will send you further instructions in a future email. We expect to publish the detailed program during January 2020.

REGISTRATION

Please take advantage of early bird conference rates **by registering online by 1 November 2019**, at https://www.midwives2020.org/registration. **Presenting authors must be registered for the Congress by that day.** If you do not register by this date, your presentation opportunity will be offered to another author.

PRACTICAL INFORMATION

For your information: If you wish to reserve a guestroom in one of the nearest hotels, please have a look at the congress website at https://www.midwives2020.org/content/hotels.

Don't forget to visit our website for updates on our Program and Speakers. We look forward to seeing you in Bali.

Should you have any doubts or questions, please don't hesitate to contact the ICM 2020 Congress Secretatiat at abstracts@midwives2020.org.

Respectfully,

Debrah Lewis and Marian van Huis

Co-Chairs, Scientific Professional Programme Committee

32nd ICM Triennial Congress

La version francaise est disponible ci=dessous

Dear Ms. Bupe Mwamba,

Some of the **ICM Africa Regional Conference** presenters agreed to share their presentation slides with the conference delegates - you'll find them at this link.

With kind regards

Hana Ledvinková

ICM Africa Regional Conference Secretariat

abstracts@midwivesnamibia2019.org

Cher(e) Ms. Bupe Mwamba,

Certains orateurs de la **Conférence Régionale pour l'Afrique de l'ICM** ont accepté de partager leurs diapositives avec les délégués de la Conférence - vous les trouverez en cliquant sur ce lien.

Cordialement,

Hana Ledvinková

Secrétariat de la Conférence Régionale pour l'Afrique de l'ICM

abstracts@midwivesnamibia2019.org

e. Appendix E

Sample of the ZOOM interview transcript

BM: What is your usual umbilical cord clamping practice?

SH: Okay. First of all, when a woman is fully dilated, we normally double-glove, sterile gloves. So when the baby is delivered, we usually remove one pair of gloves to maintain sterility. Then after that, we clamp through cord clamps. But then before we clamp, we usually wait. If the baby doesn't need resuscitation and the mother is not bleeding heavily, we usually delay not less than one minute earliest.

So after one minute, that's when we clamp with the pair of gloves. We clamp and then we put the baby on the abdomen. If the baby will need resuscitation, we don't usually delay the cord clamping. We just usually go to resuscitation.

BM: Oh, great. That's very interesting. And so have you always done your cord clamping like that?

SH: Usually, it depends. If it's an emergency, probably, we won't delay.

BM: Oh, okay.

SH: Yes.

BM: That's very interesting.

SH: And sometimes, women come fully dilated because I work in a rural. Before you even double-glove, the baby is out. So sometimes, it's compromised.

BM: I totally understand. So you've mentioned something that is very interesting. Being a rural health centre, you would have women coming in full dilation and before you even glove up, the woman would have already delivered. So does that mean they just deliver on the floor or what really happens in that scenario?

SH: Yeah. We'll make sure at least they are on the bed.

BM: Okay. So you rush them on the bed?

SH: Yes. Yes.

BM: Okay. That's lovely. And so you have also mentioned that in babies needing resuscitation and in an emergency, you don't do delayed cord clamping. Do you mind telling me more about that?

SH: Okay. So for babies that will need resuscitation, like in fetal distress, we want to deliver them very fast and resuscitate the baby because the same one minute is the golden minute that you would want to resuscitate the baby in the same one minute. So we don't want to delay cord clamping, but we'll go straight to clamp and resuscitate the baby in the same one minute.

BM: Oh, great. And so does this mean that resuscitation is usually done far away from the bedside?

SH: Not really. They resuscitate just nearby the beds.

BM: Okay. And so it's just that you wouldn't want to resuscitate with the intact cord, that's why you have to cut and clamp? Don't you think the baby may benefit from delaying clamping of the baby.

SH: Yes, the focus is to resuscitate the baby not delayed cord clamping.

BM: Okay. I see. That's very interesting.

SH: Yes.

BM: Yeah. And how many midwives do you have in your labour ward (birth unit)?

SH: We're about eight.

BM: Oh, interesting. So are you aware of what they do when the baby is born? What practice do they do?

SH: It's very difficult because most of the time, we're overwhelmed. We usually just work one-one on shifts, including night duty, of which my ward has got a lot of wards in it. I've got postnatal, antenatal, I've got neonatal. So watching others is not possible

BM: Really?

SH: I guess. Yes.

BM: I see. So you haven't had time to just observe on what others are doing, so you don't know what type of practice they are doing, if they are doing delayed cord clamping or immediate cord clamping.

SH: Yeah. I have had few moments where I have observed few, what I can say is that most people are practising a delay of 60 seconds. We have even discussed it in meetings, we usually have meetings where we discussed on care and we have discussed delayed cord clamping as well. In a month, we would schedule a meeting once in a month. But if maybe we had the MSB or fresh SB, we would want to have it as soon as possible so that we discuss what went wrong

for quality improvement. So while having those meetings, we bring up all those things.

BM: Okay. So can I say that everybody in your birth unit or your labour ward, practises a delay of at least 60 seconds?

SH: Yes, that one I am certain.

BM: Okay. And so what are your views about the best time to clamp the cord?

SH: I think one to three minutes is okay, but at least not less than one minute.

BM: Great. So that's very interesting. So you said one to three minutes, right?

SH: Yes. Others, we'll encourage it to stay at least when the cord stops pulsating.

BM: Great, so what about your personal position towards the actual practice, what do you think is the best time?

SH: Not less than one minute. I think very few people would take one to three minutes. So at least not less than one minute, which is 30 to 60 seconds.

BM: Okay. So why do you think that's the best time? Are there any benefits to the baby, to the mother?

SH: Yeah. I think most of the benefits will go to the baby.

BM: And what benefit are those?

SH: I think it's good for better establishment of the red blood cells. Also, if the baby has got a good Haemoglobin they will not need any blood transfusion, there will be decreased need for blood transfusion.

BM: Perfect. That's very true and very important points that you just mentioned. I just want to find out about your decision to clamp the cord. So what has influenced your decision? What makes you clamp at one minute and not just immediately? What factors have influenced your decision-making about when to clamp the cord?

SH: I think looking at the benefits, they are the ones which makes me delay in cord clamping because I think most of the babies, those who, let's say, were born before they arrived at the hospital, most of them, you'll see that maybe when they come for postnatal review, they normally don't put on weight so easily compared with those who had delayed cord clamping done at the facility.

Maybe the cord wasn't handled very nicely. Most of the time, they would have infection, which would lead even to a reduction in Haemoglobin. But for me, what I've seen, almost all the babies that have used this practice, they are doing fine. We've never transfused blood. They're doing fine, increasing weight nicely. I never had all those complications.

BM: Well, that's good to hear. And so one thing that I've picked out is the factors that have influenced your decision is the benefits that come with delayed cord clamping. And so you've mentioned that the other babies that are born before arrival or born at home, they rarely receive those benefits.

And you've seen some complications with regards to sepsis and even lower weight gain. So I just want to find out, you have mentioned that you have a neonatal ward in your labour ward. Do you have incubators? Do you have cots? How do you manage them? How do you manage the space?

SH: It's just a small space. We usually just accommodate about two and we only have one incubator. So if babies are more than that, we usually just transfer. We only keep those babies who are not very sick. Or if we stabilize them and they will need a specialist, we usually take them to Ndola, UTH.

BM: Oh, that's very interesting to learn about that. Yeah. That's very recommendable that even if it's a small space, at least you have somewhere where you can put the stable babies, isn't it, as they're probably waiting for women to recover.

Tell me, will you continue doing delayed cord clamping in the near future? Are you planning to continue or do you intend to get back to immediate cord clamping?

SH: I think I'll continue. And I will encourage most of my fellow midwives and other nurses who practise midwifery to continue with delayed cord clamping.

BM: Perfect. So you've mentioned that you have nurses that are working in your labour ward, right, that practise midwifery but they're just nurses?

SH: Yes and mostly outside the catchment areas. Usually, if there are complications, they'll usually call. We go and speak with the client or the patient with an ambulance and bring them to the hospital. But if everything is okay, the nurses usually deliver them from there.

BM: Oh, wonderful. And so they just use the general nursing training experience, right?

SH: Yes, yes.

BM: This means that you have got a big task of orienting and mentoring non midwives on management of women in labour isn't it?

SH: Yes.

BM: I just want to find out about the actual procedure, how do you go about doing delayed cord clamping?

SH: We usually prepare a sterile delivery pack. You prepare the baby layette. You make sure the woman is comfortable where she's sleeping, once the membranes rupture, at least you change where they are sleeping so that you have at least a safe and clean delivery. So before the baby is born, you prepare all the things. The cord clamp is usually in the sterile pack. So you double-glove and after the baby is born, you delay the clamping and the baby is placed on the abdomen, that is if the cord is long enough. But if the cord is short, we just usually put in between the thighs of the woman because it can snap. If the cord is long, you put the baby on the mother's abdomen for bonding. Then you wait for that 60 seconds or one minute, then you put two clamps using the forceps, you clamp, and cut. Then again, you get the cord clamp and put at least two to three centimetres from the abdomen or the skin from the baby. And you put your cord clamp. And you show the baby to the mother and you wrap the baby up.

BM: Great.

SH: But we are mindful that we change the pair of gloves just after delivery because most of the time, it's already contaminated with all those stuff which are there when the mother was fully dilated. So at least you remove the first pair of gloves and remain with the one which is sterile.

BM: Great. That's perfect. And that's excellent. Keep it up. So I just wanted to find out - not sure if you may know though. Are there conflicting beliefs amongst your colleagues about the use of delayed cord clamping? Have they accepted the practice or are there any issues with the practice of delayed cord clamping among your other midwives?

SH: I think because of the meetings, people are coming to accept it. Although sometimes, they'll say there are risks of delayed cord clamping like the baby may develop jaundice because the liver becomes overwhelmed because of the blood. But otherwise, I usually weigh the benefits. Probably the baby will benefit more from delayed cord clamping. Very few will have jaundice.

BM: Wonderful. I like it that you have those meetings and if somebody is having conflicting beliefs on delayed cord clamping, then you discuss them. And indeed, there has been those studies that have been done that have confirmed that there could be more jaundice if delayed cord clamping is practised and polycythaemia. But they've confirmed that that jaundice and polycythaemia is

physiological. So meaning even if the baby has been delivered immediately or delayed, they can still develop jaundice and polycythaemia.

SH: Yes, yes.

BM: Because of the changes that occur after birth. The babies are born with a higher haemoglobin level and the liver is quite immature. So in trying to haemolyse the red blood cells, then that haemolysis results in polycythaemia and subsequently, jaundice. But it's not something to worry about. Just like you have said, our main concern are the benefits.

And if we can just delay for that one to three minutes, we are reducing the chances of the lifetime risk of anaemia because remember, the 1,000 days of life are very important. So that's very good. And keep it up on that one and keep encouraging them.

I'll try and see if I can share some information that I have like some readings that you can go through and just have a clear picture with regards to the issues of jaundice and polycythaemia. And I know that is a real argument among midwives. Yeah. So thank you very much about that confirmation.

SH: Thank you.

BM: Yeah. And so do you have enough resources? Do you have guidelines on delayed cord clamping? Or what do you use? Are you able to refer to something when working or how has been your practice?

SH: I think now, we need to write up something like we've put for magnesium sulphate. Otherwise we did not have any written document. I will work on it and have it stuck so that everyone remembers to do what they're supposed to do like we do for magnesium sulphate.

BM: So how did you change from immediate to delayed, where did you learn about delayed cord clamping?

SH: A visiting doctor gave a presentation on the benefits that is what led me to change.

BM: Great

BM: And so has there been a time when you had to implement a new program, any program, not just on cord clamping, but any program in your labour ward? Have you had such a moment?

SH: I think we are now doing DBS, that's how the baby is born from a PMTCT mother. We are getting the DBS there and then. We are not waiting.

BM: Great. So when did you start that DBS program?

SH: I think less than a year ago. It should be less than a year.

BM: Oh, great. So can you tell me more? How did you come on board? Did somebody come to teach you? Were you taught as a group or one person was taught and then the person went ahead and demonstrated to others? Or how did it happen?

SH: Yes. Actually, I was on leave. So when I went back, I found that we're doing DBS. Then I was told we've changed. We're not waiting for when they go for postnatal activities, that's when we do DBS. Now, we are doing DBS just after the baby is born.

So before discharge, we have to do DBS. So one went for a workshop. I think our nursing officer went for workshop. She's the one who oriented the other midwives.

BM: And then when you went after leave, the other midwives oriented you?

SH: Yes. Yes.

BM: Oh, great. So was it easy to implement? Did everybody just agree or was it easy to implement, did people just accept the change? Or were there difficulties encountered in which others did not accept it? How has been the practice?

SH: No, it is not easy but we just keep reminding each other. That's a good part of handover. So when you're giving handover, you say, "No, this mother is on ART." Then someone will ask, "Oh, did you do DBS?" You say, "No." "Okay. I will do it for you. So next time, do this and that."

So we remind each other. So it's not most of the time that you would remember, especially now that our ward is so overwhelming, so we remind each other, especially during handover time.

BM: Perfect. And so you've mentioned that your ward is very busy. How many deliveries do you conduct per day, approximately?

SH: Maybe in my shift, especially in the night, sometimes we'd have seven. That's the maximum. Yes. So I think during the day, we'd have maybe four. In those four, maybe there are even caesarean section. Even in the night, there are referrals. So it's not even just deliveries alone. We even have a gynaecological clinic, you can imagine.

BM: In the same place?

SH: Yes.

BM: I can't even imagine. How big is it? How many beds? How many beds are in your labour ward?

SH: Our labour ward has got three. Actually, they are renovating it now. We had the space of three, so sometimes you have all the three beds occupied. So now, they have extended our labour ward. We are yet to shift. So the room that we are using, we only have three beds like we used to have. So I think the new place is bigger. Probably, it would have maybe six days.

BM: Okay. And then it's connected to a postnatal? How many beds is postnatal?

SH: Yes.

SH: In postnatal, we have six. We have six beds. In the gynaecological ward, we have seven beds. Antenatal, we have a lot, I think about 10 beds. Then we even have the Caesarean section room that's got about six beds.

BM: And you're only one per shift or two.

SH: Yes. Mostly one.

BM: Okay. I can imagine that because when I worked at UTH after finishing my midwifery, 2009, at least, the wards were bigger and would have a total of 80 post and antenatal mothers. But at least that was postnatal and antenatal women, both those that have Caesars and everything. So I can just imagine your situation. But maybe one day, I'll come and see it in the near future.

SH: Yes, you should.

BM: Because I can't just imagine that you do everything and alone. You are angels.

SH: Yes, we do it.

BM: Because labour ward, antenatal, postnatal and neonatal, everything, one midwife-

SH: Yes.

BM: You're really angels. Keep it up the good work. Yeah.

SH: Thank you.

BM: Yeah. That's very interesting to learn. Extremely interesting. I cannot just imagine handling everything alone.

SH: You can imagine.

BM: It's just so much work. But keep it up for your hard work.

SH: Thank you.

BM: Yeah. So what motivated you to change the practice? What motivated you to change the practice? And by the way, did we even discuss about this? So have you always been practising delayed cord clamping or was there a time when you were doing immediate cord clamping and then you changed into delayed cord clamping?

SH: Yeah. There was a time we were just not doing the [delayed] cord clamping. Yes.

BM: Oh, great. So what made you change from immediate to delayed?

SH: I think I was reading somewhere. I was reading somewhere then we went to a workshop on EmONC but that was a long time. Then they didn't really implement it, but they were just talking about it. Then now, when we went I went to Ndola where we usually take referrals. I found I don't know if it was a midwife or a gynaecologist. They were talking about it. So I got interested. So when I was taking the referral, I was giving handovers and all that. Then they were teaching some students, then they even mentioned about delayed cord clamping. So I got interested.

Then another gynaecologist came from UTH from Ndola rather, then they told us about an app. There's an app for most of the midwifery things, but they are summarized. In case you are alone, you need this, this and that. Yes. So I saw it there, then I read about it. Then during our meetings, the doctor mentioned it, the nursing officer mentioned it. It was like, "Oh, okay."

That's why now, everyone started. Though it took time for us to start practising this, but then eventually, we got used to it because now, we have students also. So when the students come and then you're not practising this, what are they going to take? And then they are the same people that will be deployed in the rural areas where you go and get patients. So if they don't learn, if I'm not practising and they don't know anything they, they will not know when they start practising. So it has made us also to be practising because of these students that we receive, if they don't learn it from us, they won't learn anywhere else.

BM: Oh, perfect. That's very interesting. So when did you start practising delayed cord clamping?

SH: I think it was last year (2019)? Last year or this year? If it's not late last year, it should be early this year (2020).

BM: Oh, great.

SH: So it's not for long a long time.

BM: That's very interesting and good to hear that you learned it when you went to Ndola and got interested and read through, and then there was a gynaecologist who came in with an app and all of that information, which is absolutely good.

And it just shows how passionate you are about the mothers and the babies that you care for. And so what really motivated you to practise delayed cord clamping? And what will help you sustain the practice?

SH: Definitely, the benefits.

BM: Great. Whose benefits?

SH: The benefits, to the baby. More blood for prevention of infection, anaemia etc.

BM: Perfect. And it's the benefits that will help you sustain the practice, right?

SH: Yes, yes, yes.

BM: Wonderful. Yeah, that's very interesting to learn and keep it up the hard work.

SH: Thank you.

BM: Yeah. It just shows that you're so passionate about what you do because you just go, you learn about something, then get back implement it. And then you're also concerned about the students that come in your care to see if you are not using the updated information with regards to actual practices, these are the people that are our future nurses. So they have to get the current evidence on cord clamping. So, yeah.

SH: Yeah, exactly.

BM: Thank you very much for the information. I don't know if you have any other information that you would want to share with me with regards to cord clamping?

SH: No. Not really. Our main emphasis now is during antenatal, we usually tell the mothers not to put anything on the cord, especially when they deliver from home. So we make sure they have a new razor blade so that just in case you're coming ... because sometimes people come from very far away. Maybe they are coming to the hospital and maybe along the way, they deliver.

At least they would have a clean razor blade rather than just picking up anything to cut the cord. It causes infection to the baby. So our emphasis is on

antenatal mothers to go early to the clinic when they just see the signs of labour or come to the hospital as soon as possible. We are discouraging home deliveries and all those.

BM: Perfect. So that's very interesting. So two things that I've picked out from the conversation. So the first one is just a question. So when they are coming to deliver, then they bring their own blades for cutting the cord or it has to be the baby layette? Do you also tell them about delayed cord clamping antenatal?

SH: Normally, the razor blade, we'll just tell them to buy. We usually have our own things to use. Now, just in case yes. So it's just in case, you just have to have it. No, we do not tell them about delayed cord clamping.

BM: To have something just in case they even deliver at home or on the way, then they'll have what to use. I see.

SH: Yes.

BM: Oh, great. So it's for emergency preparedness. So then the other thing that you mentioned is the involvement of antenatal women when you teach them about cord care and all of that. I'm just wondering probably if you can start up conversations with regard to delayed cord clamping antenatally. Remember when we teach them something, they can demand for it.

So in case they don't come to your hospital for delivery, wherever they go, if they were taught antenatally, they'll be able to demand it. What do you think? I don't know if you can consider teaching antenatal women the benefits of delayed cord clamping and the new practice so that they can be aware to say, "When you come to the labour ward, we're not going to rush cutting the cord.

We'll wait so that more blood moves from the placenta to the baby so that the baby can have all the benefits of the blood, the nutrients, and all the oxygen that goes through the red blood cells." So how do you look at that?

SH: That's a very good idea. I think we'll need to do that too. We'll need to do that. And surely, we will.

BM: Great. Yeah. Thank you very much. It's just something that popped up when you mentioned the issue of antenatal women being taught on cord care. And it's something that is very good because once they start putting the other things, there's usually sepsis that comes. So keep it up with the good work. And so probably, I'll try and send some reading if I don't manage today because this is 2:20pm.

I'm still at school, but I'll just go home to just eat and dress. So if I find time during the week, I'll send you some things that you can read through just to have that understanding. Yeah. So thank you very much for your time. So I

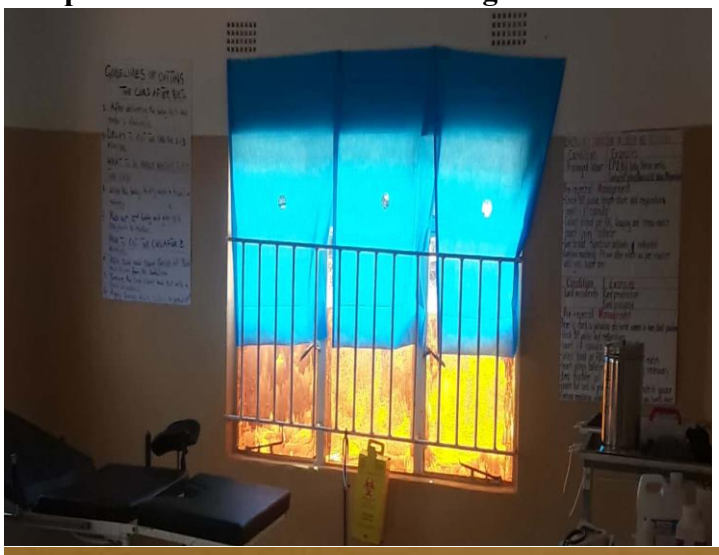
want to stop sharing so that we can have a conversation just on delayed cord clamping so that we can have more information.

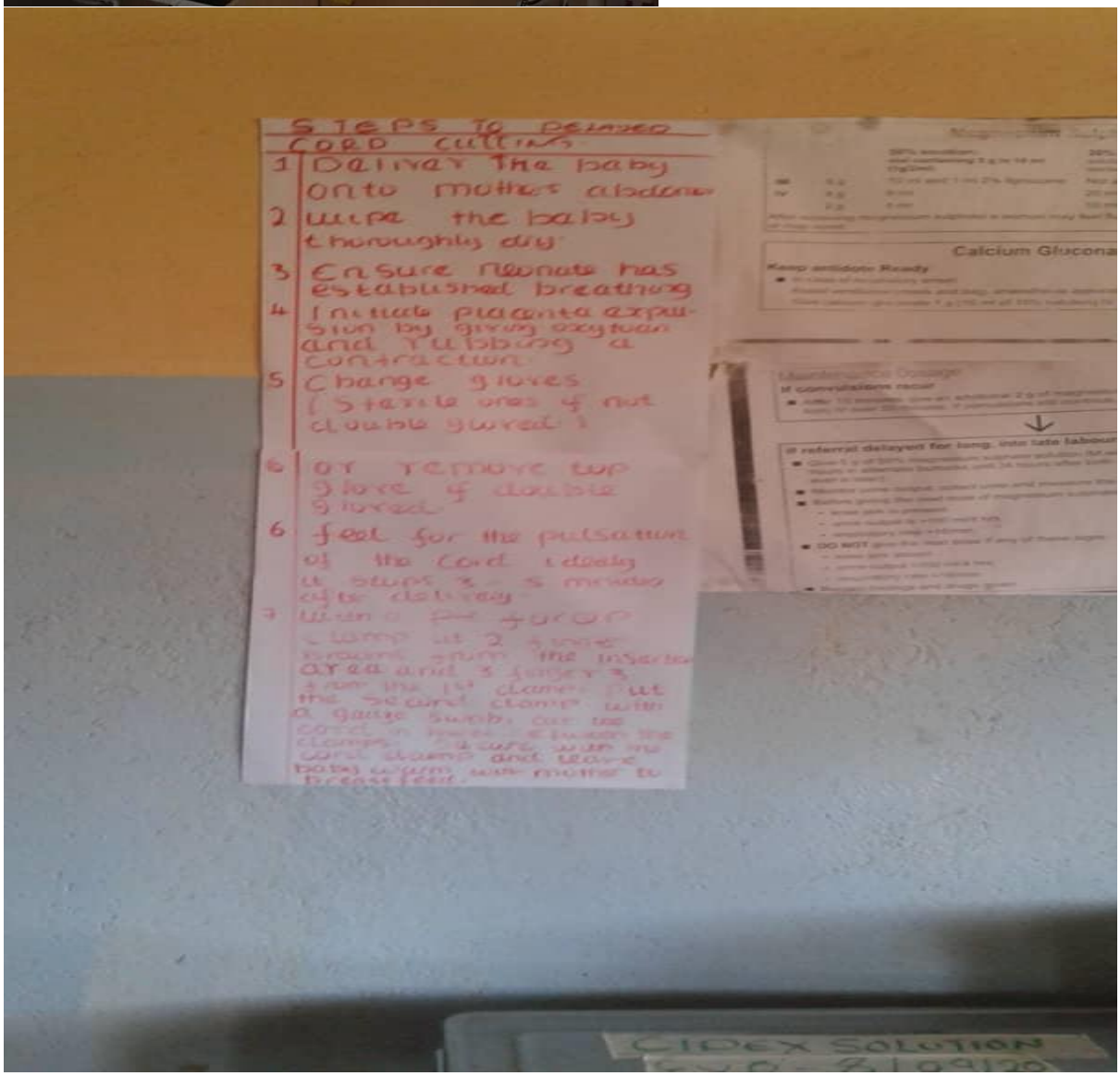
SH: It's all right. All right.

BM: Thank you very much for your time and have a blessed day.

f. Appendix F

Samples of submitted handwritten guidelines





CORD CLUMPING PROTOCOLS 2019

NORMAL BABY AND MOTHER

for Improved infant and Maternal well being **WHO** Recommends that Cord Clumping should be **DELAYED** from **1-3** minutes even up to **5** minutes as it has a positive effect on the brain structure of the newborn.

N.B If the infant requires agent Resuscitation, clump immediately after 1 minute to allow for Resuscitation.

- If the mother requires urgent attention also Clump Immediately after birth and attend to the mother.
- Cut the cord 3-5cm away from the baby. It can even be up to 7.5cm away from the baby.

g. Appendix G

Publication Plan

Upon submission of the thesis, we will embark on publications and we intend to publish a number of articles from the thesis as part of the dissemination process as follows:

- A survey of current delayed cord clamping practice in Zambia
- An exploratory qualitative study of the factors influencing umbilical cord clamping practices by Maternity Health Care providers in Zambia
- The discussion chapter of the thesis, which was the integration of the three phases