INTELLIGENT STRUCTURED INTERMITTENT AUSCULTATION (ISIA):
A MIXED METHODS EVALUATION OF AN INFORMED DECISION- MAKING
FRAMEWORK FOR FETAL HEART RATE MONITORING

BY

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Abstract

Intermittent Auscultation (IA) of the fetal heart (FH) is a screening tool for the assessment of fetal well-being during labour; the detection of changes in the FH rate and rhythm may signal fetal compromise. While the evidence reveals that IA is as effective as continuous cardiotocography (CTG) for FH monitoring for low-risk women, current practitioners favour the use of continuous CTG despite the risk of significantly increased maternal and fetal morbidity. Translating the knowledge of the effectiveness of IA into practice became the primary aim of this study.

While auscultation and palpation are essential midwifery skills, the teaching of IA does not go beyond simply outlining the protocol for frequency, duration, and timing and less is understood about the underlying physiology associated with what is heard and the reassurance of fetal wellbeing that this provides. A knowledge translation intervention, in the form of an evidence-based informed decision-making framework for Intelligent Structured Intermittent Auscultation (ISIA) and a comprehensive educational intervention were developed to enhance midwives' knowledge and awareness of IA and to influence decision-making and practice for FH monitoring for low-risk women.

A mixed methods non-experimental pre- and post - intervention study design was used to evaluate the knowledge intervention. Pre measures included a retrospective review of 511 medical records to assess existing FH monitoring practices, and focus groups with 14 midwives explored barriers and facilitators to the use of IA. The intervention was then delivered to a mix of 33 midwives and doctors three months later, followed by a second review of 422 medical records and focus groups with seven midwives to determine any changes in practice and to evaluate outcomes. The findings revealed a statistically significant increase in the use of ISIA

with improved documentation, and a relative decrease of 14% in the use an admission CTG for low risk women. The ISIA framework has wide applicability in all maternity settings.

This research has illuminated the effects of culture, organisation and the socio-political context on the ability for midwives to utilise their fundamental midwifery skills to promote, facilitate and protect normal physiological birth in the institutional maternity care setting. Engagement with a Knowledge Translation project and the introduction of the ISIA framework for FHR monitoring for low risk women has given midwives voice to generate change.

Keywords: intermittent auscultation, fetal heart rate monitoring, midwifery practice, decision-making, clinical, knowledge translation, mixed methods

Acknowledgements

Sitting in my office at home, gazing out onto a landscape bathed in the sunshine of the sixth summer of my journey to bring this thesis to a conclusion, I ponder all the people and circumstances that have enabled and empowered me to reach this point. I would be easy to use pregnancy, labour, and birth as a metaphor for this journey. Many have already, as these comments from my supporters on Facebook demonstrated when I sought inspiration from them to keep going (maybe you're transitional? Push on through. You can do it. We believe in you. . . . it hurts like hell but very soon you're gonna push that thesis right out and it will all be worth it!). Thank you to all of you for saying the right things at the time I needed it most. To recognise and acknowledge the support I have received, I will instead think of my journey as seasons of transition.

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Abbreviations

AAT	Auscultated acceleration test
ACNM	American College of Nurse Midwives
ACOG	American College of Obstetricians and Gynaecologists'
ARM	Artificial rupture of the membranes
AWHONN	Association of Women's Health, Obstetric and Neonatal Nurses
BP	Blood Pressure
CEFM	Continuous Electronic Fetal Monitoring
CESDI	Confidential Enquiry into Stillbirths and Deaths in Infancy
CMM	Charge Midwife Manager
CP	Cerebral Palsy
CS	Caesarean Section
CTG	Cardiotocograph
DHB	District Health Board
EBP	Evidence-based practice
EFM	Electronic Fetal Monitoring
FBS	Fetal Blood Sampling

FH	Fetal Heart
FHR	Fetal Heart Rate
FM	Fetal Movements
FTE	Full time equivalent
HDC	Health and Disability Commissioner
HDCA	Health and Disability Commissioner Act 1994
HMW	Hospital-employed midwives
IA	Intermittent Auscultation
ISIA	Intelligent Structured Intermittent Auscultation
ISIA	Intelligent Structured Intermittent Auscultation
IUGR	Intrauterine Growth Restriction
K2	On-line fetal surveillance programme
KT	Knowledge Translation
KTA	Knowledge-to-Action
LMC	Lead Maternity Carer
ME	Midwife Educator
NICE	National Institute for Health & Clinical Excellence
NICU	Neonatal Intensive Care Unit

NST	Non-Stress Test
NZCOM	New Zealand College of Midwives
OMRU	Ottawa Model of Research Use
PARiHS	Promoting Action on Research in Health Services
PHO	Primary Health Organisation
PRECEED	Predisposing, Reinforcing, Enabling Construct in Educational Diagnosis and Evaluation
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
RCM	Royal College of Midwives
RCOG	Royal College of Obstetricians and Gynaecologists
RCT	Randomised Controlled Trial
RMRR	Retrospective Medical Record Review
SAN	Sino-Atrial Node
SCBU	Special Care Baby Unit
SEMW	Self-employed Midwife
SOGC	Society of Obstetrician and Gynaecologists of Canada

Chapter One: Introduction – Identifying the Clinical Problem

1.0: Introduction

The monitoring of fetal¹ well-being during labour and birth is a central component of modern day midwifery care. Listening to and counting the sounds of the fetal heart beating is a monitoring technique known as intermittent auscultation (IA). The clinical practice of IA is a fundamental midwifery skill: a prerequisite for keeping birth normal. IA requires the midwife to remain close by the woman throughout labour and to be in physical contact in order to monitor the baby, as is clearly illustrated in Figure 1.1 below. IA requires effective communication as well as the ability to listen carefully and interpret what is heard. IA is a skill that is rapidly disappearing from midwifery practice because of the preferential application of an electronic and continuous means of listening to the fetal heart using a cardiotocograph (CTG) machine. This thesis argues that the practice of IA needs to be reinstated as a valid and reliable midwifery skill and presents a decision-making framework informed by evidence that sets this process in motion. A mixed methods study was conducted to determine whether the decision-making framework helped midwives in a New Zealand maternity setting to translate knowledge of the safety of IA into their midwifery practice. This study revealed that IA can be reclaimed as a fundamental midwifery skill.

¹ Fetal refers to the unborn baby—the period of intrauterine life from conception to approximately 40 weeks gestation. In the literature, the spelling is foetal or even foetal in some very early texts. For convenience, I will use fetal throughout this document.

Figure 1.1. Auscultation of the Fetal Heart Sounds with a Pinard stethoscope.

Source: Robyn Maude, 2008, permission granted.

This first chapter of the thesis establishes the pervasive nature of the clinical problem, which is that the practice of IA is under threat. There is evidence that from 1980 to 2006, in the USA and Canada, the use of electronic fetal monitoring (EFM) during labour has climbed from 62% to around 93% (Feinstein, Sprague and Trépanier, 2008; SOGC-BCPHP, 2008). As a result, women are unnecessarily exposed to a fetal well-being monitoring modality that has a high rate of error; falsely identifying that the fetus is in trouble. At the same time the woman's ability to mobilise is reduced and her family and caregivers are distanced from providing her with physical support as the focus of their attention shifts from the woman to the machine (Hindley, Hinsliff and Thomson, 2006; Tillett, 2007). Additionally, women's confidence in their ability to give birth safely without the aid of medical intervention is undermined and midwives feel threatened to conform to using a machine that distances them from personal support of the woman and baby (Hindley et al., 2006).

In the following pages I describe the central position of IA as an essential midwifery skill that underpins the process of keeping birth normal. This then enables a discussion of the issue of concern for this thesis, which is the gradual disappearance of IA from midwifery practice in favour of continuous electronic monitoring of the fetal heart during labour and birth. Evidence is presented from recent studies and from anecdotal conversations among the international midwifery community, and from my role as an expert midwifery advisor, to support the concern felt within the profession about the erosion of the practice of IA and the skill required to practice IA safely. I begin by positioning myself within the work of this thesis and reveal why IA is an issue of concern to me personally and professionally. Two recent stories from midwifery practice also provide insights into the central role of IA in keeping birth normal.

1.1 My Interest in the Issue of IA

The impetus for this research arose from my personal experience as a midwifery expert clinical advisor for a number of legal and regulatory authorities. Almost without exception the cases for which I provide expert midwifery opinion involve some aspect of fetal heart monitoring, including: a lack of appropriate monitoring during labour; unmet standards and low quality of monitoring; failure to interpret the findings of fetal heart monitoring in an accurate and timely manner; and inability to appropriately identify fetal distress, requiring immediate delivery of the baby. Over many years of reporting on such instances of inadequate monitoring practice I formed the opinion that I needed to investigate the issue more carefully and, if possible, make a difference to practice.

Underpinning my ambition to explore these matters was a belief in birth as a normal life event for the majority of women, and a personal need to consciously

respond as a guardian of normal birth in a climate of soaring intervention rates (McAra-Couper, Jones and Smythe, 2010), active management of birth by doctors and midwives, and increased reliance on technology. In their qualitative study investigating rising rates of intervention in childbirth, McAra-Couper et al., (2010) found “that the everyday world and its associated processes of socialization in the 21st century – in particular pain, choice, and technology – shape the practice of health professionals and the understanding of the public in relation to increasing intervention” (p.163).

The knowledge that midwives were becoming more and more drawn into the cascade of interventions increased the urgency of my need to undertake research into fetal monitoring. It is my belief that choice of monitoring modality is a decision that needs to be made in partnership with the well-informed woman. There is growing evidence that the form of monitoring is an intervention that has potential consequences for women, babies and midwives that need to be taken into account. In the following section I reveal the moral and ethical decision-making challenges presented to mothers and midwives on choice of monitoring modality and illustrate this issue by presenting two stories from practice.

1.2 Fetal Monitoring Choices: A Moral and Ethical Dilemma

The choice of fetal monitoring modality for high-risk women is usually limited; continuous EFM is recommended where there is a high likelihood that the fetus may become hypoxic during labour (Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG), 2006; National Institute for Health &

Clinical Excellence (NICE), 2007). For low-risk women² the choices are greater and it is in this situation that midwives face a moral conundrum around fetal heart monitoring, particularly in the hospital setting (Wood, 2003). The model of care, place of birth and decision-making frameworks influence choices around fetal heart monitoring for this group of low-risk women and ultimately may influence the outcomes of the labour and birth. The conundrum is illustrated in the stories of two New Zealand women, Christina and Susan, which I reveal below.

First, a description of the context of care for these two women is required in order to provide the reader with insights into the particular model of maternity care in New Zealand: a model that is founded on partnership between women and their care providers and informed choice for decision-making. In New Zealand all women have a named lead maternity carer (LMC) who coordinates all of their maternity care. Most women (85%) have a midwife LMC providing continuity of care throughout pregnancy, labour and birth and up to six weeks postnatally (New Zealand College of Midwives (NZCOM), 2010). LMC midwives (case loading³) may be employed by a hospital or Primary Health Organisation (PHO), or a private provider, or may be self-employed and based in the community. Most self-employed midwife LMCs are part of

² In regard to the terminology attributing a label of risk or lack of risk to the woman and her pregnancy, concerns have been raised in midwifery literature about the disempowering effect of this process (Gail-Thomas, 2003). While it is my preference to use the terminology “well women with uncomplicated pregnancies” so as not to apply labels to women, for ease of writing I will henceforth use “low-risk women” as this terminology is universally understood.

³ Case-loading means the midwife has registered as the LMC to provide all maternity care for a number of women, usually between 50 and 60 women per year.

group practices usually comprising around four to six midwives, and women have an opportunity to meet the other midwives in the group. Group practice offers a supportive and mentoring environment and provides peer support. This means each member of the group often has comprehensive knowledge of the women being cared for by their colleagues, along with the women in their own caseload. Women receiving care from an LMC midwife are classified as receiving “primary” care in that they are usually at low risk of pregnancy complications.

There is a seamless transition between primary, secondary, and tertiary maternity services in New Zealand, based on a comprehensive guideline for referral to obstetric and associated medical specialist care (Primary Maternity Services Notice, 2007). In many instances, following consultation midwives will continue to provide care for women who have some complexity in collaboration with the specialist obstetric service. As legislated autonomous practitioners, midwives have access to all the district health board (DHB) facilities and services. Within their scope of practice midwives can order laboratory tests and scans and prescribe medicines.

As mentioned previously, the New Zealand midwifery model is a partnership model underpinned by a normal birth philosophy and anchored by factors that are at the heart of the New Zealand health system: informed choice, shared decision-making and consent. The first task of the Health and Disability Commissioner, appointed as part of The Health and Disability Commissioner Act 1994 (HDCA), was to develop the Code of Health and Disability Services Consumers' Rights (the Code). The purpose of the HDCA was to promote and protect the rights of health and disability services consumers, and to facilitate the fair, simple, speedy, and efficient resolution of complaints relating to infringements of those rights. The Code

established the rights of consumers, and the obligations and duties of providers to comply with the Code (<http://www.hdc.org.nz>).

The two consumer rights that have most relevance to this discussion are Right 6: The right to be fully informed and Right 7: The right to make an informed choice and give informed consent. Right 6 states that consumers are entitled to all the available information required by them to make a decision about care options and choices. This information includes the risks, side effects, benefits, and costs associated with those options or choices and the results of research. Right 7 states “Services may be provided to a consumer only if that consumer makes an informed choice and gives informed consent. . . ” (p.2) and the consumer has the right to refuse services and to withdraw consent to services. Both of these Rights are central to the New Zealand midwifery professional and regulatory bodies.

I have presented this contextual background because I propose that the context of care, which includes the model of midwifery practice and the location for care, has a bearing on the fetal monitoring options that are offered to women and the choices that are made, and these choices contribute to the safety of women and babies. This idea is supported by a recent study of English midwives that revealed midwives struggle with the notion of informed choice in the context of a dominant medical model of care (Hindley & Thomson, 2005). The proposed relationships between model of practice, monitoring choice, and outcomes of birth are further explored in the next section through the stories of two women derived from my own clinical practice and my work as an expert midwife.

1.2.1 Two stories from practice.

Both Christina and Susan and their experiences are real but their names are not, in order to maintain anonymity. I regard their stories as typical of the spectrum of women's experiences that I encounter in my range of midwifery roles.

The first story is that of Christina, who was expecting her second child and who planned a home birth. She had a self-employed LMC midwife providing her maternity care. During her first pregnancy, she had planned for the birth at home. However, she transferred to hospital in latent labour and her labour was augmented, leading to a difficult birth. This was followed by breastfeeding and bonding issues.

For her second pregnancy Christina again planned a home birth. During the last two to three weeks of the pregnancy she prepared for the impending birth, including setting up a birth pool as she was keen to labour and birth in water. Christina and her midwife, a different midwife from the one she had for the first birth, discussed the planned birth from every angle and talked about the potential reasons for transfer to hospital so that there could be no surprises, but both had a strong belief that this birth would go as planned. They discussed the benefits and risk of fetal heart monitoring during labour and different types of listening devices agreed to listen with a Doppler device (a hand-held ultrasound transducer used to detect movement within the fetal heart beat to provide an audible simulation of the heart beat, and to display the heart rate in beats per minute on small screen). The midwife also talked about minimising interruptions to Christina's birthing rhythms and concentration. Christina's birth plan, influenced by her previous experience, specifically asked for no clocks or timeframes, no intrusions to normal birth rhythms, and definitely no negative comments about progress.

A week past her due date, Christina had long bouts of irregular contractions over several days. She alternated between rest and exercise, paying attention to her nutrition and hydration. Occasional visits from the midwife reassured her that both she and the baby were well. Christina was aware that her baby moved often and the auscultated fetal heart rate (FHR) was within normal range and that fetal movements continued as usual. A vaginal examination found her cervix to be about 5 cm dilated, soft and stretchy, un-effaced, and poorly applied to the fetal head, with the baby in a posterior position. Both Christina and her midwife expected the labour to establish overnight; however, when she received no call-out, the midwife visited in the morning. Christina was in strong labour. A quick review of her overnight story revealed all was well and the baby was moving as usual. As agreed, her midwife took the opportunity to listen to the fetal heart with a hand-held Doppler device at moments when Christina was not deeply concentrating. The auscultated FH remained within normal parameters. Her partner prepared the birth pool and continued to provide support, nourishment, and back rubbing. Getting into the birth pool was a great relief.

Fetal heart monitoring with a waterproof Doppler device was reassuring. Pushing sensations were accompanied by a spontaneous rupture of the membranes and clear liquor flowed into the water. Christina started spontaneously bearing down at the peak of each contraction, with FH auscultation after each effort. Soon a “peep” of head was seen in the mirror, and Christina reached her hands down and received her daughter as she emerged from her body. Claspings her to her chest, she cradled her baby in her arms as time stood still for a moment. There was wonderment followed by overwhelming joy and an enormous sense of accomplishment. No clocks, no timeframes, no intrusions to normal birth rhythms, and definitely no negative

comments about progress. Breastfeeding and attachment between Christina and her baby were successful. This birth healed some of the grief Christina had previously experienced and renewed her faith in the power of her body to do what it is designed to do given time, encouragement and trust.

In contrast, the second story reveals issues with the notion of shared decision-making and a model of care that did not support the key principle of continuity of care. Susan was having her first baby. She attended the hospital antenatal clinic where she received care from a team of hospital-employed midwives. She planned to birth at the local hospital. Susan had a care plan/birth plan, but choices and preferences for fetal heart monitoring during labour were not discussed.

At 38 weeks gestation, while at work, Susan felt some niggling lower abdominal discomfort. Over the course of the evening, the “niggles” became a bit stronger but did not last long. Susan’s partner called the delivery suite for advice and was advised to bring Susan into the maternity unit for assessment. On arrival at the hospital, the delivery suite midwife conducted an admission assessment, including a vaginal examination and admission CTG⁴. Susan’s cervix had only dilated 1 cm and was still firm. The CTG showed a normal FH pattern and a few irregular contractions.

The midwife discussed her findings with the doctor on call in the delivery suite, who advised Susan and her partner that there had been a “failure to progress”

⁴ Admission CTG is the application of electronic fetal heart monitoring, conducted using a cardiotocograph machine. A contraction transducer and an ultrasound sensor record the fetal heart rate and the presence of changes in abdominal pressure and plot them onto a continuous strip of paper marked with a grid. Admission CTG usually runs for 20-30 minute and is performed when a woman first presents to the delivery suite.

because Susan had been experiencing contractions all day and her cervix was not dilating. He recommended augmentation⁵ of labour. Tired and fearful, Susan accepted an artificial rupture of the membranes and an intravenous infusion of oxytocin (syntocinon) was commenced. Continuous EFM began, with the result that Susan was confined to her bed. Contractions started coming very fast and strong and Susan and her partner were frightened and anxious. With her partner's support, Susan asked for and received an epidural for pain relief.

Within a couple of hours, the syntocinon was running at maximum rate and the fetal heart tracing showed baseline decelerations and reduced variability. The registrar was called and a vaginal examination revealed Susan's cervix was now partially effaced and 2 cm dilated. The liquor had changed colour and was now meconium stained. The registrar advised an immediate caesarean section for fetal distress. The baby was born 30 minutes later, cried at birth and had Apgar⁶ scores of nine and 10. Unfortunately, the baby developed a little grunting and nasal flaring and was admitted to the neonatal intensive care unit (NICU) for observation. Initiation of skin-to-skin contact and breastfeeding was delayed, but Susan was assisted to express colostrum, which was taken to the NICU by her partner some time later. The baby stayed in the NICU for 48 hrs and Susan stayed in hospital for five days, as a result of breastfeeding difficulties and the need for a blood transfusion after significant blood loss during the operation. Postnatally she was visited at home for six

⁵ Augmentation of labour is a procedure used to stimulate uterine contractions during pregnancy before labour begins spontaneously.

⁶ The Apgar score is an assessment of how well the fetus transitions to extrauterine life by measuring heart rate, respiratory effort, colour, reflexes, and tone with a total score out of 10. This score is performed at 1, 5 and 10 minutes of age.

weeks by the hospital primary midwives. Unfortunately, she abandoned breastfeeding at the end of the third week, because of on-going nipple trauma. There was no debriefing of her labour and the decisions leading to her caesarean section.

There are many issues that the reader might draw from comparing and contrasting these stories that would stimulate excellent debate. However, I am choosing to focus on the fetal monitoring aspects. For Christina, the midwife shared her understanding from current research and reassured her that there was no evidence to support the use of invasive forms of monitoring as she was low risk. This meant she could make an informed decision about this aspect of her care. They chose to use IA with a hand-held Doppler device, opportunistically, during the labour. Opportunistically means that the midwife would take the opportunity to listen to the FHR when the woman changed her position or talked, or decided to go to the toilet, rather than disturbing the rhythm of labour and the woman's concentration by listening to the FHR at prescribed frequencies. Despite the long latent phase of Christina's labour, with occasional checking of the fetal heart by Doppler and a conscious awareness of the baby's normal fetal movement patterns both the woman and the midwife were reassured of fetal well-being.

In contrast, Susan had no antenatal discussion about fetal heart monitoring in labour and so had no understanding of the various methods, or the risks and benefits associated with the various options. Anxiety about the labour and birth led the couple to elect an early admission to hospital, which led to the use of the admission CTG despite the evidence from research indicating its use is not recommended in low-risk women (ACOG, 2005; RANZCOG, 2006; NICE, 2007; SOGC, 2008). This action led to a cascade of interventions which arguably need not to have happened.

There is an interesting challenge that arises in the circumstances described in the second story, especially around fetal heart monitoring. That challenge would be to find the way and means of providing women with evidence-based information on fetal heart monitoring during labour in circumstances when they do not have continuity of care during the antenatal period. To make informed decisions about care, women need to be provided with up-to-date information of fetal surveillance methods, based on current evidence. Hospitals are advised to develop evidence-based fetal monitoring guidelines that outline the appropriate methods for fetal surveillance based on an individualised assessment of each woman and baby's potential risk for fetal compromise during labour, so that low-risk women are not exposed to unnecessary EFM. As well, midwives and doctors must be skilled at interpreting both IA and EFM so that appropriate actions are taken. From the midwifery perspective, the most important need is for midwives to have a comprehensive working knowledge of the research on fetal surveillance and to fulfil their role as the guardians of normal birth (NZCOM, 2005).

So what do these stories illustrate about choices of fetal monitoring? From my perspective they illustrate the importance of a known, named midwife providing continuity of care. They tell me midwives must be engaged with current evidence, know how to interpret it and share it with the women they engage with, and should use informed decision-making regardless of where they practice as midwives. This perspective led me to consider how midwives engage with evidence; what is the evidence that IA is a safe fetal monitoring modality; and how is this evidence made available for midwives. Therefore, in the next section I review the evidence on which IA is based and the guidelines that support its use in informed decision-making.

1.3 Evidence and Guidelines for Intermittent Auscultation of the Fetal Heart

Informed decision-making follows a discussion of the risks and benefits of the various options for FHR monitoring. Historically, IA of the fetal heart was a well-established method of intrapartum fetal surveillance⁷. Today, many professional midwifery and obstetric organisations around the world state that IA is the method of intrapartum fetal surveillance that should be recommended and offered for all low-risk women (ACNM, 2007; ACOG, 2005; AWHONN, 2008; NICE, 2007; NZCOM, 2005; MIDIRS, 2003; RANZCOG, 2006; RCM, 2005; RCOG, 2001; SOGC, 2007⁸). As Table 1 describes, IA is normally conducted at predetermined intervals as detailed in fetal monitoring guidelines. However, there are variations between the many international professional bodies regarding the frequency, timing, and duration of IA. Some recommend listening every 15 minutes and others every 15 to 30 minutes in the first stage of labour, and every 5 mins in the second stage of labour or after every contraction in the pushing stage. There is, however, widespread agreement that listening to the fetal heart should be conducted at the end of a contraction and for at least one full minute (Table 1). All guidelines recommend palpation of the maternal

⁷ The two most common methods of fetal surveillance are by intermittent auscultation (IA) and by electronic fetal monitoring (EFM). IA involves listening to the fetal heart at predetermined intervals using either a Pinard stethoscope or a hand-held Doppler ultrasound device. EFM is conducted via a cardiotocograph (CTG). The aim of fetal surveillance is to identify the fetus potentially at risk of hypoxic injury so that birth may be expedited.

⁸ Many other professional organisations around the world also have fetal surveillance guidelines but these were not available in English

radial pulse simultaneously with listening to the fetal heart so that the two heart rates can be differentiated and this procedure is illustrated in Figure 1.1.

I was interested to discover why such variation exists in relation to the conduct of IA. Since IA has existed for centuries, one would assume the technique has been well researched and articulated but a thorough search of the literature failed to uncover any scientific basis for the recommendations found in fetal monitoring guidelines. It is apparent that the current protocols for IA frequency, timing, and duration were developed in the context of the protocols for IA used in randomised controlled trials comparing IA with EFM (Chapter Two, Table 2.1). These trials will be discussed in more detail in the following chapter. The protocols for IA used in the clinical trials were based on expert opinion provided at a particular time, in a particular context, and for a particular model of care. It was first described by Benson, Shubeck, Deutschberger, Weiss, and Berendes (1968) in their publication on the FHR as a predictor of fetal distress. Drawing on the data from the 1950s Collaborative Study of Cerebral Palsy, Mental Retardation, and Other Neurological Diseases and Blindness, the authors evaluated fetal heart recordings from 24,863 labours that resulted in single births (live or fresh stillbirths). The protocol for IA in the Collaborative Project was described as:

Fetal heart rates were obtained by specially trained observers every 15 min [utes] during the portion of the first stage of labour under study and every 5 min[utes] during the second stage or during serious complications. Fetal heart rates were not taken while a contraction was in progress or for 30 sec [onds] thereafter. (p. 260)

Following a very busy period of research over the 1970s and 1980s, the use of the 15 minute frequency for IA in the first stage of labour became embedded into practice and guidelines, particularly in the UK.

Table 1

Intermittent auscultation protocols described in fetal surveillance guidelines from a range of professional groups.

Guideline	Country	Frequency		Timing	Duration
		1 st Stage	2 nd Stage		
RCOG, 2001	UK	Active 1 st stage Every 15 minutes	Active 2 nd stage Every 5 minutes	After contraction	For 60 seconds
RCM, 2005	UK	Every 15 minutes	Every 5 mins	After contraction	For minimum of 60 seconds
NICE, 2007	UK	At least every 15 minutes	At least every 5 minutes	After contraction	For a minimum of 1 minute
SOGC, 2007	Canada	15-30 minutes	5 minutes	After contraction	For 30-60 seconds. In active labour, a 30 second count may be more feasible but a 60 second count will improve accuracy
ACOG, 2007	USA	No risk: every 30 minutes in active labour Risk factors present: every 15 minutes	No risk: at least every 15 minutes Risk factors present: every 5 minutes	Risk factors present: before, during and after contraction	Not stated
ACNM, 2007	USA	Every 15–30 minutes	Every 5 minutes	After contraction	For 30-60 seconds
AWHONN, 2008	USA	Every 15–30 minutes	Every 5-15 minutes	After contraction	For at least 30-60 seconds
RANZCOG, 2006	Australia and New Zealand	Active 1 st stage At least every 15-30 minutes	At least every 5 minutes	Commence towards the end and at least 30 seconds after each contraction during active pushing in the second stage of labour	

Studies describing compliance with IA protocols are limited, although there are many studies describing midwives' attitudes to fetal heart monitoring (Dover & Gauge, 1995; Sinclair & Gardner, 2001; Walker, Shunkwiler, Supanich, Williamsen & Yensch, 2001; Hindley & Thomson, 2005; Blix and Öhlund, 2005; Mead, Bogaerts, & Reyns, 2006; Altaf, Oppenheimer, Shaw, Waugh, & Dixon-Woods, 2006; Hindley, Hinsliff, & Thomson, 2006). One study, conducted in New Zealand, surveyed 708 midwives regarding the practice of maternal and fetal observations in normal labour (Muir, 2006). At that time the fetal surveillance guidelines of most maternity units in New Zealand were influenced by recommendations from the RCOG (2001) and RANZCOG (2002) guidelines. In relation to IA frequency, timing and duration, the study findings revealed that midwives were more likely to listen to the fetal heart every 30 minutes than to listen every 15 minutes (48% and 28% respectively) in the first stage of labour (Muir, 2006). In the second stage, they were more likely to listen to the fetal heart after every contraction than to listen every 5 minutes (40% and 14.3% respectively) (Muir, 2006).

Furthermore, a clinical audit of 193 medical records to determine compliance with a New Zealand tertiary hospital policy for IA found 71.8% compliance with the recommended first stage of labour frequency of every 15 to 30 minutes, which closely follows the findings of Muir (2006). However, compliance with the recommended second stage IA frequency of every 5 minutes was only 38.5% (Maude & Foureur, 2009). Documented evidence of the maternal pulse being taken in either first or second stage was rarely seen (Maude and Foureur, 2009). Of concern in this audit was the finding that only half of the women eligible to receive IA during labour (those women who had no indications for electronic fetal monitoring, as specified in the hospital policy) actually received IA during labour, with the other half of low-risk

women having continuous CTG monitoring. An admission CTG was used for 86% of all women with a third of these women having no indications for intrapartum EFM. Over half of the women who had an admission CTG went on to have continuous EFM during the remainder of their labour (Maude & Foureur, 2009).

The revelation that low-risk women were unnecessarily exposed to EFM led me to explore further the consequences of the use of this technology in maternity care and to think about the ethical impact of these decisions. Wood (2003) has provided some insight into how the routine use of EFM for women who are considered low risk creates a professional and moral dilemma for many midwives.

1.4 Applying Ethical Principles to Decision-making for Fetal Monitoring

Despite the evidence to support the use of IA for low-risk women, several studies have demonstrated that there is widespread use of continuous fetal heart monitoring in institutional maternity units. So it seems that the evidence is not translated into practice even though most units would espouse a belief in evidence-based practice. Wood (2003) explored two ethical decision-making models (deontological and utilitarian) by Langana and Duderstadt (1995) to answer the question “is it ethical to offer a method of fetal assessment to a low-risk obstetrical patient that can increase her risk without benefitting the fetus?” (p. 294). In presenting an articulate essay that applied the ethical principles of autonomy (self-determination), beneficence (to do good), non-maleficence (to prevent harm), and justice (fair and equal treatment), Wood (2003) provided an answer to the dilemma of fetal heart monitoring by convincingly demonstrating that there is no ethical support for the use of continuous electronic fetal monitoring for low-risk women.

Wood's (2003) conclusion is strongly supported by Tillett (2007), who reported that continuous electronic fetal monitoring for low-risk women without clinical indications for its use was dangerous. This view is supported by Gibb and Arulkumaran (2008) in the forward of the third edition of their fetal monitoring in practice handbook when they say, "[e]xcessive technology should not be applied to those [women] who are manifestly at low risk. It may confer no benefit, can generate both non-medical and medical anxiety, and through subtle effects may cause significant harm" (p.vii). Tillett (2007) argued that the information gained from the CTG trace is controversial, has poor specificity, validity and reliability and leads to unnecessary interventions and operative deliveries that carry increased risks for both the woman and her baby (Tillett, 2007).

The conclusion of this exercise of applying the ethical principles to the decision-making processes around intrapartum fetal heart monitoring is that the use of intermittent auscultation of the fetal heart in labour for low-risk women is supported by the midwives' scope of practice, the midwifery model of care (partnership, continuity of care, informed choice/consent), ethics, and research (Wood, 2003). Therefore, the knowledge that IA as a fetal heart monitoring modality for low-risk women is well supported should be reassuring for practising midwives. With this background in mind, I began the search for answers as to why IA use has diminished over recent decades and to consider how IA could be reinstated as the preferred fetal monitoring option for low-risk women.

1.5 Arriving at the Research Question

The need for another survey of midwives' practices seemed unnecessary in light of the audit and survey findings described previously. This led me to reconsider what my study should be. I started out with a keen interest in the recommendation in first

stage of labour to listen to the fetal heart and determine its rate every 15 minutes (NICE, 2001). This led me to ask “what is ‘wrong’ with listening to the fetal heart rate every 15 minutes?” So I decided to pose this question to my midwife colleagues on a New Zealand midwives email discussion list (nzmidwives@yahoogroups.com) of which I am a member. The posting, on Monday 26 March 2007 at 7:38 a.m., under the subject heading “Intermittent Auscultation”, was responded to by eight midwives from a range of practice environments. Respondents commented that following a ‘prescription of care’ for FHR monitoring (i.e., every 15 minutes) instead of taking an individualised approach was likely to introduce pathology to the labour by disturbing the woman’s labour rhythms (personal communication, March 26, 2007). One midwife said, *“I feel we do induce some fear and anxiety— by listening frequently we may implant the idea that the baby is at risk or that we are expecting problems thereby maybe affecting the normal hormonal activity”* (personal communication, March 31, 2007). In this setting continuity of care and carer provides the midwife with knowledge of the woman and her baby and enables the timing of IA to be geared to the woman’s labour philosophy (personal communication, March 31, 2007).

Several midwives referred to using fetal movements as an indicator of fetal well-being and described how they incorporated this knowledge into women’s care. Assessing fetal movements was not a component of any fetal monitoring guideline that I had recently examined, so I was intrigued to discover how widespread the practice was amongst midwives in other settings.

The email discussion with New Zealand midwives was followed by a similar posting to two very active international email discussion lists: <https://www.Midwifery-Research@jiscmail.ac.uk> and <https://www.Normalbirth-Research@Jiscmail.ac.uk> of which I am a member. The membership of the two lists includes expert midwives and

midwife researchers from the UK, the USA, Australia, and Europe, who are well known for their collective contributions to the body of midwifery knowledge. The trigger question for the discussions that ensued during June and July 2007 was in relation to the frequency with which intermittent auscultation (IA) of the fetal heart rate (FHR) during labour was performed. My message sent on 14 June 2007 at 00:50 a.m., broadly stated that the literature frequently points out the lack of evidence around timing, frequency and duration of IA. I was keen to determine where the expert midwives felt research was best targeted. Therefore I asked the list which of four research issues would be most important to pursue. The four areas were:

1. An RCT comparing 15 min with 30 min auscultation frequency; even though I realised this would be potentially problematic as the numbers needed to demonstrate no difference would be large.
2. A survey (nationally, internationally) of current practice around IA and what informed this practice—that is, if midwives' practice does not reflect the current guidelines for IA (15 to 30 min in first stage and 5 min or after each contraction in second stage, for 1 full minute, after a contraction, comparing with maternal pulse) then what do midwives do and how do they reassure themselves and women about the baby's well-being in labour?
3. An international eDelphi study, which would see the creation of international expert midwifery opinion to inform practice around IA.
4. Developing a (midwifery) model for IA and testing it.

There were 55 postings on the email list from 31 midwives from New Zealand, Australia, UK, USA, and Europe. The postings were grouped around six common

themes that helped me decide the direction my research would take. These themes included a discussion of the evidence/guidelines, staffing levels impacting on midwives' ability to perform IA, EFM used as a defensive practice, use of fetal movements with IA, questioning the accuracy/variability of IA, and using normal physiology as the starting point for understanding and interpreting IA.

There was agreement that there was a lack of evidence to support IA frequency as recommended in current guidelines with descriptions of practice ranging from IA every 5 minutes to hourly or more, but with 15 minutes being the most common. Several respondents were of the opinion that IA was studied in contexts where EFM was considered the ideal and IA every 15 minutes was considered the maximum tolerable interval without hearing the FHR (personal communication, June 16, 2007). Several postings asserted that current staffing levels made it impossible to comply with IA every 15 minutes unless one-to-one care was provided (personal communications, June 15, 2007; June 16, 2007; June 17, 2007). Respondents asserted that midwives were forced to resort to less optimal practice of continuous electronic fetal monitoring (CEFM) since one-to-one care was not common (personal communications, June 15, 2007; June 17, 2007). A related discussion concerned the defensive practice of providing a printout of the fetal heart rate in birth settings where women's bodies were not trusted. Opinion was divided as to whether it was possible to determine the accuracy of IA in terms of recognition of fetal heart rate variability, with one respondent claiming to use knowledge of EFM interpretation when using IA.

The most useful and insightful discussions for me in considering the direction of my research were those related to starting from a premise of normal physiology and incorporating fetal movements into the IA process. I was inspired by the level of engagement of the midwives on the discussion lists and realised that many members

of the midwifery profession internationally were grappling with similar issues. On reflection I determined that developing a detailed IA framework that would provide midwives with clear direction on how to conduct IA might increase their confidence in practising it.

The “problem” of IA and the lack of evidence supporting the frequency, timing and duration again appeared on the international email discussion list again in 2010. Another lengthy discussion ensued between February and September 2010, focused again on the evidence to support current IA protocols. There was a discussion about the evidence to support different types of listening devices, of which there is very little. One midwife reported *“There are many forms of 'monitoring' the woman and using evidenced based practice [is just one] along with, practitioner’s expertise and the woman’s beliefs”* (personal communication, March 11, 2010). Another midwife educator commented about issues she saw in practice involving IA. She said, *“Midwives are brilliant at recording the heart rate (e.g., FH 142) but don’t add any other information—for example, when they auscultated in relation to the contraction; how long they listened in for; whether they heard any accelerations etc”* (personal communication, September 16, 2010). This midwife made a call for any tool/strategy/tips to facilitate the successful teaching and implementation of IA in practice. Others agreed that such tools should contain information to assist clinicians develop an understanding of the physiology behind FHR monitoring. They wanted a tool to inform midwives why it was important to listen for accelerations and to listen for a length of time. The discussions helped me to focus on the area most needing research, that being how to reinstate IA as a fundamental midwifery skill, based on evidence and underpinned by physiology, and how to move evidence into practice and increase use of IA.

1.6 Summary

In this chapter I have established that the focus of my research is the issue of IA for low-risk women during labour. There is both anecdotal and empirical evidence that IA is disappearing from practice, replaced by CEFM. My argument is that the displacement of IA has implications for the ethical conduct of midwifery and the safety of mothers and babies. As a consequence my proposal is that IA needs to be re-established as a fundamental midwifery skill and should be offered to eligible women as a safe alternative to CEFM. Therefore, two broad research questions were proposed to be explored in this thesis. The questions were: (a) is it possible to re-establish the validity of IA as a fundamental midwifery skill underpinning midwifery guardianship of normal birth and (b) can the knowledge of the validity of IA as a fundamental midwifery skill be translated into midwifery practice?

Outline of Subsequent Chapters

These questions led me to undertake a critical review of the literature that claims to provide evidence of the safety of IA compared with CEFM. This first step was an essential precursor to designing my study as I considered that I would need to be intimately acquainted with every study done in the area in order to present IA to my midwifery colleagues as a safe and ethical practice. This also required me to examine the original randomised controlled trials conducted decades ago, rather than rely on recent systematic reviews and meta-analyses.

Several tools in the form of evidence-based fetal surveillance guidelines from professional obstetric and midwifery bodies from Canada, the USA, the UK and Australasia were also critically examined to develop a deeper understanding of how this evidence is used to inform clinical practice. In addition, descriptions of IA practice that provide instruction on the basic steps and rationale for the practice of IA are

reviewed. My aim was to discover whether the evidence supporting IA is robust and how well the evidence is articulated in guidelines and practice descriptions to help clinicians make sense of it to support their practice. Chapter Two presents the review of this literature.

In order to inform the design of my study I then undertook a search for concepts and theories to explain how research evidence is diffused or disseminated to end-users. The examination of a number of theoretical ideas about how knowledge is translated into practice is presented in Chapter Three. The tradition that has formally come to be known as Knowledge Translation (KT) and in particular the Knowledge-to-Action, or KTA process, was used as the conceptual model for this inquiry and the design of my study. The KTA process has two component parts: knowledge creation and the action cycle. The action cycle represents the activities and processes related to use or application of knowledge (Graham, et al., 2006). Subsequent chapters are framed around components of the KTA cycle. These are: adapting knowledge to the local context; assessing the barriers to knowledge use; selecting, tailoring, implementing interventions; monitoring knowledge use; and evaluating outcomes.

The action cycle of the KTA process is represented as a cycle. However, the stages making up the cycle are not necessarily sequential. Graham et al. (2006) assert that the stages can be undertaken in any order with each element often informing another. Therefore, while the thesis presents chapters in a linear sequence it will become apparent that often stages in the research process occurred concurrently with one informing the other, as occurs in real world settings.

Following writing the literature review and theoretical chapter, it became clear that a more robust framework for IA was needed to provide midwives with confidence

to incorporate this method of monitoring into practice. As described in Chapter One, discussions with “expert” midwives nationally and internationally, via yahoo discussion groups focusing on issues of normal birth and midwifery research, explored current practice issues with IA that contributed to the development of the model. As a process, this represented the stage in the action cycle named “adapting or customising the knowledge to the local context”. In this stage of the cycle, knowledge is customised to better suit local needs, thereby making it more acceptable and potentially encourage greater adherence. As a result of this, a new informed decision-making framework for IA evolved. The framework is called Intelligent Structured Intermittent Auscultation (ISIA). An educational intervention incorporating a review of the evidence related to IA, and the basic physiology underpinning the materno-utero-placental unit and control of the fetal heart was developed as a means of introducing the innovation to maternity care providers. The ISIA-informed decision-making framework and an educational framework to present it to clinicians are described in detail in Chapter Four.

Chapter Five describes the research design that evolved out of the need to test the new ISIA framework as part of the implementation of knowledge using the action cycle of the KTA process. A mixed methods study using a non-experimental pre and post-intervention design was employed. Retrospective medical record reviews (RMRR) before and after the provision of an educational intervention provided insights to the fetal monitoring practice of midwives as evidenced in their clinical documentation. Focus groups to explore the barriers and facilitators to knowledge translation as it relates to both the use of IA in the pre-intervention phase and changes in fetal heart monitoring practice following the intervention were also undertaken.

Chapter Six presents the findings of the stage of the KTA cycle called “assess barriers to knowledge use”. Focus groups with self-employed and hospital employed midwives in the pre-intervention phase explored barriers to the use of knowledge of IA in practice at their maternity unit. Constant comparison analysis of this data was performed using the deductively attained main categories of “personal/professional” and “system/organisational”. Emergent themes were clustered around these four major categories and included continuity of care(r), practice, IA conduct, admission CTG, evidence, technology, environment and equipment. The focus groups were conducted concurrently with the pre-intervention RMRR and the emerging themes were used to inform the development of the educational intervention.

The pre-intervention RMRR reviewed the documentation of fetal monitoring practices from a convenience sample of births in a three-month period at one DHB in New Zealand. This RMRR provided the baseline data to “identify the problem” and to answer four specific questions. Those four questions were: (a) what number of women were eligible to receive IA (low-risk women), (b) what number of eligible women received IA, (c) was there compliance with the DHB’s policy for the conduct and documentation of IA, and (d) what were the maternal and fetal outcomes of care where IA was used for ongoing FHR monitoring? This baseline data was entered in SPSS and basic chi-squared tests were applied to determine whether differences occurred between two groups of intrapartum midwife caregivers. An identical data collection occurred in the post-intervention phase, three to six months following the intervention. These data were then compared with the pre-intervention data to determine whether there were any changes in practice as revealed in the midwives’ documentation. These findings are presented in Chapter Seven.

Chapter Eight presents a major theme that emerged from the post-intervention focus groups. Retaining two of the previous categories, “personal/professional” and “system/organisational”, the major theme to emerge was “Doing things differently”. The midwives were clear that the educational intervention had renewed their confidence in the evidence supporting the use of IA for low-risk women. They described the various ways their behaviour and practice changed as a result of being exposed to an evidence-based ISIA decision-making framework. Within the organisation, the study site, these midwives are the key adopters of knowledge related to IA for low-risk women. These midwives have identified the need for ongoing facilitation for change to the culture.

In the final chapter of the thesis I present a synthesis of the findings from the research together with insights from field notes and my reflections on the context within which the study was conducted. Chapter Nine therefore provides a discussion of the findings that revealed ISIA is a powerful tool for practice change that made a significant difference to the fetal monitoring practices of many midwives in this setting. Whether the changes will be sustained in the long term remains to be assessed with further research, since the follow-up period of six months is a limitation of the study. Other limitations are examined by considering whether the setting for the study, which was a relatively small metropolitan maternity unit in New Zealand, enables the ISIA framework to be as successful in facilitating change in other settings. One of the most significant findings of the study is revealed in the way ISIA appears to have triggered a process of culture change towards re-examining practice and the evidence that underpins it. Midwives in this study described how their understanding of ISIA and their practice of it has renewed their confidence in reasserting their role as guardians of normal birth. The chapter concludes by

establishing the importance of ISIA as a fundamental midwifery skill that must be disseminated widely to both the national and international midwifery communities so that women and their babies can receive its evidence-based benefits.

Chapter Two: Identification, Review, and Selection of Knowledge to Support Intermittent Auscultation

In the previous chapter I established that over the last few decades, the use of IA has gradually disappeared from practice as it became replaced by CEFM. The increased use of CEFM has distanced the midwife from the more “hands-on” approach and from the close contact with the labouring woman that is associated with the fundamental midwifery skill of IA. One of the questions I pose is: is it possible to re-establish the validity of IA as a fundamental midwifery skill underpinning midwifery guardianship of normal birth?

This chapter begins to answer this question through a critical examination of the literature to determine the safety and efficacy of IA for low-risk women during labour. In addition, the chapter examines current influential international and national fetal surveillance guidelines and practice descriptions of IA to determine whether they provide adequate direction for midwives around the use and interpretation of IA. I was particularly interested to identify any gaps in the literature. I reviewed both primary randomised controlled trials (RCTs) comparing IA with EFM, and primary RCTs comparing IA with admission cardiotocography (CTG). I also reviewed the systematic reviews and meta-analyses containing the most robust of these primary studies. I have included RCTs comparing IA with admission CTG because the point of first contact in labour, often when the woman is first admitted to the delivery suite, is the time when assessments are made that influence decisions regarding the choice of ongoing fetal heart monitoring. The RCTs, systematic reviews, guidelines and practice descriptions are summarised in a number of tables located at the end of this chapter for ease of reading.

2.1 Search Strategy

I undertook computerised searches of MEDLINE, Pub Med, CINHALL and the Cochrane Library databases using the following search terms: fetal⁹ monitoring, fetal heart monitoring, intrapartum fetal monitoring, electronic fetal monitoring, fetal surveillance, cardiotocogram, cardiotocograph, CTG, non-stress test, NST, labour admission test, admission CTG, and admission cardiotocograph. The search terms for intermittent auscultation included: auscultation, intermittent auscultation, periodic listening, fetal heart auscultation, and auscultated accelerations. The search terms for literature on current IA practice protocols were: fetal monitoring guidelines, fetal surveillance guidelines, intermittent auscultation with Pinard, and intermittent auscultation with Doppler device. In addition, the subject headings from the different databases were added to the search strategy. I also searched the reference lists of all relevant articles and hand-searched midwifery, nursing, and obstetric journals in libraries at the hospital and at the university where I work. Eligible papers, in English, were then obtained in full text for further assessment. No specific date restrictions were applied, as I was interested to access historical and seminal literature around both IA and EFM. The computerised searches generated 177 titles.

I have chosen to structure the literature review in a manner that reflects the knowledge creation funnel of the Knowledge-to-Action (KTA) process which will be discussed fully in the following chapter (Chapter Three). The knowledge creation funnel, an inverted triangle, symbolises the creation of knowledge through knowledge inquiry, knowledge synthesis, and knowledge products/tools. As knowledge moves through the knowledge creation funnel, it becomes more refined

⁹ Where fetal was used in a search term, I also added the alternate form of spelling – foetal

and useful to the end users of the knowledge (Brouwers, Stacey, & O'Connor, 2010). The three areas of knowledge generation are also known as first, second and third generation knowledge. To establish the validity of IA as a fetal heart rate (FHR) monitoring modality for low-risk women, it is necessary to explore the evidence that has informed current fetal surveillance guidelines. First generation knowledge is that which has come from the primary, for example randomised controlled trials (RCT). Second generation knowledge or knowledge synthesis helps the reader to make sense of research findings from multiple sources in the same area of research, rather than relying on the findings from an individual study. Amalgamation of the outcomes and findings from several RCTs through the process of systematic review and meta-analysis adds greater validity to the evidence base and is used to develop knowledge products/tools. Known as third generation knowledge, these knowledge tools are guidelines, care pathways and decision aids (Graham, et al., 2006; Straus, Tetroe & Graham, 2009; Brouwers, Stacey & O'Connor, 2010). These knowledge tools present evidence from research to stakeholders in more user-friendly formats, which in turn helps to facilitate greater uptake of knowledge (Graham et al., 2006).

Following this template, I begin this review of the literature by critically appraising the first generation knowledge or primary RCTs that present evidence of the safety of IA as a FHR monitoring modality for low-risk women. This is followed by the second generation knowledge to emerge from the synthesis of RCTs of IA versus EFM.

The first and second generation knowledge from studies comparing IA with admission CTG follows. Finally, third generation knowledge in the form of fetal

surveillance guidelines from the UK, the USA, Canada and Australasia, and IA practice descriptions from two key sources are reviewed.

2.2 Primary Randomised Controlled Trials Comparing IA with EFM and IA with Admission CTG

Early RCTs arose out of a need by obstetricians to determine the efficacy of the application of what was known at the time as “fetal intensive care”, including the use of CEFM and fetal scalp blood collection and analysis, to improve the detection of intrapartum fetal distress: the purpose for which EFM was designed (Boehm, 1974). Early uncontrolled investigations into the use of EFM in the place of IA made claims of a world-wide reduction in perinatal morbidity and mortality as a direct result of continuous FHR monitoring (Gabert & Stenchever, 1973; Paul & Hon, 1974). However, in the early- to mid-1970s there were still many sceptics and maternity clinicians were divided over their acceptance of this technology as a routine measure for all women regardless of risk status (Renou, Chang, Anderson & Wood, 1976; Kelso, et al., 1978). As a result of this scepticism, there were calls for properly designed RCTs to be conducted to assess the effects of CEFM on maternal and fetal outcomes.

I have chosen to review all of the primary RCTs because they represent seminal works comparing IA and EFM. The findings from these trials have influenced nearly a quarter of a century of fetal surveillance guideline development, practice, and ongoing research. The first section of the literature review examines studies comparing IA with EFM. Primary RCTs were conducted to confirm the findings of earlier studies that had not used controls (Shenker, Post, & Seiler, 1975; Edington, Sibanda, & Beard, 1975; Weinraub et al., 1975; Koh, Creves, Yung, & Peddle, 1975;

Lee & Baggish, 1976; Hochuli, 1976; Lehman, Newman, Kessler, & Jonathan, 1976; Johnstone, Campbell, & Hughes, 1978) but which suggested that routine EFM during labour was associated with a reduction in perinatal mortality (Vintzileos, Nochimson, Guzman, Knuppel & Schifrin, 1995).

2.2.1 RCTs comparing IA with EFM.

My search of the literature located nine RCTs conducted between 1976 and 1993 comparing IA with EFM. The details of these trials are provided in Table 2.1 at the end of this chapter. Two other RCTs (Herbst & Ingemarsson, 1994; Leveno et al., 1986) are not included in this review as they were not comparing IA with EFM. The Herbst and Ingemarsson (1994) trial conducted in Lund compared intermittent EFM with continuous EFM (Herbst & Ingemarsson, 1994), while the Dallas study by Leveno et al. (1986) compared selective monitoring (CTG for high-risk women) with universal monitoring (all labouring women). The method of randomisation in this study occurred through different access to CTG machines in alternate months. The number of available CTG machines alternated between seven (selective monitoring) in the first month and 19 (universal monitoring) in the second month. During the selective monitoring month, seven CTG machines were available in the 20-bed labour unit. High-risk women were cared for in the five-bed labour intensive care unit, where CTG use was routine. In the alternate month when universal monitoring was conducted, an extra 12 CTG machines were made available, bringing the total number of CTG machines available in the 20-bed labour unit to 19. In the labour intensive care unit the ratio of women to nurses was 2:1 with the nurse in constant attendance, while the women in standard labour rooms were visited every 30 minutes. These women received IA with a hand-held Doppler (Leveno et al., 1986).

Of the included trials, the earliest (Renou et al., 1976) was conducted in Australia followed by a second trial five years later (Wood, Renou, Oats, Farrell, Beischer & Anderson, 1981). Three of the trials were conducted in the USA (Haverkamp, Thompson, McFee & Cetrulo, 1976; Haverkamp, Orleans, Langendoerfer, McFee, Murphy & Thompson, 1979; Luthy, Shy, van Belle, Larson, Hughes, Benedetti, Brown, Effer, King & Stenchever, 1987). Two trials were conducted in Ireland and the UK (Kelso et al., 1978; Macdonald, Grant, Sheridan-Periera, Boylan & Chalmers, 1985) with the study by Macdonald et al. (1985) containing the largest number of participants (13,000). From the mid-1980s to early 1990s, two trials were conducted in Europe (Neldam, Osler, Hansen, Nim, Smith & Hertel, 1986; Vintileos, Antsaklis, Varvarigo, Papas, Sofatzis & Montgomery, 1993). The time span and variation in location for the studies are important considerations for a number of reasons.

The first of several issues to consider are the conditions under which most of the trials were conducted. These conditions included the significant increase in the availability of EFM within maternity units. As well, there was growing belief amongst the obstetric community that all women would benefit from CEFM, based on the findings of the few observational studies conducted prior to the RCTs (Vintzileos et al., 1993). In most of the trials, the use of internal EFM was performed by attaching a fetal scalp electrode (FSE) to the fetal head. This was often accompanied by internal measurement of uterine contractions, achieved by inserting a pressure transducer behind the fetal head. For these forms of monitoring to be used, artificial rupture of the membranes (ARM) was required. This intervention was considered appropriate at the time these studies were conducted, particularly in the context of determining the presence or absence of meconium staining of the amniotic fluid surrounding the

fetus. Meconium stained liquor was believed to be an indicator of fetal distress, making it desirable to know at the outset of labour so that decisions for care, particularly the choice of fetal monitoring modality, could be made. As well, most of these trials were conducted in hospitals that had a policy in place at the time of the trial for active management of labour¹⁰ for nulliparous¹¹ women.

It is possible some of these factors may have positively or negatively affected the outcomes of the trials. For instance, in regard to routine early breaking of the waters (ARM), Caldeyro-Barcia and colleagues (1972), had written about the links between ARM and FHR decelerations (Caldeyro-Barcia, Schwarcz, & Althabe, 1972). These authors noted the increased presence of type 1 decelerations¹² associated with cord compression, thought to be caused by the loss of protectiveness of amniotic fluid. They also noted that the progress of labour was not significantly influenced by the earlier timing of ARM during labour (Caldeyro-Barcia et al., 1972). The findings of the

¹⁰ Described by O'Driscoll and Meagher (1980), active management of labour for nulliparous women included one-to-one midwifery care in labour, early diagnosis of labour, early amniotomy (breaking the waters), and early augmentation of labour with oxytocin.

¹¹ Parity is a technical term that refers to the number of times a female has given birth to a fetus. A woman who has never completed a pregnancy beyond 20 weeks is referred to as being nulliparous, a nullipara or para 0. A woman in her first pregnancy can also be referred to as being primipara, which can be shortened to primip.

¹² Type 1 decelerations of the fetal heart rate are defined as early, uniform and repetitive decreases of the fetal heart of at least 15 beats per minute below the baseline rate and for at least 15 seconds. Type 1 decelerations mirror contractions by starting at the time of the contraction and finishing by the time the contraction ends

RCTs, particularly where early ARM, oxytocin augmentation of labour and internal FHR monitoring was used, must be interpreted in light of these interventions. They do not continue to be relevant for many maternity units now. Conversely, under trial conditions, many of the women received one-to-one midwifery care during labour. This may have had a positive influence on the outcomes for these women, as recent research into the role of continuous support during labour has demonstrated has demonstrated (Hodnett, Gates, Hofmeyr, & Sakala, 2003).

The objective of most studies was to determine the effectiveness of EFM in terms of maternal and neonatal outcomes. Several studies used fetal blood sampling (FBS) to measure fetal blood pH levels along with acid-base measures, and oxygen and carbon dioxide levels. These measurements can indicate whether or not the fetus was hypoxic during the labour and birth. The effects of EFM on perinatal mortality and neurodevelopment for premature babies was the main interest in a study by Luthy et al. (1987), while the usefulness of EFM as a measure of fetal distress was the main objective for a study by Kelso et al. (1978). The effects of EFM on the outcomes for low-risk women were the focus of only one of the RCTs (Wood et al., 1981).

Although my interest is specifically in outcomes for low-risk women, appraisal of the RCTs revealed that there were differences between the studies in the risk status of the included women. As it appears there are very few differences in the findings of the studies regardless of risk status, I have included all the RCTs in this review. The findings of these nine RCTs are summarised in Table 2.1 located at the end of this chapter. I have described each study using headings for: included women, objectives, intervention description, staff/women ratio, findings and conclusion. Slight

variations are apparent in the descriptions of the intervention used, but most women received internal FHR monitoring and an internal pressure transducer to measure contraction intensity. The control used was IA and it was described in a range of ways or not at all.

2.2.1.2 The included women.

Use of EFM was relatively widespread for women with pregnancy complications at the time of the RCTs, while IA was still used for low-risk women. There was debate in obstetric circles about whether EFM should be applied to all women regardless of their risk status. This debate resulted in the differences in the risk status of women included in the various trials.

The largest study, with nearly 13,000 high- and low-risk participants, was conducted in Dublin (Macdonald et al., 1985). Women participant numbers for the other eight studies ranged from 350 to 1428. Four studies included only high-risk participants (Haverkamp et al., 1976; Renou et al., 1976; Haverkamp et al., 1979; Luthy et al., 1987) with a degree of variation in conditions amongst the studies leading to classification of the high-risk status. The trial by Luthy and colleagues (1987) included only women with pre-term singleton pregnancies with fetal weights of 700–1750gms, which clearly made them fit the high-risk profile (Luthy et al., 1987). A mixture of low- and high-risk women was included in three of the RCTs (Macdonald et al., 1985; Neldam et al., 1986; Vintzileos et al., 1993). In two studies low-risk women only were included (Kelso et al., 1978; Wood et al., 1981). These two studies are particularly relevant to this research as they used only low-risk women as participants. The study by Wood et al., (1981) found high rates of caesarean section in the group of low-risk women monitored by EFM with no

significant perinatal benefits. Wood et al., (1981) concluded that it seemed doubtful that continuous EFM monitoring of low-risk patients would significantly reduce the incidence of fetal asphyxia. These findings were echoed in the remainder of trials and influenced the recommendations of fetal surveillance guidelines. It is hard, therefore, to understand why maternity care practitioners today still persist in using EFM in the absence of a clinical indicator.

2.2.1.3 The controls, interventions and midwife to women ratio.

As previously mentioned, internal FHR and contraction monitoring was used in many of the studies. This invasive form of FHR monitoring would require the woman to be confined to her bed in a semi-reclined or left lateral position. Restricting the woman's freedom of movement can impact on the efficiency of labour (Simkin & O'Hara, 2002). Therefore, being largely bed-bound during labour, as the women in these trials will have been, is likely to have impacted on progress of labour. This slow progress would result in increased use of synthetic oxytocin delivered by intravenous infusion to speed up the "slow" labour. Eight of the trials included women who received oxytocin, ranging from between 23% and 63% (Alfirevic et al., 2007). In the context of maternal and fetal outcomes, these practices must be considered to have had some influence.

2.2.1.4 The description of IA in the trials.

The ways in which the IA protocols were described varied. Two trials had no descriptions of how the IA was conducted for women in the control group (Renou et al., 1976; Wood et al., 1981), which makes it difficult to genuinely compare them with other studies. The remainder, with the exception of Neldam et al. (1986), described the IA protocol as listening to the FHR every 15 minutes in the first stage and every

five minutes in the second stage of labour. Auscultation occurred after a contraction with counting lasting 30 seconds to one minute (Haverkamp et al., 1976; Kelso et al., 1978; Haverkamp et al., 1979; Macdonald et al., 1985; Luthy et al., 1987). In the study by Vintzileos et al. (1993), auscultation was performed during and immediately after a contraction, making this the only study to auscultate the fetal heart rate during a contraction, which may have an impact on the findings. Auscultation during a contraction has several drawbacks. FHR decelerations during a contraction (with recovery to the average baseline by the end of the contraction) are largely caused by head compression and are considered harmless in the absence of other indicators for concern, such as a rising baseline rate. It is also uncomfortable for the woman, who may be asked to lie down or to remain still during auscultation. IA with a Pinard during a contraction might cause discomfort for the woman because of the pressure needed to be exerted to the ear piece in order to hear the FHR.

In the control group of the RCT from Copenhagen, first stage IA frequencies were slightly different from those mentioned in other studies (Neldam et al., 1986). In the Neldam (1986) study the IA protocol required the first stage of labour auscultation to be done twice an hour (every 30 minutes) for at least 15 seconds until the woman's cervix was dilated to five cms., then auscultation every 15 minutes for at least 15 seconds from five cms. to full dilatation. In the second stage of labour auscultation occurred after every contraction or at least every five minutes for 30 seconds (Neldam et al., 1986). The variations in frequency, timing and duration of IA used in these RCTs may make comparison between studies complicated. However, the main issue is a seeming global lack of consistency in how IA is conducted, making meaningful ongoing research of IA problematic. An RCT to test different frequencies, timing and duration is warranted.

2.2.1.5 The equipment for IA and midwife to woman ratio in the trials.

There was more consistency in the description of the equipment used during IA in the nine RCTs. A Pinard stethoscope or hand-held Doppler was used to listen to the FHR for women in the control groups in most of the studies. The first of the trials by Haverkamp and colleagues (1976) was somewhat unique in that the women in the control group, who were receiving IA, were also attached to the CTG machine with internal FHR and contraction monitoring occurring simultaneously with the IA. In a rather unique twist, the CTG machine for these women was positioned outside the labouring room, blinded to the staff and could not be used for clinical decision-making during labour. I believe the likelihood of this practice receiving ethics approval now would be very low.

One of the critical commentaries of the RCTs comparing IA with EFM is that under trial conditions the women who had IA received one-to-one care during labour, which is not or may not always be possible in every maternity unit. However, only five of the studies reported midwife to woman ratio during the trial. The RCTs conducted in Athens (Vintzileos et al., 1993), Denver (Haverkamp et al., 1976; Haverkamp et al., 1979), Dublin (Macdonald et al, 1985) and Seattle (Luthy et al., 1987) all report a one-to-one ratio. There was no information on midwife to woman ratio for the trials from Copenhagen (Neldam et al., 1986); Sheffield (Kelso et al., 1978) or either of the Melbourne studies (Renou et al., 1976; Wood et al., 1981). A criticism of IA is that it requires the continuous presence of the midwife in order to meet the requirements of the IA protocol (i.e., every 15 minutes in first stage and every five minutes in second stage). An argument against the decision to use IA is that it would have economic ramifications for many maternity units today. However, more recent research has demonstrated that close continuous support during labour

also reduces interventions and improves outcomes (Hodnett et al., 2003). It is possible that the one-to-one care from a midwife during the trials may have positively influenced the outcomes for the women receiving IA. This merely reinforces that the use of IA with one-to-one midwife care is the “gold standard” for FHR monitoring for low-risk women.

2.2.1.6 The findings and conclusions.

The main objective of the RCTs was to determine the effects of EFM compared to IA on the care and course of labour as revealed in maternal and fetal outcomes. Almost without exception there were findings of increased caesarean section for women in the groups who received EFM, many with statistically significant increases in operative delivery (Renou et al., 1976; Kelso et al., 1978; Wood et al., 1981; Vintzileos et al., 1993). Two trials reported markedly increased caesarean section rates, but these did not reach significance (Haverkamp et al., 1976; Haverkamp et al., 1979). Only in the Luthy et al. (1987) and Neldam et al. (1986) trials were no differences found in the caesarean section rates between groups.

The main findings for neonatal outcomes were higher rates of admission to NICU for the EFM group. One trial of mixed-risk women performed a sub-group analysis for the low-risk women and found a significant reduction in the rate of neonatal seizures for babies born to women in the EFM groups (Macdonald et al., 1985). A one year follow-up of the babies who suffered neonatal seizures in the Macdonald et al. (1985) trial found three babies in each group who were judged to have major neurological disabilities including cerebral palsy (CP). The overall risk of intrapartum and neonatal death was the same in the two groups. The findings related to neonatal seizures and the potential link with intrapartum asphyxia later became the topic of

much debate. Recommendations were made that any subsequent trials should include longer neonatal follow-up of these babies in an attempt to establish a causal link.

The researchers from Denver (Haverkamp et al., 1976; Haverkamp et al., 1979) summed up the collective findings from their studies involving high-risk women by acknowledging that EFM offers no greater benefit to low-risk women. As well, in the discussion of the Wood et al., (1981) trial, the authors have summarised their findings and those from the previous four RCTs (Renou et al., 1976; Haverkamp, et al., 1976; Kelso et al., 1978; Haverkamp et al., 1979) and highlighted several pertinent points. In discussing the finding that all of the trials failed to demonstrate a reduction in perinatal deaths through the use of EFM, Wood et al. (1981), asked what effect EFM has. The answer was women receiving EFM experienced a significant increase in caesarean section and assisted delivery, but without any improvement in measurements of neonatal well-being measured in the Apgar scores or need for resuscitation and admission to the neonatal intensive care unit (NICU) (Wood et al., 1981). They also highlighted the difficulties with inconsistent interpretation of CTGs and the need for a consistent approach and language, given that "...only 25% of FHR abnormalities are significant" (p. 532). From their analysis of the collective results of previous trials, the authors made some bold decisions for FHR monitoring moving forward. The Wood et al., (1981) trial concluded by saying:

The final decision whether to monitor will depend on a number of factors; the accuracy and reliability of monitoring and auscultation, the facility for proper interpretation and measurement of the FHR and scalp pH within the institution, or an institution closely matching that of the hospital, the relative costs of monitoring versus auscultation. At the Queen Victoria

Medical Centre, high risk women are monitored [with EFM] and low risk women are not monitored [with EFM]. (p. 533)

These conclusions delivered a strong message that the use of EFM should be restricted to women who have complicated pregnancies, which placed their fetus at higher risk of hypoxic injury. Importantly, they concluded that IA for FHR monitoring for low-risk women is safe and effective. A number of systematic reviews and meta-analyses conducted between 1995 and 2007 supported these assertions.

2.3 Systematic Reviews and Meta-analyses of RCTs Comparing IA and EFM

Systematic reviews of RCTs comparing IA with EFM (Table 2.1) and IA and admission CTG (Table 2.2) are presented in this section. A systematic review summarises primary studies according to a rigorous and predefined methodology (Greenhalgh, 2000) while a meta-analysis is performed to integrate the numerical data from several, usually small, studies examining the same question to improve the possibility of demonstrating a statistically significant difference (Greenhalgh, 2000).

A meta-analysis of nine RCTs discussed above conducted by Vintzileos and colleagues (1995), the findings of which were strongly influenced by the largest trial (Macdonald et al., 1985), demonstrated a high rate of caesarean section for women in the EFM group in four of the RCTs (Haverkamp et al., 1976; Renou, et al., 1976; Kelso et al., 1978 and Haverkamp et al., 1979), as well as higher overall rates of caesarean section (CS) for fetal distress (Haverkamp et al., 1976; Haverkamp et al., 1979; Macdonald, 1985 and Vintzileos et al., 1993). Higher rates of instrumental delivery were also found in four of the nine trials (Wood et al., 1981; Macdonald et al., 1985; Neldam et al., 1986 and Vintzileos et al., 1993). In terms of perinatal

outcomes, the meta-analysis demonstrated there were very few perinatal deaths and they were evenly distributed between the groups with 40 (4.2/1000) in the EFM group and 45 (4.9/1000) in the IA group. The perinatal death rates specifically due to fetal hypoxia were significantly decreased in the EFM group with 7 (0.7/1000) compared to 17 (1.8/1000) in the IA group (Vintzileos, Nochimson, Guzman, Knuppel, & Schiffrin, 1995).

The systematic review highlighted several limitations of the included trials and suggested the sample sizes for most of the studies were too small and several lacked power analyses. Some of the trials used fetal scalp blood testing as an adjunct to fetal monitoring and some allowed crossover between the groups in the presence of meconium-stained liquor and FHR abnormalities. The inconsistency in interpretation of CTGs was also highlighted in this systematic review (Vintzileos, 1995). The conclusion by Vintzileos and colleagues, (1995) was:

[t]he use of EFM as the primary fetal surveillance technique in labour is associated with a reduction in deaths caused by fetal hypoxia by approximately 60%. It may be that one perinatal death is prevented per 1000 births by the use of EFM during labour. However, the price that one has to pay for this reduction in perinatal mortality is an increase in surgical intervention and the use of forceps. (p.154)

According to Vintzileos and colleagues (1995), the final word is that the intention of EFM was to reduce perinatal morbidity and mortality, not to reduce the CS rate, so clinicians will either accept the findings of the meta-analysis as evidence that EFM should be used for all labouring women or continue to call for further RCTs of greater numbers to validate the results (Vintzileos et al., 1995). This conclusion leaves the

door open for health practitioners to make their own decisions on FHR monitoring options rather than use the evidence from clinical trials. As we will see later, evidence-based practice does indeed support the clinician to draw on their clinical experiences, but also to seek out the best-evidence available to guide decision-making. The inclusion of the woman into decision-making around FHR monitoring, also a tenet of evidence-based practice, is raised for the first time in each of the following systematic reviews.

A systematic review by Thacker, Stroup & Chang (2001) found 13 RCTs. However, four were excluded because they did not meet the selection criteria (randomised controlled trials) (Mahomed, Nyoni, Mulambo, Kasule, Jacobus, 1994; Garite, Dildy, McNamara, Nageotte, Boehm, Dellinger, Knuppel, Porreco, Miller, Sunderji, Varner, & Swedlow, 2000); Herbst and Ingemarrson, 1994; Leveno et al., 1986). It is noted that none of these excluded RCTs were included in the meta-analysis by Vintzileos and colleagues (1995). The main finding from this review was a statistically significant decrease in neonatal seizures (RR 0.51, 95% CI [0.32-0.82]) in the EFM group. The long-term impact of neonatal seizures was further examined in two follow-up studies and it was found that the long-term neurological effects of the neonatal seizures have been minimal. However, the increased rates of caesarean section (RR 1.41, 95% CI [1.23-1.61]) and assisted vaginal delivery (RR 1.20, 95% CI [1.11-1.30]) associated with the use of EFM continued to be statistically significant, especially in the low-risk population (Thacker, Stroup & Chang, 2001). The authors concluded that while there was a significant reduction in the rate of neonatal seizures in the EFM group, this information must be discussed and shared with the woman for informed decision-making to occur regarding the choice of FHR monitoring modality.

The most recent systematic review by Alfievic, Devane, and Gyte (2007) found 16 potential studies and of those, 12 studies with 37,615 women were evaluated. Nine studies previously included in both the Vintzileos et al. (1995) and Thacker et al. (2001) systematic review have been discussed above. Three studies were excluded (Garite et al., 2000; Mahomed, Nyoni, Mulambo, Kasule, & Jacobus, 1994; Stefos, Sotiriadis, Tsirkas, Korkontzelos, Papadimitriou, & Lolis, 2001; D'Souza, Black, & MacFarlane, 1982). Alfievic et al. (2007) include a study by Azhar and Neilson (2001), conducted in Pakistan, comparing EFM plus fetal blood sampling with IA in the context of a developing country. However, as this was an unpublished study, it was undiscoverable in my literature search.

The findings of this systematic review demonstrate a significant increase in the rate of CS in the continuous CTG group, which may have been influenced by the quality of the trials. There were no significant statistical differences in perinatal mortality between the groups (PNM 01.27: RR 0.85, 95% CI [0.59 to 1.23] N = 33,513, 11 trials). However, there was a higher level of neonatal seizures in the IA groups, although the incidence of neonatal seizures varied considerably between trials.

As with many obstetric interventions, practitioners are interested to understand the logic of the widespread application of a new treatment or technology in terms of how many “patients” need to receive the treatment or technology to make a difference to the outcome. In other words, what are the numbers that need to be treated (NNT) to prevent one additional bad outcome. Advising caution with this type of calculation in the context of the findings, Alfievic, Devane and Gyte, (2007), have

revealed that, “661 women would have to be continuously monitored during labour to prevent one neonatal seizure (95% CI 384 to 2002)” (p. 12).

Debate around the significance of the finding of increased neonatal seizures has continued since it was first reported by Thacker and Stroup (2000). These authors concluded that the long-term benefit of this reduction in neonatal seizures must be weighed against the increased risk of assisted vaginal delivery and caesarean section and that the woman should be included in the decision-making process. In commenting on the incidence of increased neonatal seizures in the largest of the trials (Macdonald et al., 1985) included in the Thacker et al. (2000) systematic review, Parer and King, (2000), note:

The long-term follow-up of the newborns with seizures failed to find significant sequelae. Most importantly, the majority of newborns in the trial as a whole who had cerebral palsy were not in the group of those fetuses that had FHR tracings that were considered ominous. (p. 984)

The Alfrevic and colleagues (2007) systematic review also provided a subgroup analysis for low-risk women¹³, specifically from three of the included studies (Kelso et al., 1978; Wood et al., 1981; Leveno et al., 1986) and found the outcomes for increased assisted vaginal delivery and caesarean section consistent with the overall results (Alfrevic, Devane, & Gyte, (2007). Again, no difference was found in the rate of perinatal death but, as in the full analysis there was a reduction in neonatal seizures. However, the incidence of cerebral palsy was not reported. Two studies in

¹³ Imprey et al. (2003) defines women at low obstetric risk as having: no adverse obstetric history, no evidence or suspicion of antenatal fetal compromise.

the sub-group (Leveno et al., 1986; Wood et al., 1981) reported an increase in the number of babies admitted to neonatal intensive care unit in the continuous CTG group. The reported reduction in neonatal seizures needs to be interpreted cautiously because of the absence of long-term follow-up. More recently, our understanding of the causal link between the development of cerebral palsy and hypoxic ischaemic encephalopathy is that the injury is more likely to have occurred as a result of a sentinel event occurring in the antenatal period (McLennan, 1999).

From the perspective of decision-making around each monitoring modality, it is clear that both the risks and benefits of each of these methods should be discussed with women antenatally so they are able to make informed decisions about intrapartum fetal heart monitoring. Low-risk women must have a clear understanding of the risk of assisted delivery and caesarean section associated with EFM and the problems associated with interpretation.

Finally, in completing this review of the second generation knowledge of IA versus EFM, I have noted the following statement in the systematic review by Alfirevic and colleagues (2007) that has influenced me to make a change to how I refer to FHR monitoring. I will now use the term CTG instead of EFM:

The term 'electronic fetal monitoring' is sometimes used synonymously with CTG monitoring, but is considered to be a less precise term because (1) CTG monitoring also includes monitoring the mother's contractions and (2) other forms of fetal monitoring might also be classed as 'electronic' e.g. ECG, fetal pulse oximetry. (p. 4)

Now I will turn to the RCTs that have compared IA with admission CTG. These studies are summarised in Table 2.3. Admission CTG, like continuous CTG, has

become used increasingly as an admission assessment when a labouring woman arrives in the maternity unit.

2.3.1 RCTs comparing IA with admission CTG.

Admission CTG, also known as the Labour Admission Test (LAT), is the application of electronic fetal monitoring (EFM) via a cardiotocograph (CTG) machine as soon as possible after admission of the labouring woman to the labour ward. The admission CTG usually runs for 20 to 30 minutes and is a screening test for fetal well-being.

The RCTs comparing IA and admission CTG sit alongside the large body of evidence from primary RCTs comparing IA with continuous CTG (Table 2.1). These trials, described above, repeatedly demonstrated that continuous CTG was associated with increased rates of interventions including assisted and surgical delivery but with no demonstrable differences in perinatal outcomes. Interventions occurred as a result of suspected but unconfirmed fetal distress determined by assessment of the FHR patterns on the CTG tracing. Despite this evidence, and changes made to professional associations' fetal surveillance guidelines recommending IA for low-risk women, admission CTG and continuous CTG are still the FHR monitoring modality of choice in many maternity units.

The ongoing use of continuous CTG for low-risk women is unsupported by the research; however, one of the arguments proffered in support of its continued use is the difficulty in assessing which woman/fetus is at high risk and which woman/fetus is truly low risk at the time labour starts. With this in mind, it was proposed that admission CTG might potentially identify compromised fetuses in low-risk pregnancies early enough in the labour process to allow intervention or immediate

delivery. A number of observational studies and RCTs comparing IA with admission CTG have resulted from this hypothesis. In this literature review, I will focus on the RCTs.

Between 2001 and 2003 three primary studies (RCTs) compared IA with Admission CTG (Mires, Williams & Howie, 2001; Impey, Reynolds, MacQuillan, Gates, Murphy, & Shell, 2003; Cheyne, Dunlop, Shields & Mathers, 2003). A summary of these three studies is found in Table 2.3. A further protocol for an RCT of cardiotocography versus intermittent auscultation of the fetal heart on admission to labour ward for assessment of fetal well-being is registered with the Cochrane Collaboration (Devane, Lalor, Daly, McGuire, & Smith, 2010) at the time of writing this literature review. Looking at each RCT, it is clear to see no justification remains to use the continuous CTG for low-risk women.

In the earliest of the trials comparing IA with Admission CTG (Mires et al., 2001), women were randomised in the third trimester and the envelope indicating which group the woman had been randomised to, was attached to their medical record. Between this time and going into labour, 1384 (37%) women developed a complication that warranted continuous CTG in labour; the largest group being those women requiring induction of labour. Analysis was done on an intention to treat basis as well as a sub-group analysis for the low-risk women. The study found no neonatal benefit, as assessed by the presence of metabolic acidosis at delivery, when an admission CTG was performed. Concerns regarding inter-observer and intra-observer variation in interpretation of CTGs were expressed by the authors. The result of this variation of interpretation is that there is a tendency to over-report FHR

abnormalities leading to a cascade of intervention, ultimately leading to increased rates of operative delivery.

Two RCTs were published in 2003: Impey et al., (2003) and Cheyne et al., (2003). The hypothesis for Impey and colleagues' (2003) RCT was that admission CTG would reduce the rate of serious neonatal morbidity by 50%. However, this hypothesis was not confirmed as the RCT found no improvement in neonatal outcomes from the use of admission CTG for low-risk women. Unlike other RCTs comparing IA with continuous CTG, there was no significant increase in operative delivery and this was attributed to the use of fetal scalp blood sampling during labour for abnormal FHR, which was not a measure used in the earlier study by Mires et al (2001).

In the Impey et al. (2003) study, women in both groups were required to have amniotomy on admission prior to randomisation. The control group had "usual care" described as one-to-one midwifery care with IA every 15 minutes in first stage of labour and every five minutes in second stage of labour, for one minute after a contraction. The women in the intervention group had a 20-minute admission CTG, which was assessed against the stated criteria. If assessed as "normal", these women went on to have "usual unit care", that is, IA as described above. If the admission CTG was found to be abnormal, these women went on to continuous CTG until delivery. Sixty-eight percent of the admission CTGs were classified as normal. The findings from the Impey et al. (2003) trial revealed no differences in primary outcome measure of neonatal morbidity and mortality or for the secondary neonatal outcomes. More women in the intervention group had continuous CTG and had one or more fetal scalp blood samplings. The rates of CS, assisted delivery and

episiotomy did not differ between the groups. The authors concluded that admission CTG for low-risk women cannot be justified (Impey et al., 2003).

In the second 2003 study (Cheyne et al., 2003), the stated rationale for the RCT was the perception that the use of continuous CTG initiated a cascade of interventions. The hypothesis was stated as, “[t]he use of admission [CTG] for healthy pregnant women in spontaneous labour would result in an increase in continuous CTG when compared to women who have no admission [CTG]” (p. 222). The study took place in the Midwives Birth Unit (MBU) at the Glasgow Royal Maternity Unit. Low-risk women in spontaneous labour admitted to the MBU were randomised to have either a 20-minute admission CTG or not. Those that were randomised to no admission CTG had auscultation of the FHR for a minimum of one minute. Following this, both groups received IA as per usual protocol. Forty-six percent of potential women were excluded and 34 did not consent, leaving eligible 334 women. There were no differences in the use of continuous CTG; however, the women in the control group had significantly more additional CTG than those in the intervention group, usually as a result of the admission CTG not being removed or the detection of abnormal FHR on auscultation. No statistically significant differences were found between the groups for most common labour interventions.

To date, the only trials conducted comparing IA with admission CTG for low-risk women have been conducted in Ireland and Scotland and these were since the turn of the 21st century. Systematic reviews of RCTs comparing admission CTG with IA has been conducted (Blix, Reinar, Klovning, and Øian, 2005; Gourounti and Sandall, 2007) and the findings follow.

2.3.2 Systematic reviews comparing IA with admission CTG.

The purpose of the systematic reviews into IA compared with admission CTG (Table 2.4) was to determine whether continuous CTG improved maternal or neonatal outcomes and was a reliable predictor of adverse fetal outcomes. Despite most fetal surveillance guidelines containing a list of conditions where continuous CTG in labour is warranted, some maternity care providers find it difficult to let go of the technology. As a result of this perceived difficulty, low-risk women are increasingly exposed to the use of admission CTG. An alternative method of assessment of fetal well-being at the first point of contact in labour is warranted.

The use of admission CTG for low-risk women was reported in the most recent systematic review by Alfrevic et al. (2007). In 2000, approximately 79% UK maternity units reported they used admission CTG routinely (Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI, 2001). In Ireland, the rate of usage is as high as 96% of maternity units (Devane, 2007) and approximately 76% of Canadian hospitals (Kaczorowski, 1998; cited in Devane, Lalor, Daly, McGuire & Smith, 2010). In one small audit (193 women) at a maternity unit in New Zealand, 86/193 (44.5%) of all women in the sample received an admission CTG (Maude & Foureur, 2009). Of those 86 women, 25 (29 %) had no indications for continuous CTG as listed in the hospital's fetal monitoring policy. Of all the low risk women who had an admission CTG 49/86 (57%) went on to have CEFM (Maude and Foureur, 2009).

The first systematic review of IA versus admission CTG was conducted by Blix, Reinart, Klovning, and Øian (2005). This review included not only the RCTs but also 11 observational studies involving IA and admission CTG conducted between 1986

and 2003. Meta-analysis of the findings of RCTs revealed that women in the admission CTG group had more obstetric interventions such as epidural analgesia, continuous CTG and fetal blood sampling (FBS) than women in the IA groups. There were no statistically significant differences in the rates of assisted delivery, assisted delivery for fetal distress, or caesarean section for the women in the admission CTG group. In the observational studies, the predictive value of the admission CTG was poor.

The conclusion drawn from this systematic review was that there is no evidence supporting that the labour admission test is beneficial in low-risk women (Blix et al., 2005). These conclusions are echoed in the systematic review conducted a year later by Gourounti and Sandall (2007). The review looked at the three RCTs and specifically used effects on neonatal Apgar score, rate of CS and instrumental delivery. A summary of these two reviews is found in Table 2.4.

Like the findings from the review of RCTs comparing IA and continuous CTG, the trials and systematic reviews of IA versus admission CTG have failed to provide evidence that routine use of admission CTG for low-risk women improved perinatal outcomes. However, it has demonstrated that maternal outcomes are significantly affected.

Summary of Key Findings

The purpose of this review of literature was to establish the safety of IA for FHR monitoring for low-risk women. It is clear that the current evidence from RCTs and systematic reviews does not find that continuous CTG, or admission CTG, is any “safer” as a fetal heart monitoring modality for low-risk women than IA. With this knowledge in mind, the next section of the literature review examines fetal

surveillance guidelines to determine whether they are evidence-based and clear enough to guide practitioners and women to make informed decisions around FHR monitoring during labour.

2.4 Fetal Surveillance Guidelines

Evidence-based clinical guidelines for fetal surveillance can be used by practitioners and women to make evidence-based decisions. In this section I present an overview of a range of current and influential national and international fetal monitoring guidelines for intermittent auscultation. The guidelines were purposely selected from Australasia, UK, USA and Canada (Table 2.5). Other non-English countries have fetal monitoring guidelines based on either the USA or UK guidelines, but are not included in this review as they are not available in English.

2.4.1 Fetal surveillance guidelines for the conduct of IA.

As a response to the findings from the primary RCTs comparing IA with continuous CTG, professional organisations developed guidelines recommending IA as an appropriate FHR monitoring modality for low-risk women. The main components of these fetal surveillance guidelines from the USA, UK, Canada, and Australasia are summarised in Table 2.5. The lack of empirical evidence on the optimal frequency of intermittent auscultation is well documented in the literature, but there is a consensus in the guidelines that the fetal heart should be auscultated at least every 15 minutes (some say 15 to 30 minutes) in the active first stage of labour and at least every five minutes in the second stage of labour. The fetal heart beat should be counted for a full minute and from the end of the contraction (ACNM, 2007; ACOG, 2005; AWHONN, 2008; NICE, 2007; NZCOM, 2005; MIDIRS, 2005; RANZCOG, 2006; RCM, 2008; RCOG, 2001; SOGC, 2007; SOGC &BCPHP, 2008).

Each guideline includes statements to the effect that for women who are well and have uncomplicated pregnancies, IA should be offered and recommended. All the guidelines recommend that women receiving IA should have one-to-one care from a midwife. This may be a barrier to IA use in some maternity units as they may not be sufficiently resourced to provide this level of care. The current fetal surveillance guidelines span a timeframe from 2005 to 2008 (the RCOG/NICE, 2001 are now replaced by NICE Intrapartum Guidelines, 2007). Updates have incorporated all of the work done, especially around CTG language and interpretation, but there have been no updates for IA. Fetal surveillance guidelines mention the need for multi-disciplinary education and the need for maternity units to have clear policy for fetal monitoring but there are no strategies for the dissemination of updated information around fetal surveillances to practitioners.

2.4.2 Current IA practice descriptions.

In this section of the literature review I have summarised practice descriptions relating to the conduct of IA for low-risk women from two different sources (Goodwin, 2000; Feinstein, Sprague & Trépanier, 2008) (Table 2.6). These practice descriptions were chosen because they are widely referred to in the literature and fetal surveillance guidelines as being the “gold standard” for the conduct of IA. Their point of difference from the simple protocols for frequency, timing and duration of IA laid out in fetal surveillance guidelines is that they provide step-by-step instructions for doing IA accompanied by a rationale for each step. There is very little difference between the descriptions despite an eight-year time span between them.

The first practice description reviewed was developed as a response to the evidence from the RCTs comparing IA with continuous CTG (Goodwin, 2000) (Table

2.6). The impetus for her review of the general principles of IA was an understanding that practitioners had become somewhat deskilled with IA as the use of technology had significantly increased. Her argument was based on an assertion that (midwives) need a broad knowledge base and clinical competence in both IA and uterine palpation to provide competent care, educate the woman and her supporters, and create and implement a safe care plan that takes into account the wishes and preferences of the woman and her family (Goodwin, 2000).

As with the other practice descriptions, auscultation and palpation of the maternal abdomen are considered to be closely connected and do not sit in isolation from each other as forms of assessment used during labour. Palpation not only identifies the fetal position and therefore the optimal positioning of the auscultation device, it also enables assessment of uterine activity. This IA practice framework highlights the importance of communication, documentation and informed consent along with guidance on interpretation of the main FHR characteristics obtained during IA— rate, rhythm and FHR increases.

The fetal surveillance guidelines from the US (ACNM, 2007) and Canada (SOGC, 2007), not included in this review because of repetition, also provided guidance for practitioners in the conduct and interpretation of IA, both referring the reader to Feinstein et al. (2008). As with the previous description, these guidelines also identify the importance of distinguishing a difference between the maternal and fetal heart rates by palpating the maternal pulse simultaneously with auscultation of the FHR.

The second edition of the comprehensive monograph on intermittent auscultation of the fetal heart rate by Feinstein et al., (2008), provides a practice

framework (Table 2.6) for the conduct of IA that is supported by explanations of the physiological basis for the fetal heart rate, as well as a discussion around capabilities, benefits and limitations of auscultation devices, interpretation of auscultated FHR characteristics, management strategies, and documentation and communication. The authors also touch on the educational needs of care providers in relation to fetal surveillance along with staffing and legal issues in the context of practice realities in the 21st century.

The result of this review of fetal surveillance guidelines and IA practice descriptions is that there is some detailed literature around the underlying principles, conduct and interpretation of IA. However, there is a significant gap in all of the IA guidelines and practice descriptions in failing to mention the assessment of fetal movements as an indicator of fetal well-being. This is an area where the guidelines would benefit from redevelopment.

2.5 Summary

Three main areas of the literature around fetal heart rate monitoring were considered in this literature review: the primary RCTs, systematic reviews and meta-analyses, and review of guidelines and practice descriptions. The purpose of the literature review was to determine the safety of intermittent auscultation and to determine, from the literature, the existence of a robust and methodical protocol for IA that provides clear guidance for maternity care professionals in its conduct and interpretation.

The clinical trials and systematic reviews have overwhelmingly confirmed that IA is a safe and effective FHR monitoring modality for low-risk women. The fetal surveillance guidelines have incorporated this evidence and give advice that IA

should be offered and recommended for low-risk women. In their role as guardians of normal physiological birth, midwives and the midwifery model of care are ideally positioned to “enthusiastically support the use of intermittent auscultation and not regard the time and energy expended as a burden” (Tillett, 2007, p. 81). If we truly believe it is the right of every woman to receive personalised one-to one care during labour and birth, then IA, as an evidence-based FHR monitoring modality for low-risk women, provides the ideal opportunity to deliver this level of care. It is the job of midwives to disseminate this knowledge, to be seen using IA when appropriate, and to elevate this message to managers and decision-makers in our maternity institutions.

To disseminate knowledge of the safety of IA from research into practice, robust knowledge tools to assist decision-making, practice, and interpretation of IA are needed. Consistency of IA protocols and decision pathways are needed to support this practice. The literature revealed variation amongst IA practice descriptions and protocols as to how IA is used and interpreted. This creates a gap in knowledge of how IA is incorporated into practice. Coupled with the increased reliance of many maternity care providers on the use of technology, it is vitally important to develop a national and internationally consistent approach to IA.

The literature has answered the question posed at the beginning of the chapter: that it is possible to re-establish the validity of IA as a fundamental midwifery skill underpinning midwifery guardianship of normal birth. A second question posed at the end of Chapter One asked: can the knowledge of the validity of IA as a fundamental midwifery skill be translated into midwifery practice? With the evidence strongly supporting the safety of IA for low-risk women, a new question emerges: what is

preventing maternity care health professionals from implementing this evidence-based FHR monitoring method in everyday practice?

This led me to undertake an examination of the theoretical ideas of the movement known as Knowledge Translation (KT), since the KT literature provides insights into what might be an effective way forward. In the next chapter I explore the literature informing the tradition of knowledge translation and search for direction into how this issue can be addressed in my research.

Table 2.1

Randomised Controlled Trials (RCTs) Comparing IA with EFM (high- and low-risk women) 1976–1994

Study Author/Year/Location	No./type of Women	Objective	Protocol/Equipment	Nurse/Midwife: Woman ratio	Findings	Conclusion
Renou et al. 1976 Melbourne 1	350 -high risk women	To assess the effects, if any, of fetal monitoring on the course and conduct of labour and fetal and maternal outcomes	Control: No EFM or FBS, FHR monitoring method not described. Intervention: Continuous EFM and FBS	Not available	No difference in Apgar scores or need for resuscitation, but a significant increase in admission to NICU ($p<0.001$) and neurological symptoms ($p<0.0001$) in the control group. Increased rate of CS in intensive care group ($p<0.05$), a non- significant finding for assisted vaginal delivery.	Intensive care was associated with improved neurologic and biochemical status of the neonate.
Haverkamp et al. 1976 Denver 1	483 high-risk women	Comparing the effectiveness of EFM with IA in changing perinatal mortality and morbidity rates and neonatal outcomes	All women: A fetal scalp electrode and internal pressure transducer were used. Control: Odd numbers at randomisation - Remote and Blinded EFM with IA every 15 minutes in the 1 st stage and every 5 minutes in the 2 nd stage for 30 seconds after contractions Intervention: Even numbers at randomisation – EFM with standard obstetric criteria	Study nurse in addition to house staff and nurses for auscultation group only. 1: 1 ratio for IA group	No differences in the infant outcomes in any measured category between EFM and IA groups. The CS rate was significantly higher in the EFM group ($p<0.01$).	The presumptive benefits of EFM for improving fetal outcomes were not found in this study

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Study Author/Year/Location	No./type of Women	Objective	Protocol/Equipment	Nurse/Midwife: Woman ratio	Findings	Conclusion
Kelso et al. 1978 Sheffield	504 low-risk women	To evaluate the usefulness of CEFM in labour using the dip area as a measure of fetal distress with or without intrauterine pressure recordings.	Control: IA using a Pinard every 15 minutes, or more frequently if indicated, for 1 full minute immediately following a contraction. Doppler device could be used if there was difficulty hearing with a Pinard. Intervention: FHR monitoring via fetal scalp electrode +/- intrauterine pressure catheter.	No ratio stated but all women in the trial received the same level of care as other women in the labour ward from nurses and doctors	No significant differences for 1 minute Apgar <6, admission to SCBU. There was limited umbilical blood gas analysis, which showed no statistical differences between the two groups. There was a significantly higher rate of CS in the monitored group (p<0.05)	We have shown neither beneficial nor harmful effects as a direct result of the use of CEFM
Haverkamp et al. 1979 Denver 2	690 high-risk women	To assess the differential effects of CEFM and fetal pH scalp sampling as compared with auscultation	Control: Auscultation every 15 minutes in 1 st stage and every 5 minutes in 2 nd stage for 30 seconds after a contraction Intervention 1: EFM with Fetal scalp electrode and pressure catheter Intervention2: EFM with Fetal scalp electrode and pressure catheter and option for FBS	Study nurse in addition to house staff and nurses for both EFM and the IA group. 1: 1 ratio	No difference in perinatal outcomes. Three neonatal deaths (no intrapartum deaths) all in the monitored groups. No differences in Apgar scores at 1 and 5 minutes. No differences in mean pH and blood gas values in the 3 groups EFM group – increased CS rate	EFM with or without fetal blood sampling did not improve perinatal outcomes over that achieved by auscultation alone. CS was much higher among the EFM groups. Since no differences were in outcome were found in high-risk women in the Denver studies it would seem unlikely that a low-risk term patient experiencing a normal labour would benefit from monitoring if she is properly auscultated

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Study Author/Year/Location	No./type of Women	Objective	Protocol/Equipment	Nurse/Midwife: Woman ratio	Findings	Conclusion
Wood et al. 1981 Melbourne 2	828 low-risk women	To determine the effects, beneficial or otherwise, of FHR monitoring in normal low-risk patients.	Control: Not described Intervention: external CTG was used until amniotomy was performed then internal monitoring used	No ratio stated	No differences in Apgar score, neurological symptoms and signs. Only 1 perinatal death recorded (monitored group) Significantly more operative deliveries (forceps + CS) in the monitored group ($p<0.01$). No difference in CS rates	Findings continue to support the high rate of CS in monitored group with no perinatal benefits. Because of this it seems doubtful that monitoring of low-risk patients will significantly reduce the incidence of fetal asphyxia. As a result of the two Melbourne studies, the QVMC continue to monitor high-risk women with EFM but no longer monitor low-risk women with EFM.
MacDonald et al. 1985 Dublin	12,964 low- and high-risk women	To compare two current policies for FHR monitoring	Control: IA + FBS. IA at least every 15 minutes in the 1 st stage and after every contraction in the 2 nd stage following a contraction for 60 seconds, using a Pinard or Doppler if difficulties with Pinard Intervention: CEFM +FBS. Fetal scalp electrode was used if possible and external tocodynamometer	1:1	No difference in low Apgar scores, need for resuscitation, transfer to NICU, but an increase in neonatal seizures in the control group (21 cf. 9; $p<0.05$). Intervention group had shorter labours, a non-significantly higher rate of CS and significantly higher rate of forceps delivery ($p<0.0001$) mainly due to abnormalities of the FHR.	EM was associated with a 55% reduction in the frequency of neonatal seizures. This is compatible with a real reduction of between 9% and 78%. Or to prevent one case of neonatal seizures it is necessary to use EFM on 433 fetuses or between 240-2167 fetuses. Length of labour may be relevant
Neldam et al. 1986 Copenhagen	969 low- and high-risk women	To ascertain influence of EFM and auscultation on labour and fetal and maternal conditions. maternal attitudes to EFM and Auscultation	Control: IA twice an hour in 1stage of labour up to 5cms dilatation, then every 15 minutes from 5cms to full dilatation for at least 15 seconds. In 2 nd stage	Not stated	No significant difference for Apgar score. More normal FHR patterns (893) in 1 st stage in IA group compared with EFM (830) group.	No significant statistical differences in Apgar score between the EFM and Auscultation groups. CTG gave more information about the FHR than auscultation,

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		before and after delivery	auscultation after every contraction or at least every 5 minutes for 30 seconds Intervention: either external ultrasound transducer or internal fetal scalp electrode with pressure transducer occasionally.		In later first stage more bradycardia, tachycardia and variable decelerations in the EFM group No difference in the rate of CS for pathological FHR, but significantly more vacuum extractions in the EFM group (12.6% cf. 6.9%).	resulting in more vacuum extractions in EFM group, but not more CS. The specificity of both methods is high (80%) but predictive value for both methods low (50%)
Luthy et al. 1987 Seattle	246 women with pre-term singleton pregnancies, gestational age 26–32 weeks and EFW 700–1750gms	To determine whether EFM was associated with a clinically important improvement in perinatal mortality and neurodevelopment at 18 months (corrected) age.	Control: Using a DeLee fetoscope or amplified Doppler IA was done every 15 minutes in the 1 st stage and at least every 5 minutes in the 2 nd stage for 30 seconds after a contraction as determined by palpation. A baseline was obtained between contractions Intervention: External CTG when the membranes were intact. Internal scalp electrode and pressure catheter were used with ruptured membranes	Control: one-to-one care by a study nurse trained in auscultation Intervention: one-to-one care by a trained study nurse.	Perinatal or infant deaths were associated with 14% in the EFM group and 15% in the auscultation group. Monitoring technique was not associated with a significant difference in mortality in any birth weight category. Frequency of neonatal seizures, severe RDS and intracranial haemorrhage were not significantly different between the two groups. No differences were found in the 5 minute Apgar score, intrapartum acidosis, intracranial haemorrhage or rate of CS The primary CS rates was 16% for EFM group and 15% IA group	Compared with EFM, intrapartum auscultation as done in this study is unlikely to be associated with detectable differences in perinatal outcomes within the high-risk setting of pre-term labour.

<p>Vintzileos et al. 1993</p> <p>Athens</p>	<p>1428 low- and high-risk women</p>	<p>To determine whether the use of CEFM during labour is associated with decreased perinatal mortality and morbidity compared with intermittent auscultation in a population with a relatively high perinatal mortality rate.</p>	<p>Control: Doppler device was used for IA. The baseline FHR was counted between contractions and subsequently the FHR was auscultated every 15minutes in 1st stage and every 5 minutes in 2nd stage during and immediately after a contraction for at least 30 seconds afterwards. The maternal pulse is also counted. Uterine contractions were palpated</p> <p>Intervention: External EFM as long as the FHR trace was adequate and internal if any problems with quality.</p> <p>EFM traces were evaluated at least every 15 minutes in 1st stage and every 5 minutes in 2nd stage</p>	<p>One-to-one ratio for both groups</p>	<p>The perinatal death rate related to fetal hypoxia was significantly less in the EFM group (0 of the 736 versus 6 of the 682, p=0.03). There were 2 neonatal deaths in the EFM group and 9 perinatal deaths in the IA group (2 intrapartum and 7 neonatal). No difference in neonatal outcomes of Apgar score, NICU admissions, neonatal resuscitation</p> <p>EFM group – significantly more augmentation of labour (p=0.0001), induction of labour (p=0.0001), length of labour (p=0.006),increased non-reassuring patterns (p=0.0001), increased CS (p=0.005) and assisted delivery rates (p=0.002)</p>	<p>Intrapartum EFM as a primary and only method of intrapartum fetal surveillance was associated with decreased perinatal mortality due to fetal hypoxia but also higher rates of surgical intervention for suspected fetal distress.</p>
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Table 2.2

Systematic Reviews of RCTs Comparing IA with EFM

Study name/year	Included studies	No./type of women/	Objective	Outcomes	Conclusion
Vintzileos, et al., 1995	<p>Denver 1, 1976</p> <p>Melbourne 1, 1976</p> <p>Denver 2, 1979</p> <p>Melbourne 2, 1981</p> <p>Dublin, 1985</p> <p>Copenhagen, 1985</p> <p>Seattle, 1987</p> <p>Dallas, 1986</p> <p>Athens, 1993</p>	<p>Meta-analysis</p> <p>18,561 high and low-risk women of 26wks gestation or greater</p> <p>9 RCTs</p>	To determine whether the use of CEFM as the main method of intrapartum surveillance is associated with improved pregnancy outcome compared to IA.	Women monitored electronically had a significantly decreased perinatal mortality due to fetal hypoxia, higher overall CS rate, increased forceps or vacuum for suspected fetal distress	EFM is associated with increased rates of surgical intervention and decreased perinatal mortality due to fetal hypoxia
Thacker, et al., 2001	<p>Denver 1, 1976</p> <p>Melbourne 1, 1976</p> <p>Denver 2, 1979</p> <p>Melbourne 2, 1981</p> <p>Dublin, 1985</p> <p>Copenhagen, 1985</p> <p>Seattle, 1987</p>	<p>Systematic Review</p> <p>18,561 high and low-risk women</p> <p>9 RCTs</p>	To compare the efficacy and safety of routine CEFM during labour with IA, using the results of published RCTs	<p>No significant differences were observed in 1 minute Apgar scores below 4, 1 minute Apgar score below 7, rates of admission to NICU and perinatal death. A statistically significant decrease was associated with routine CEFM for neonatal seizures.</p> <p>An increase with the use of EFM was observed in the rate of C/S and operative vaginal delivery</p>	The only clinically significant benefit from the use of routine CEFM was in the reduction of neonatal seizures. In view of the increase in C/S and operative vaginal deliveries, the long-term benefit of this reduction must be evaluated in the decision reached jointly by the pregnant woman and her clinician to use CEFM or IA during labour.

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	Dallas, 1986				
	Athens, 1993				
Alfirevic, et al., 2007	<p>Athens, 1993</p> <p>Copenhagen, 1985</p> <p>Dallas, 1986</p> <p>Denver, 1976</p> <p>Denver, 1979</p> <p>Dublin, 1985</p> <p>Lund, 1994</p> <p>Melbourne, 1976</p> <p>Melbourne, 1981</p> <p>Pakistan, 1989</p> <p>Seattle, 1987</p> <p>Sheffield, 1978</p>	<p>Systematic Review</p> <p>over 37,000 women</p> <p>12 RCTs.</p>	<p>To evaluate the effectiveness and safety of continuous CTG when used as a method to monitor fetal well-being during labour.</p>	<p>No significant difference in perinatal mortality between the groups, (outcome 01.27: RR 0.85, 95% CI [0.59 to 1.23], N = 33,513, 11 trials). The use of continuous CTG monitoring was associated with a halving of the risk of neonatal seizures (outcome 01.26: RR 0.50, 95% CI [0.31 to 0.80], n = 32,386, nine trials), although no significant difference was detected in cerebral palsy. There was a significant increase in the caesarean section rate in the CTG group (relative risk (RR) 1.66, 95% confidence interval (CI) [1.30 to 2.13], N = 18,761, 10 trials). Women were also more likely to have an instrumental vaginal birth. Data for subgroups of low-risk, high-risk, pre-term pregnancies and high quality trials were consistent with overall results.</p>	<p>Continuous CTG during labour is associated with a reduction in neonatal seizures, but no significant differences in cerebral palsy, infant mortality or other standard measures of neonatal well-being. However, CEFM was associated with an increase in caesarean sections and instrumental vaginal births.</p> <p>The real challenge is how best to convey this uncertainty to women to enable them to make an informed choice without compromising the normality of labour.</p>

Table 2.3

Randomised Controlled Trials (RCTs) Comparing IA with Admission CTG for low-risk women

Study Name/Year/ Setting	No./type of Women	Objective	Protocol/Equipment	Nurse/Midwife: Woman ratio	Findings	Conclusion
Mires et al. 2001 Dundee	3752 low-risk women	To compare the effect of admission CTG and Doppler auscultation of the FHR on neonatal outcomes and levels of obstetric intervention.	Control: FHR auscultation with a hand-held Doppler device during and immediately after at least one contractions Intervention: 20 minutes of CTG on admission	Not stated	There were no significant differences in the incidence of metabolic acidosis or any other measure of neonatal outcome. Compared with Doppler auscultation, women who had an admission CTG were significantly more likely to have CEFM, augmentation of labour, epidural analgesia and operative delivery	Compared with Doppler auscultation of the FHR, admission CTG does not benefit neonatal outcome in low-risk women. Its use results in increased obstetric intervention, including operative delivery
Impey et al. 2003 Dublin	8580 low-risk women	To explore the efficacy of admission CTG in low-risk women in labour in terms of neonatal and maternal outcomes	Control: IA every 15 minutes in 1 st stage of labour and every 5 minutes in 2 nd stage of labour for 1 minute after a contraction Intervention: 20 minutes admission CTG	One-to-one care in both groups	There were no differences between the groups for neonatal morbidity or mortality. The rates of CS, instrumental delivery, episiotomy did not difference between groups, although interventions were slightly more frequent in the intervention group.	Routine use of CTG for 20 minutes on admission to the delivery suite does not improve neonatal outcome. No significant increase in operative delivery was apparent, probably because of the liberal use of fetal blood sampling
Cheyne et al. 2003 Glasgow	334 low-risk women	To test the hypothesis that admission CTG for healthy women in spontaneous labour would result in an increase in CEFM when compared to women who have no admission CTG	Control: 20 minute admission CTG Intervention: No admission CTG. FHR auscultated during and immediately after a contraction for a minimum of 1 minute with a hand-held Doppler device.	Not stated	No statistically significant differences between the groups for use of CEFM, but significantly more women in the control group did receive additional EFM. No statistically significant differences between the groups for any other interventions included.	The use of admission CTG did not in itself lead to a cascade of intervention. Other factors including the setting of care and philosophy of caregivers may have an effect on the rate of intervention in labour.

Table 2.4

Systematic Reviews of RCTs Comparing IA with Admission CTG for low-risk women

Study name/year	Included studies	No./type of women/	Objective	Outcomes	Conclusion
Blix, Reinar, Klovning and Øian, 2005	<p>RCTs</p> <p>Impey et al. (2003)</p> <p>Cheyne et al. (2003)</p> <p>Mires et al. (2001)</p> <p>Observational</p> <p>Blix et al (2003)</p> <p>Chua et al. (1996)</p> <p>Ducey et al. (1990)</p> <p>Elimian et al.(2003)</p> <p>Farrell et al.(1995)</p> <p>Farrell et al.(1998)</p> <p>Ingemarsson et al (1986)</p> <p>Ingemarsson et al.(1988)</p> <p>Sarno et al (1989)</p>	<p>11,259 low-risk women in 3 RCTs</p> <p>+</p> <p>5831 women in 11 observational studies (8 mixed populations and 3 with low-risk populations)</p>	<p>The assess the effectiveness of the labour admission test in preventing adverse outcomes, compared with auscultation only, and to assess the test's prognostic value in predicting adverse outcomes.</p>	<p>RCTs – women in the LAT group</p> <p>were more likely to have minor obstetric interventions like epidural analgesia [relative risk (RR) 1.2, 95% confidence interval (95% CI) [1.1–1.4], continuous electronic fetal monitoring (RR 1.3, 95% CI [1.2–1.5]) and fetal blood sampling (RR 1.3, 95% CI [1.1–1.5]) compared with women randomised to auscultation on admission. There were no significant differences in any of the other outcomes.</p> <p>From the observational studies, prognostic value for various outcomes was found to be generally poor. Likelihood ratio (LR) for a positive test was above 10 in 2 of 28 single outcomes and between 5 and 10 in six outcomes.</p>	<p>There is no evidence supporting that the labour admission test is beneficial in low-risk women.</p>

	Sarno et al (1990) Somerset et al. (1993)				
Gouranti and Sandall, 2006	Impey et al. (2003) Cheyne et al. (2003) Mires et al. (2001)	Pregnant women between 37 and 42 gestational weeks that were considered to be at low risk on their admission to the labour ward.	The aim was to determine whether intrapartum admission CTG in women at low obstetric risk can improve neonatal outcome (in terms of Apgar score) and whether it is associated with an increase in the incidence of instrumental delivery and caesarean section.	The pooled RR for having an Apgar score < 7 at 5 min was higher in the admission CTG group (RR 1.35, 95% CI [0.85–2.13]) but it was not statistically significant. The pooled RR for CS (RR 1.2 95% CI [1.00–1.41]) and an instrumental delivery (RR 1.1 95% CI [1.00–1.18]) were both higher in the admission CTG group. Both these were statistically significant.	Intrapartum admission cardiotocography in women at low obstetric risk increases the risk of caesarean section and instrumental delivery. In addition, there is no evidence for neonatal benefit in terms of Apgar score at 5 min after delivery. A larger sample size would be needed in order to answer this important question.

Table 2.5

Selected Fetal Monitoring Guidelines for Intermittent Auscultation

	NICE, 2007	ACOG (Guidelines for Perinatal care), 2007	SOGC and BCPHP, 2008	RANZCOG, 2006
Intermittent Auscultation	Intermittent auscultation of the FHR is recommended for low-risk women in established labour in any birth setting.	The method of fetal heart rate monitoring for fetal surveillance during labour may vary depending on the risk assessment at admission	The preferred method of fetal heart auscultation for low-risk women during labour is IA with a hand-held Doppler.	IA is recommended as a minimum for women who, at the onset of labour, are identified as having a low risk of developing fetal compromise.
Level of Support in Labour	A woman in established labour should receive supportive one-to-one care. A woman in established labour should not be left on her own except for short periods or at the woman's request.	ACOG has recommended a 1:1 ratio if intermittent auscultation is used as the primary technique for fetal surveillance.	Intensive fetal surveillance by intermittent auscultation or electronic fetal monitoring requires the continuous presence of nursing or midwifery staff. One-to-one care of the woman is recommended, recognising that the nurse/midwife is really caring for two patients, the woman and her unborn baby.	Women should have the same level of care and support, regardless of their decision about intrapartum fetal surveillance
Protocol for IA	<p>Intermittent auscultation can be undertaken by either Doppler ultrasound or Pinard stethoscope.</p> <p>In the active stages of labour,</p> <p>Intermittent auscultation of the fetal heart after a contraction should occur for at least 1 minute:</p> <ul style="list-style-type: none"> at least every 15 minutes in the first stage, and the rate should be recorded as an average at least every 5 	<p>If no risk factors are present at the time of the patient's admission, a standard approach to fetal surveillance is to determine, evaluate, and record the FHR:</p> <ul style="list-style-type: none"> every 30 minutes in the active phase of the first stage of labour at least every 15 minutes in the second stage of labour. 	<p>Auscultation, for one full minute, should occur immediately after a contraction and should be performed and documented every</p> <ul style="list-style-type: none"> every 15- 30 mins in active first stage every 5 mins during the second stage 	<p>Auscultation should occur with Doppler signal on speaker mode. Each auscultation should commence toward the end of the contraction and continue for at least 30 seconds after the contraction has finished</p> <ul style="list-style-type: none"> At least every 15-30 mins in the active phase of the first stage of labour At least every 5 minutes in the second stage of labour <p>Towards the end and at least 30 seconds after each contraction during active pushing in the second stage of labour C</p>

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	<p>minutes in the second stage</p> <p>The maternal pulse should be palpated if an FHR abnormality is detected to differentiate the two heart rates.</p>			
Action if IA non-reassuring	<p>Continuous EFM should be offered and recommended in pregnancies previously monitored with intermittent auscultation:</p> <ul style="list-style-type: none"> • If there is evidence on auscultation of a baseline less than 110 or greater than 160 bpm. • If there is evidence on auscultation of any decelerations. • If any intrapartum risk factors develop 	<p>If risk factors are present at admission or appear during labour, there is no difference in perinatal outcome between intermittent auscultation and continuous fetal monitoring if one of the following methods for FHR monitoring is used:</p> <ul style="list-style-type: none"> • 15minutes in active first stage, preferably before, during and after a uterine contraction • During the second stage the FHR is determined, evaluated, and recorded at least every 5 minutes 	<p>In circumstances where non-reassuring fetal heart-rate patterns are discovered on intermittent auscultation, it is appropriate to begin continuous electronic fetal monitoring.</p> <p>Reassuring: Normal baseline rate 110-160 bpm. Presence of accelerations</p> <p>Non-Reassuring: Abnormal baseline rate a) tachycardia FHR >160bpm</p> <p>b) bradycardia FHE <110bpm</p> <p>Presence of decelerations</p>	<p>In clinical situations where the FHR pattern is considered abnormal, immediate management includes:</p> <ul style="list-style-type: none"> • Identification of any reversible cause of the abnormality and initiation of appropriate action • Initiation or maintenance of EFM • Consideration of further fetal evaluation or delivery if significant abnormality persists

Table 2.6

Description of procedure for auscultation and palpation (Source: Goodwin, 2000; Feinstein, et al., 2008)

Action	Agreement	Rationale and purpose	Rationale and purpose
		Goodwin, 2000	Feinstein et al., 2008
1. Explain the procedure and offer the opportunity for questions	Yes	1. Provides support by involving the woman in her own care and offering information	1. Allays fear and anxiety; offers opportunity for emotional and informational support
2. Position the woman in semi-Fowler's or supported lateral position	Yes	2. Promotes fetal oxygenation and maternal comfort	2. Prevents supine hypotension syndrome and promotes comfort
3. Perform abdominal palpation to locate the fetal back	Yes	3. Helps to determine the best location for placement of the fetoscope or Doppler device	3. Locates the fetal vertex, buttocks and back and determines the best location for auscultation (fetal heart sounds are best heard through the fetal back)
4. Palpate for uterine activity; determine and document contraction frequency, duration, intensity and resting tone	Yes	4. Allows for accurate assessment of uterine activity; identifies appropriate time to begin auscultation	4. Determines the FHR response to uterine activity
5. If Doppler device is used, apply conduction gel to the surface	Yes	5. Promotes effective transmission of ultrasound waves and optimizes FHR signal	5. Provides an airtight seal and aids in the transmission of ultrasound waves
6. Position the bell of the fetoscope or surface of Doppler device on the maternal abdomen, over the fetal back and listen for a consistent signal. Reposition the fetoscope or Doppler device if indicated	Yes	6. Provides a FHR signal that can be accurately counted	6. Obtains the strongest signal

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7. Palpate the woman's radial pulse		Yes	7. Validates the FHR, not maternal heart rate, is being heard and counted	7. Differentiates maternal heart rate from FHR
8. Palpate the uterus to identify the end of a contraction; focus on the audible FHR signal and count for 30-60 seconds		Yes	8. Provides timing and duration for auscultation that are consistent with ACOG/AWHONN guidelines	8. Identifies the baseline FHR (in bpm), the rhythm (regular or irregular) and the presence or absence of FHR increases or decreases
9. Note the baseline FHR, regular or irregular rhythm, and presence of accelerations (Goodwin, 2000)	9. To clarify FHR increases or decreases, counting for multiple, consecutive brief periods of 6-10 seconds (multiplied by 10 and 6 respectively) may be particularly helpful (Feinstein et al., 2008)	No	9. Ensures that important characteristics of the FHR are noted and documented (Goodwin, 2000).	9. Clarifies the presence of FHR changes, such as abrupt versus gradual changes, and amplitude
10. Document the counted FHR as one number, rhythm as regular or irregular, and accelerations if identified		Yes	10. Provides a record of assessment of fetal well-being and FHR trending	10. Provides a record of assessment
11. Inform woman of findings and offer the opportunity for questions		Yes	11. Involves women in her care. Provides additional opportunity to clarify information	11. Provides informational support
12. Notify medical provider	12. Promote maternal comfort	No	12. Promotes communication between providers. Ensures appropriate responses and	12. Provides physical support and promotes fetal well-being

as indicated by protocol (Goodwin, 2000)	and continued fetal oxygenation (Feinstein et al., 2008)		intervention when indicated	
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Chapter Three: How is Knowledge Translated into Practice?

The key driver for this research was an understanding that the evidence supporting the practice of IA of the fetal heart during labour for low-risk women has not been effectively translated into practice. This disconnect between evidence-informed guidelines (what is known) and the decisions informing practice (what gets done) is referred to as the “know-do” gap (Landry, Amara, Pablos-Mendes, Shademani, & Gold, 2006). More than a decade ago the know-do gap, in relation to the use of IA for low risk women, was acknowledged in a journal editorial where the question was posed: “If our best evidence-based guidelines no longer recommend electronic fetal monitoring (EFM), why are so many clinicians still using it?” (Kripke, 1999). This question remains relevant today. Following a review of the literature cataloguing the research comparing IA with EFM, a recent comprehensive guide to fetal heart rate auscultation noted that on the basis of the current body of evidence, most professional associations consider IA an acceptable method of fetal heart monitoring for women of low obstetric risk (Feinstein, Sprague, & Trépanier, 2008). These authors were also moved to ask; “[w]ith the existing evidence . . . why [is] EFM . . . still being used extensively as the sole method of fetal surveillance and why [are] intrapartum care providers . . . hesitant to use auscultation as a primary method of fetal surveillance” (p.6). A further review of the evidence presented in the previous chapter has also asserted the safety of IA, but rather than simply continue to ask why is it not being used, my question is; what will encourage clinicians to bridge the know-do gap?

It is apparent that changing practices to reflect current research findings is a complex process requiring the identification of barriers to change as well as the development of effective interventions or initiatives to close the gaps in translating knowledge into practice (Straus, Tetroe, & Graham, 2009). This complexity has been integral to the development of the science of Knowledge Translation (KT) (Canadian Institute of Health Research [CIHR], 2005). Therefore KT appeared to offer the most useful conceptual and theoretical perspectives to inform the research to be undertaken for this thesis.

In this chapter I explore KT along with a number of influential KT frameworks including the knowledge-to-action (KTA) process, an example of a planned change model developed by Graham, Logan, Harrison, Straus, Tetroe, Casswell, and Robinson (2006). The KTA process is especially suited to my research as it establishes a relationship between the evidence generated from research and the end users of this knowledge. Furthermore, KTA processes are directly concerned with the implementation and evaluation of evidence into practice. Straus, Tetroe and Graham (2009), describe the KTA process as a “model for the promotion of the application of research and the process of knowledge translation” (p. 165). I begin the chapter by defining KT and the theoretical underpinnings that informed the development of a variety of KT models, including the KTA process. I finish the chapter by outlining how the KTA process will be applied to this research.

3.1 Defining KT

The concept of KT developed because of the unprecedented global investment in health research. That research has generated a vast pool of

knowledge that we now know is underused, or not translated rapidly enough into new or improved health policies, products, services or outcomes (Landry, Amara, Pablos-Mendes, Shadmani, & Gold, 2006). The term “knowledge translation” was coined by the Canadian Institute of Health Research (CIHR, 2000). The following definition from their website (<http://cihr-irsc.gc.ca/e/29418.html>) describes KT as:

a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically sound application of knowledge to improve . . . health . . . provide more effective health services and products and strengthen the health care system. This process takes place within a complex system of interactions between researchers and knowledge users that may vary in intensity, complexity and level of engagement depending on the nature of the research and the findings as well as the needs of the particular knowledge user (More about Knowledge Translation at CIHR, paragraphs 1 and 2).

This definition reveals that KT moves research evidence beyond its creation, distillation and dissemination into actually being used in decision-making. Since its focus is the use of knowledge in decision making, KT is not to be confused with continuing education or commercialisation or technology transfer (Straus, Tetroe, & Graham, 2009). Furthermore, “[s]trategies for KT may vary according to the target audience (e.g. researchers, clinicians, policy-makers, the public) and the type of knowledge being translated (i.e., clinical, biomedical or policy-related)” (p. 165).

KT is a term used to explain a range of activities, which include dissemination, linkage and exchange and, as a term, KT is often used synonymously with evidence-based decision making, research utilisation, innovation diffusion, knowledge transfer, research dissemination, research implementation and research uptake (Estabrooks, Thompson, Lovely, & Hofmeyer, 2006; Graham, & Tetroe, 2007). While it is acknowledged that there is an absence of an overarching KT theory, a range of theories and concepts have informed the development of KT. Graham and Tetroe (2010) have said of the KTA process, “given the action cycle’s grounding in planned action theory, the [KTA] framework can be considered evidence-informed” (p. 212). The theories and concepts informing the tradition of KT are examined in the next section to reveal how each conceptual framework contributed to the design of this study and how I came to choose KTA as the most appropriate framework.

3.2 Theories and Concepts Underpinning KT

KT has its origins in the studies of knowledge utilisation that in turn stem from Rogers’ “Diffusion of Innovation Theory” (Rogers, 2005). Three research utilisation conceptual models that were arguably more or less influenced by Rogers’ earlier work are critically examined to provide insights into the barriers and facilitators of translating knowledge into practice. These include the medically led Evidence Based Practice (EBP) movement, the nursing led Promoting Action on Research in Health Services (PARiHS) model (Kitson, Harvey, & McCormack, 1998; McCormack, Kitson, Harvey, Rycroft-Malone, Titchen, & Seers, 2002; Harvey, Loftus-Hills, Rycroft-Malone, Titchen, Kitson, McCormack, & Seers, 2002; Rycroft-Malone, Seers, Titchen, Harvey, Kitson, & McCormack, 2004), and the Ottawa Model of Research

Utilisation (OMRU) (Logan and Graham, 1998; Graham & Logan, 2004).

Greenhalgh's systematic review of Diffusion of Innovations (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004) is included in this discussion since the review findings were presented as a conceptual model that also attempted to articulate the complexity of translating knowledge into practice. I begin by describing the foundational work of Rogers' Diffusion of Innovation Theory (Rogers, 1962).

3.2.1 Rogers' Diffusion of Innovation theory.

Diffusion of Innovation theory seeks to explain the spread of new ideas. Rogers' theory was first published in 1962 and is well recognised as foundational knowledge that has underpinned studies in the area of diffusion of innovation for over half a century. Rogers used examples from research in the field of rural sociology to highlight the difficulties associated with moving new ideas into action (Rogers, 2005). The theory describes diffusion as "the process by which an innovation is communicated through certain channels, over time, among the members of a social system" (p.5).

Four main elements that influence the spread or diffusion of a new idea include: the *innovation* itself (the idea, practice or object that is perceived to be new by the potential adopters), *communication channels* (how knowledge about the new idea is communicated to potential adopters), *time* (the innovation to decision process) and a *social system* (the factors influencing the adoption of new ideas). In addition, the characteristics of an innovation help to explain why different innovations may have different rates of adoption. These characteristics are: *relative advantage* (is the new idea better than the previous idea), *compatibility* (is the new idea consistent with the

values, experiences and needs of the potential adopter), *complexity* (how difficult is it to understand and use the new idea), *trialability* (can the new idea be tested and altered to improve it) and *observability* (can others using the new idea see the same results). Rogers asserted that “[i]nnovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovation[s]” (Rogers, 1995, p.16). For diffusion of the innovation to be successful, how it is communicated to potential adopters must be understood.

Rogers’ theory asserts that individuals do not necessarily rely on the findings from scientific studies to evaluate an innovation, but are more likely to be influenced by the subjective evaluation communicated to them by other individuals who have already adopted the new idea. As a result, modelling and imitation by potential adopters make diffusion a social process (Rogers, 1995). The social process relies on a particular form of communication and communication channels, which are the means by which the message of the new idea passes from one individual to another. Communication is affected by the quality of the relationship between the giver and receiver of the information. According to the Diffusion of Innovation theory, face-to-face exchanges of information are more effective in persuading individuals to accept new ideas (Rogers, 2005). However, communicating new ideas to individuals and groups takes time, and this aspect is explored next.

The time component of the Diffusion of Innovation theory is used to measure the *innovation-decision process* (the process potential adopters pass through from first knowledge to adoption or rejection). Rogers proposed that individuals progress

through five stages in the innovation-decision process. The five stages begin with the potential adopter(s) becoming aware of the existence of an innovation and understanding its purpose, the “knowledge” stage. Then, through a stage of “persuasion”, the individual forms an opinion of the innovation. Engaging in activities that encourage adoption, or not, of the innovation is the “decision” stage, followed by the “implementation” stage where the innovation is put to use. The final stage is that of “confirmation”, where the individual may seek reinforcement of the decision to adopt the innovation (Rogers, 1995). The innovation-decision process is directly affected by the social system into which the innovation is to be introduced; meaning the initiator(s) of the innovation must take time to understand it for the diffusion process to be successful. Diffusion occurs within a social system where the structure, norms and opinion leaders influence the adoption of new ideas. For the new idea to be diffused, a change agent must work alongside opinion leaders within the social system. These opinion leaders guide the change agent to understand the behaviour patterns of the potential adopters within the social system. As the norms of the social system influence the adoption of new ideas, identification of what is important or abhorrent to the people or organisation is critical.

Even half a century after it was proposed, Rogers’ theory provides useful insights into understanding how new ideas become accepted and integrated into practice. But it is also apparent that the theory has not had the impact it deserves when planning to have a new idea taken up. For example, the theory does not appear to have been overtly considered in the development of the major movement in the 1990s towards evidence-based practice. Evidence-based practice (EBP) as an approach sought to

support clinician decision-making by integrating research evidence (generally from clinical trials) with clinical expertise and the values and beliefs of the patient. While EBP was embraced by many health care professionals, it has largely failed in its aim to ensure health care practice is based on robust research evidence, arguably because there was no apparent theory to underpin its development. EBP is unidirectional, and misses the steps for implementation that are implicit in Rogers' theory. It does this by appearing to assume that adopters would be motivated simply by being able to locate and appraise the best evidence according to the hierarchy of evidence and would then apply it in practice. In the following section I reveal the key components of EBP and identify how it has arguably failed to address the know-do gap.

3.2.2 Evidence-based practice (EBP).

Originally known as evidence based medicine (EBM), this represented a paradigm shift in medical practice away from a reliance on individual expertise gained through experience over time, to practice based on advances in clinical research, such as single clinical trials and meta-analyses of many similar trials (Bradt, 2009). Defined by Sackett, Rosenberg, Gray, Haynes and Richardson (1996), EBM is:

the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research.

(p. 71)

Two key aspects of EBP are to obtain the best external clinical evidence, which is usually from clinical trials and meta-analyses, and the skilled clinical “expert”, who has built up a body of knowledge through formal education, practice experiences, and the influence of day-to-day contact with patients. Combining these two key elements provides a support for evidence-based decision-making (Pozsolt et al., 2003).

According to Landry and colleagues (2006), EBP, “used a ‘push strategy’ of both active dissemination of practice guidelines and education for their local interpretation and adaption” (p.597). The lack of acknowledgement of factors that influence successful uptake of new ideas (how the innovation works, how to get the message through to the adopters, how long the process may take and who and what might assist in the process of moving new evidence into practice) means that health care practitioners are left without strategies to implement change (Greenhalgh et al., 2004). For example, the practice of EBM was about finding and critically appraising the evidence and then getting the findings from high quality research into practice, usually by way of guideline development.

Guidelines, developed from the most up-to-date research findings, were designed to support the implementation of evidence into practice (Hakkennes & Green, 2006). However, unless health care practitioners adhere to the recommendations of practice guidelines they will have little or no impact on actual clinical practice. In addition, guidelines do not take into account the many other contextual factors that may prevent evidence, no matter how robust, from influencing practice. For example, the clinical setting may not be able to afford the innovation or

there may not be sufficient staff capable of delivering the innovation. Despite this, in my opinion, the EBP framework five steps process provides the clearest description of a starting point for health professionals seeking to translate evidence into practice. Those five steps are: Step 1: formulating a well-built question; Step 2: identifying articles and other evidence-based resources that answer the question; Step 3: critically appraising the evidence to assess its validity; Step 4: applying the evidence; Step 5: re-evaluating the application of evidence and areas for improvement (Sackett et al., 1996).

While EBP increased awareness that clinical practices need to be effective to improve patient outcomes and that research has established evidence of effectiveness for many practice innovations, history has revealed that relatively few innovations have been widely implemented. One example is the practice of IA. While IA is hardly a practice innovation, since it has been in existence for decades, it is now an evidence-based practice that has not been implemented. Concern over the lack of evidence-based health care practice and practice innovation led the British government to fund Trisha Greenhalgh and her colleagues to undertake a systematic review and meta-synthesis of studies in this area. Their review aimed to identify common features of successful innovations so that others could use these insights to bring about change. I present their findings in the next section.

3.2.3 Greenhalgh's systematic review of Diffusion of Innovation.

Greenhalgh, Roberts, MacFarlane, Bate and Kyriakidou (2004) identified 495 studies of diffusion of innovation work in health services and conducted a meta-synthesis to reveal how health care system attributes influence research utilisation

and practice change. Their systematic review has relevance for this study, since the research will be conducted in a health service setting. Greenhalgh and colleagues produced a conceptual model of diffusion of innovation to illustrate the complex interrelationships between elements of the processes of diffusion that they identified. Figure 3.1 provides a simplified version of the Greenhalgh et al. (2004) conceptual model.

Figure 3.1. Conceptual Model of Diffusion of Innovations (after Greenhalgh, Roberts, MacFarlane, Bate, & Kyriakidou, 2004).

In this conceptual model, innovations in service delivery in the context of health care are described as a novel set of behaviours, routines, and ways of working that

are directed at improving health outcomes, administrative efficiency, cost effectiveness, or users' experiences, and are implemented by planned and coordinated actions. In this model, diffusion is defined as the passive spread of innovation, while dissemination is described as active and planned efforts to persuade target groups to adopt an innovation. Adoption or assimilation refers to a complex process in which individuals seek innovations. Greenhalgh et al. (2004) stated that:

People are not passive recipients of innovations, they seek innovations, experiment with them, evaluate them, find meaning in them, develop feelings about them, challenge them, worry about them, complain about them, work around them, gain experience with them, modify them to fit, . . . [and] try to improve or redesign them . . . (p. 6).

This fits well with Rogers' (2005) description of characteristics for the successful adoption of innovations previously described.

System antecedents (Figure 3.1) for innovation in the Greenhalgh et al. (2004) model include *structural determinants* of how ready the organisation is for innovation. This is determined by considering the size and maturity of the organisation, the degree of formalisation, differentiation, decentralisation, and resource capacity. The *absorptive capacity* for new knowledge considers the pre-existing knowledge and skills base within the organisation. This includes assessing whether there is an ability to find, interpret, recodify, and integrate new knowledge, along with enabling knowledge sharing through internal and external networks. The *receptive context for change* requires strong leadership and a clear strategic vision. Good managerial

relations, a risk-taking climate with visionary staff in pivotal positions with clear goals and priorities, and high quality data capture throughout the organisation are required.

Another key element identified in the review was that system readiness (Figure 3.1) must be determined (Greenhalgh et al., 2004). Key elements of system readiness include a tension for change that occurs when staff perceive the current situation as intolerable, and that the proposed innovation fits well with the organisation's existing values, norms, strategies, goals, skill mix, and ways of working. For the innovation to be successful, the number of supporters needs to outnumber opponents, with excellent support and advocacy. Budget for the implementation of the innovation must be both adequate and ongoing.

Building strong links between components of the model is important for successful implementation. This is especially the case during the development stage. When innovation developers work closely with the potential end users to capture and incorporate their ideas at the development stage, the innovation is more likely to be widely and successfully adopted. Finally, Greenhalgh and colleagues tell us that an organisation's decision to adopt an innovation and its efforts to implement and sustain it depend on a number of external influences. These influences include the sociopolitical climate, incentives and mandates, inter-organisational norm-setting and networks, and environmental stability. However, sometimes a political directive or mandate will increase the organisation's predisposition but not its capacity.

Greenhalgh et al. (2004) revealed that individuals adopt and spread different innovations at different rates, with some innovations never being adopted at all.

However, they were able to identify the key attributes of innovations which are likely to be adopted. Consideration of these key attributes has relevance to the dissemination of IA, which is the focus of this research project. The key attributes for successful innovations are that they should be:

Theory-driven: there needs to be an explicit link between the hypotheses and defined outcomes of the innovation in order to understand what will effect a change.

Process rather than “package” oriented: research questions should be framed to illuminate what characteristics account for the success of innovation implementation rather than looking for a causal link.

Ecological: the reciprocal interaction between the innovation implementation program and the setting where it is to be implemented should be recognised, as each influences the other.

Participatory: end users should be engaged as partners in the research process to increase the validity and success of innovation implementation (Greenhalgh et al., 2004).

These recommendations provide a complex but robust template for the dissemination of innovations in health care practice. In considering what I could learn from this systematic review to assist IA to be implemented in practice, I was aware of the importance of identifying an underpinning theory or framework to guide the process; that I needed to understand the research context well to know how its characteristics might influence the success of the project; that I had to do more than simply provide a “package” to incur change; and that I needed to engage the end

users in the research. The first step was to locate a suitable framework, so I continued my search.

A less complex theoretical model is that developed by Alison Kitson and her colleagues in the UK. It is known as the Promoting Action on Research in Health Services (PARiHS) Model. The PARiHS model describes three key concepts to be considered to increase the likelihood of success when innovations are to be implemented. This model is described in the next section.

3.2.4 Promoting Action on Research in Health Services (PARiHS).

The body of work for the PARiHS model comes from Kitson and colleagues (Kitson, Harvey & McCormack, 1998; McCormack et al., 2002; Harvey et al., 2002; Rycroft-Malone et al., 2004). This group proposed the following formula for implementing research into practice: $SI = f(E, C, F)$. The relationships between these elements are illustrated in Figure 3.2. What the formula and the figure describe is that successful implementation (SI) of research is a function (f) of the relationship between the level and nature of *evidence* (E), the *context* (C) or environment into which the research is introduced, and the process of *facilitation* (F). Each element is positioned on a high-to-low continuum, which defines the level of potential success of implementation.

Kitson and colleagues tell us that most successful implementation seems to occur when evidence is scientifically robust (it is high on the evidence continuum) and matches professional consensus and patients' preferences. However, research evidence can only address one small part of the complex experiences surrounding

health care. Therefore, although research evidence may be viewed as the “gold standard” it is always tempered by clinical experience and expertise, as well as the experiences and preferences of the users of the health care services. In 2004 Rycroft-Malone and colleagues modified the PARiHS framework to expand the evidence element to include "local data/information" (Rycroft-Malone et al., 2004). Local data and information are also a critical part of the complex makeup of what constitutes evidence. The four parts of the evidence component of the PARiHS model (research, clinical experience, patient experience, and local data) (Figure 3.2) are combined in clinical decision making. More effective care can be delivered by finding ways to use all the diverse aspects of this broader evidence base.

PARiHS - Promoting Action on Research Implementation in Health Services

Figure 3.2. Promoting Action on Research Implementation in Health Services

Figure 3.2 reveals that in promoting innovation or research evidence we are not dealing merely with the uncomplicated dissemination of findings to a passive and receptive audience, as contextual factors play a role in either facilitating or inhibiting the process. There are three elements of context that play an equally important role. These are the culture, leadership, and evaluation. The use of the term context was derived from the literature on “learning organisations, organisational excellence, continuous quality improvement and change management” (Kitson et al., 1998, p.105). Within the element of culture, organisations at the high end of the continuum are more likely to be those that are “learning organisations”, in that they embrace the key characteristics that facilitate learning and implementing change. These organisations value individuals’ contributions, are open, have decentralised decision-making, a shared vision, and quality organisational systems that tend to build innovative, facilitative cultures. The starting point is to gain an understanding of these characteristics of the organisation as a prerequisite to introducing evidence into practice.

According to both the PARiHS model and Rogers’ Diffusion of Innovation theory, leadership is a key element of innovation diffusion. Leaders have a key role to play in transforming cultures and shaping contexts that are ready for change. Leadership is about knowing how to make visions become reality. Transformational leaders, as opposed to those who command and control, have the ability to transform cultures to create contexts that are more conducive to the integration of evidence into practice (Burns, 1978; Bass, 1985). Transformational leaders believe everyone is a leader of something; they inspire staff to have a shared vision and do so in a stimulating

challenging and enabling way (Burns, 1978; Bass, 1985). This is similar to Rogers' (1995) proposal that opinion leaders influence innovation diffusion. The third element of the PARIHS model, facilitation, is the technique by which one person makes things easier for others. The purpose of facilitation is holistic rather than task oriented, with the aim of enabling teams and individuals to analyse, reflect, and change their own attitudes, behaviours and ways of working.

The PARIHS model incorporates all the elements of Rogers' Diffusion of Innovation theory and builds on his work by explaining each element from its position on a high-low continuum, this being a major factor in successful implementation of evidence or innovation. This model provides a robust template for the researcher keen to implement an innovation aimed at improving the uptake of evidence into practice.

In considering whether the PARIHS model could appropriately be applied to the design of my study, I was aware of deficiencies in relation to the context and facilitation of where this study was to be conducted that could impact on the success of the project. Regarding the context, these deficiencies included a lack of transformational leadership within the organisation; poor mechanisms for data management and information; an absence of any measurement of the quality of the services or individuals; little or no continuing education; and a disengaged learning culture coupled with a lack of resources for skilled facilitation. I considered these were challenges I would need to consider in the design and conduct of my study. They are the realities of practice in many organisations and could therefore enhance the external validity of my research.

Several similar models of evidence implementation were also developed in Canada and have been reviewed by the influential KT researcher Estabrooks and her colleagues (Estabrooks, Thompson, Lovely, & Hofmeyer, 2006). In their guide to KT theory this group identified five KT theories amongst which was the Ottawa Model of Research Use (OMRU), which also offered a model that could be usefully applied to my research.

3.2.5 Ottawa Model of Research Use (OMRU).

The OMRU is a context-focused interactive model of research with an interdisciplinary focus incorporating six elements: the practice environment; the potential research adopters; the evidence base for the innovation; research transfer strategies; the evidence adoption and outcomes of interest (Logan & Graham, 1998; Graham & Logan, 2004). Integral to the OMRU process is the systematic assessment, monitoring, and evaluation of the state of each of the six elements before, during, and following any research transfer efforts (Sudsawad, 2007). A key component of the model is barrier assessment applied to the innovation, the potential adopters, and the practice environment. The assessment of innovation phase measures the innovation against the criteria established by Rogers (2005). Those characteristics are: relative advantage, compatibility, complexity, trialability, and observability. The barrier assessment then influences the implementation plan as the innovation is adapted to address the barriers identified in the local context. Monitoring and evaluation are built into the model to determine the effectiveness of the innovation in influencing outcomes. The model is illustrated in Figure 3.3.

Figure 3.3. Ottawa Model of Research Use (OMRU) (Graham and Logan, 2004).

OMRU is the model that has been used most often to test whether evidence has actually been put into practice. The authors assert that OMRU is particularly useful when developing a program to introduce research into nursing practice (Graham and Logan, 2004; Sudsawad, 2007). Therefore, it was of great interest to me. The OMRU framework is thorough, particularly in its barrier assessment phases, but in terms of the study I was undertaking, it was more than one single researcher could reasonably achieve in the time available.

3.2.6 Key attributes of the models and theories.

The OMRU model, like the PARiHS model, contains many of the elements of Rogers' Diffusion of Innovation theory and the recommendations from Greenhalgh's synthesis. The key insights gained from the preceding reviews are that each

model/theory asserts the innovation must not only be evidence based, but it must also be a new or novel idea; the innovation needs to be developed by engaging with end users or adopters and barriers to successful implementation must be assessed and, one assumes, addressed in the design of the implementation plan. One strength of the PARiHS model lies in the inclusion of facilitation as a critical aspect to successful implementation. When considering my potential research site I recognised significant challenges existed in relation to each of the three elements defined by PARiHS (evidence, context, facilitation), since successful implementation is dependent on the relative position of each of the three elements on a high-low continuum (with the higher, the better). From Greenhalgh and colleagues I identified key insights into the characteristics of the innovation itself that would need to be addressed in the design of my study. These key insights relate particularly to the attributes for successful innovations. I have been mindful of these recommendations in my development of a KT intervention for this study.

While searching the literature for concepts and theories to inform my study, I followed the progress of KT models developed over time and came across the KTA process (Graham et al., 2006). This model appealed to me on a number of levels. Firstly, it incorporates all the important components of the Rogers theory and the Greenhalgh synthesis. As well, the KTA process incorporates aspects from the PARiHS framework, namely the influence of continuous quality improvement and change management (the action cycle) within the context of the study. As a simplified version of the OMRU model, I believed it would be more achievable as a guide for the research design of this study. This led me to conduct a deeper investigation into

the suitability of KTA as a tool to inform the design of my study. The KTA process is described in detail below.

3.3 The KTA Process

Refinement of previous KT models occurred with a critical analysis of KT conceptual models by Graham et al. (2007). This group conducted the critical analysis to increase understanding of the theoretical underpinnings of KT. The authors reported that conceptual frameworks can guide implementation and facilitate the interpretation and understanding of implementation (including quality improvement) efforts. Conceptual models of implementation are essentially models or theories of change and fall into two basic kinds—classical and planned. The classical models for change explain or describe how change occurs but are not specifically designed to be used to effect change. In contrast, a planned change model helps people to cause change. A planned change model is defined as:

a set of logically interrelated concepts that: explain, in a systematic way, the means by which planned change occurs; predict how various forces in an environment will react in specified change situations; and help planners or change agents control variables that increase or decrease the likelihood of the occurrence of change” (Rimmer & Johnson, 1998 as cited in Graham, Tetroe, & KT theories research group, 2007).

In their critical analysis of the conceptual models of implementation, Graham et al. (2007) identified 31 models/frameworks from a variety of disciplines (nursing, medicine, social work, occupational health, family planning, health education, and health informatics) published between 1983 and 2006. A number of commonalities in

the steps/phases of the planned action models were found. These action categories representing steps/phases of a planned action model are to:

Identify a problem that needs addressing

Identify a need for change

Identify change agents

Identify the target audience

Assess barriers to using the knowledge

Review the evidence and literature or develop or adapt an innovation

Select and tailor interventions to promote the use of the knowledge

Link to appropriate individuals or groups who have a vested interest in the project

- Implement
- Evaluate
 - Develop a plan to evaluate use of the knowledge
 - Pilot test
 - Evaluate process
 - Evaluate outcomes
- Maintain change or sustain ongoing knowledge use
- Disseminate results of the implementation process (p.939)

These planned action steps or phases have all been incorporated into the KTA process (Grahamer al., 2006), that I will now describe.

The following description of the KTA process draws on a series of articles published in the Canadian Medical Association Journal in February 2010 (Brouwers, Stacey, & O'Connor, 2010; Kitson & Straus, 2010; Harrison, Légaré, Graham, &

Fervers, 2010; Wensing, Bosch, & Grol, 2010; Davis & Davis, 2010; and Straus et al., 2010).

The KTA process (illustrated in Figure 3.4) developed by Graham et al. 2006, was adopted by the Canadian Institutes of Health Research as the accepted model for promoting the application of research and for the process of KT (Straus, Tetroe, & Graham, 2009; Brouwers, Stacey, & O'Connor, 2010). The KTA process is an iterative, dynamic, and complex process concerning the creation and application of knowledge (Straus, Tetro, & Graham, 2009). According to Graham and Tetroe(2009) “application refers to the iterative process by which knowledge is actually considered, put into practice or used to improve health and the health system” (p.157), and encompasses conceptual, instrumental and symbolic knowledge use.

The KTA process has two component parts: *knowledge creation*, which is symbolised by the inverted triangle in the centre of the framework, representing a funnel through which knowledge is distilled, and the *action cycle* surrounding the funnel representing the activities and processes related to use or application of knowledge (Graham et al., 2006). Although it is drawn as a cycle, the authors point out that the seven phases may be used either sequentially or simultaneously, with the knowledge creation phase informing each of the action phases. As well, each of the seven action phases can be influenced by the phase before it and it is also possible for feedback between the phases, which is demonstrated in the cycle by the use of double-sided arrows. This is what makes the process dynamic. When using this process, it is essential that the end users of the knowledge are included to ensure the knowledge and its subsequent implementation is relevant to their needs

(Graham & Tetroe, 2009). The two component parts are discussed in more detail below.

Figure 3.4. Knowledge-to-Action Process (Graham et al., 2006), reprinted with permission from <http://www.cihr-irsc.gc.ca/e/39033.html#Knowledge-Users> retrieved 1/12/11 at 1930hrs

3.3.1 Knowledge creation.

The knowledge creation funnel consists of the major types of knowledge or research in health care. As knowledge moves through the funnel, it becomes more distilled and refined and more useful to stakeholders and end users (Graham et al., 2006; Straus, Tetroe & Graham, 2009; Brouwers, Stacey & O'Connor,

2010). Throughout the stages of knowledge creation, the knowledge can be tailored for purpose. This tailoring can include refining research questions to fit the specific clinical problem identified, shaping the messages specific to the end users, and adapting the best method of dissemination. The knowledge creation funnel has three stages: knowledge inquiry, synthesis of knowledge and the creation of knowledge tools.

The *knowledge inquiry* stage represents first generation knowledge or knowledge derived from primary studies, such as randomised controlled trials. This knowledge may be of variable quality and is in its natural state and largely unrefined. It is often difficult for clinicians to make sense of the vast array of primary studies and how the findings should or could be applied to practice. Implementation of evidence from individual studies may be misleading because of bias in conducting studies or random variations in findings. This has led to greater emphasis on knowledge syntheses as the foundation of efforts to implement knowledge (Brouwers, Stacey & O'Connor, 2010). Knowledge synthesis is the next phase of the knowledge creation funnel.

Knowledge synthesis, or second generation knowledge, is the process of combining research findings from many primary studies. The process involves the application of explicit and reproducible methods to the identification, appraisal, and synthesis of studies or information relevant to specific questions. It is done to make sense of all the relevant knowledge. This knowledge often takes the form of systematic reviews, including meta-analysis and meta-synthesis. Synthesised knowledge provides the basis for knowledge tools for the KT.

Knowledge tools or products, known as third generation knowledge, come at the end of the knowledge funnel and present the best-quality knowledge synthesised and distilled into decision-making tools. These decision tools consist of things such as practice guidelines, decision aids and rules, care pathways and algorithms.

According to Brouwers and colleagues (2010), evidence-based guidelines assist health care professional, consumers, policy-makers and managers to make decisions about appropriate health care and are an important tool to inform evidence-based practice. This supports the earlier definition by Graham and colleagues (2006):

The purpose of these tools is to present knowledge in clear, concise, and user-friendly formats and ideally to provide explicit recommendations with the intent of influencing what stakeholders do and to meet the stakeholders' knowledge or informational needs, thereby facilitating the uptake and application of knowledge. (p. 19)

One drawback associated with knowledge tools, in particular clinical guidelines, is that evidence-based decision-making is not guaranteed because of their existence. Even with evidenced-based guidelines, dissemination of knowledge requires considerable effort to encourage uptake at the point of care delivery (Harrison, Légaré, Graham & Fervers, 2010).

The next component of the KTA process is the action cycle, which relates to the application or implementation of knowledge or evidence from research to practice.

3.3.2 Action cycle.

The action cycle represents activities that may be needed for knowledge application and implementation. The seven phases are dynamic, can occur sequentially or simultaneously, can influence each other, and can be influenced by the knowledge creation phases. The action cycle comes from a review of planned-action theories, frameworks, and models as discussed previously. The parts of the action cycle are outlined by Graham and colleagues (2006) and Straus and colleagues (2009) and are explained below.

3.3.2.1 Identifying the problem that needs addressing.

This may involve a group or individual identifying that there is a problem or issue that deserves attention. This stage involves identifying and understanding the gap between the best available research-based evidence and actual practice (Graham, et al. 2006).

3.3.2.2 Identifying, reviewing, and selecting the knowledge to implement.

This involves searching for knowledge or research that might address the identified problem (Doran, 2010). The research evidence is critically appraised to determine its validity and usefulness for the problem at hand, with consideration of the local and social context (Kitson, 2009). It might also mean identifying or becoming aware of a knowledge tool, such as a practice guideline, and then determining whether there is a knowledge-practice gap that needs filling with the identified knowledge.

3.3.2.3 Adapting or customising the knowledge to the local context.

This phase represents the processes groups or individuals go through as they make decisions about the value, usefulness, and appropriateness of particular knowledge to their setting and circumstances. The local context is taken to be anywhere along a continuum from a single clinic or hospital through to the region, or indeed the nation (Harrison et al., 2010). The knowledge may be customised to better suit their needs, thereby making it more acceptable and potentially encouraging greater adherence. Identifying the people who can help, support, or facilitate the change is useful at this stage (Graham et al., 2006).

3.3.2.4 Assessing the barriers to using the knowledge.

The uptake of knowledge can be influenced by issues related to the knowledge to be adopted, the potential adopters, and the context or setting in which the knowledge is to be used. At the barriers assessment phase, those wanting to bring about change (implementers or change agents) should assess for potential barriers that may impede or limit uptake of the knowledge so these barriers may be targeted and, hopefully, overcome or diminished by intervention strategies. The barrier assessments should also identify supports or facilitators that can be taken advantage of. Methods for the identification of barriers to change can include interviews, questionnaires, and group-based methods. Barriers to knowledge use may be related to knowledge, attitudes, and behaviours of the clinicians (Cabana et al., 1999, as cited in Harrison et al., 2010). Furthermore, Harrison and colleagues (2010) have developed a detailed and useful taxonomy of barriers and facilitators of knowledge use (available at www.cmaj.ca/cgi/content/full/cmaj.081232/DC1).

3.3.2.5 Selecting, tailoring, implementing interventions to promote the use of knowledge, that is, implement the change.

This phase is the one usually equated with the concept of dissemination or transfer strategies. It is about planning and executing interventions to facilitate and promote awareness and implementation of the knowledge. Change is more likely with planned and focused interventions. Interventions such as decision-making tools that bring the information closer to the point of care are more effective than lectures and conferences.

Wensing and colleagues (2010) report that rigorous evaluation of interventions for KT is lacking. However, of those that have been evaluated, in particular educational programmes, feedback and reminders demonstrate the overall absolute change in professional performance is usually not more than 10% on selected outcomes. Although this may seem a small change it may in fact be clinically and economically relevant. The authors note:

Passive educational interventions such as written guidelines, lectures, and conferences are unlikely to change behaviours if used alone. Active educational interventions, such as outreach-based visits, are more likely to induce change. Materials or websites for active self-study can be effective. Professional interventions that bring information close to the point of decision-making, such as reminders and decision-making support tools, are likely to be effective (Wensing et al., 2010, p.E85)

3.3.2.6 Monitor knowledge use.

This phase follows the implementation of the intervention and relates to monitoring the use or application of knowledge. Monitoring use of knowledge is necessary to determine how and to what extent the knowledge has been used by the end users. According to Straus and colleagues (2010) use of knowledge can be classified as *conceptual*, which implies changes in knowledge, understanding and attitudes; *instrumental*, or the concrete application of knowledge that describes changes in behaviour or practice, and *persuasive*, the strategic or symbolic use of knowledge and research used as a political or persuasive tool (p. E94).

Many tools are used for assessing use of knowledge but most have unknown validity or reliability (Straus et al. 2010). Most frequently, tools for the utilisation of knowledge measure instrumental use of knowledge. This can be done by measuring adherence to recommendations or quality indicators or care pathways.

3.3.2.7 Evaluating outcomes or impacts of using the knowledge

The purpose of this phase is to evaluate whether application of knowledge actually makes a difference to health, practitioner, and system outcomes. It is the only way to determine whether the efforts to promote its uptake of knowledge were successful and worth it.

3.3.2.8 Sustain knowledge use.

Sustainability is “the degree to which an innovation continues to be used after initial efforts to secure adoption is completed” (Rogers, 2005, p.429). This phase

These barriers may be different from the barriers that existed previously. However, the processes are the same and include: assessing the barriers, tailoring interventions to those barriers, monitoring knowledge use, and evaluating the impact of the initial and sustained use of the knowledge. The process represents a feedback loop that continues to cycle through the action phases and is similar to the cycle used in quality improvement.

KTA is the most comprehensive KT conceptual framework in that it draws together all of the elements revealed in the various models and theories previously reviewed in this chapter. The framework also has a simplicity that is inviting, because it clearly demonstrates that knowledge creation through knowledge distillation is central to the process of KT. No other model or theory has explicitly provided this element. KTA also uses a process that reflects a continuous quality improvement cycle with which I am most familiar. Therefore, the KTA process will guide the design of the research to follow.

3.4 Application of the KTA Cycle to this Research

Several theoretical and conceptual models reviewed in this chapter have provided ideas to consider in the design of my study. From Rogers' Diffusion of Innovation theory (2005) I took the four main elements that influence the spread or diffusion of a new idea. Those elements are described as "the process by which an innovation is communicated through certain channels, over time, among the members of a social system" (Rogers, 2005, p.5). Rogers, says that the innovation must be perceived to be new by the potential adopters. The innovation for this study, to be described in the next chapter, is a new framework to guide the practice of IA.

The “newness” of the ISIA framework is its inclusion of fetal movements and auscultated FHR increases in the assessment of fetal well-being, and the inclusion of basic physiology that aids interpretation.

Consideration of the communication channels or how the knowledge about the new idea was communicated to potential adopters of the knowledge led to the development of a short teaching session that was delivered to staff in the usual in-service teaching slot within the maternity unit. The time element was considered in the design of the research, influencing the choice of a before and after design to be described in chapter five. Becoming engaged with the potential adopters of the knowledge was seen as a factor influencing the adoption of new idea.

From Greenhalgh and colleagues (2004) I have incorporated three of the key attributes of innovations described as being likely to increase the adoption of knowledge into practice. These elements are: the innovation needs to be theory-driven, process rather than “package” oriented, and ecological. For the first part, use of the KTA process, where knowledge creation informs the knowledge application process, an explicit link was revealed between the hypotheses and defined outcomes of the innovation to understand what will effect a change. The KTA process, as a conceptual model, encourages engagement between stakeholders and the researcher to determine the barriers to knowledge use and also to identify the facilitators. This process-driven approach, where the characteristics for successful uptake of knowledge are used to adapt the intervention to the local context by tailoring the innovation to the specific organisation’s needs, accounts for the success of innovation implementation From an ecological perspective, there is an

acknowledgement of the potential for interaction between the innovation implementation program and the setting where it is to be implemented, simply as a result of the researcher/stakeholder engagement.

The PARiHS conceptual framework focuses on evidence, context, and facilitation and measures the success of the implementation of knowledge on a high-low continuum. This framework provided useful insights into the roles of context and facilitation as key attributes to the successful implementation of evidence into practice. These insights have led me to delve deeper into understanding the characteristics of culture, leadership, and methods of evaluation at the study site maternity unit and to nurture the growth and development of the future facilitators of knowledge use within the organisation. The KTA process, incorporating many of the steps and phases of the planned action conceptual frameworks, provides an ideal template for this research because it engages the end users of research in a collaborative process aimed at identifying where the gaps in knowledge exist, and helps to tailor an intervention to address those gaps. Engagement with end users throughout the process is a key part of the success of KT action.

The two previous chapters of this thesis have established that the knowledge of IA is not being translated into practice despite evidence to support its use. I planned to undertake research to bridge this 'know-do' gap. Keeping the KTA process diagram in mind, it is clear to see that the previous chapter, which contained a review of the literature, represented the central component of the KTA process, known as the knowledge creation funnel, where first, second and third generation knowledge of FHR monitoring was explored.

The following chapter represents another phase of the action cycle of the KTA process by describing the development of the intervention to be used in this study. The intervention consists of a new evidence-based decision-making framework for the conduct of IA and an educational session designed to deliver the message to midwives. The framework is called Intelligent Structured Intermittent Auscultation (ISIA)

Chapter Four: Development of a Framework for Informed Decision-making Using Intelligent Structured Intermittent Auscultation (ISIA)

In the previous chapter, I described the KTA process, the conceptual framework for this study. In this chapter I focus on the phase of the KTA process that involves selecting, tailoring, and implementing interventions to promote the use of knowledge to undertake a planned change. In Chapter One, I posed two questions that guided this research. They were:

1. Is it possible to re-establish the validity of IA as a fundamental midwifery skill underpinning midwifery guardianship of normal birth?
2. Can the knowledge of the validity of IA as a fundamental midwifery skill be translated into midwifery practice?

The first question has been answered by the literature review of first and second generation knowledge related to the use of IA compared with EFM and admission CTG. However, during the review of the evidence and guidelines for IA (detailed in Chapter Two) and two IA practice descriptions (Goodwin, 2000; Feinstein et al., 2008) it became apparent that there was insufficient detail provided in any of them to appropriately support IA practice. In an attempt to answer the second research question, I believed it was important to develop a more robust framework for the conduct of IA; one that I propose needed to be overtly informed by an understanding of fetal physiology and research evidence. The new IA framework developed for this study is called Intelligent Structured Intermittent Auscultation, or ISIA. It is presented here as a decision-making framework with two parts: “Admission Assessment or First

Contact in Labour” and “Ongoing IA in Active Labour”. The Admission Assessment or First Contact in Labour component (illustrated in Figure 4.1) will be used by the maternity care provider when a woman is first admitted to an institutional birth setting or when first seen during early labour, which may be in her home. The second component, Ongoing IA in Active Labour (illustrated in Figure 4.2), will be used when the findings of the assessment phase indicate the woman is suitable for ISIA as the ongoing FHR monitoring modality. The ISIA informed decision-making framework is detailed in Section One.

Section Two provides a background understanding of the normal physiology underpinning the ISIA framework and introduces literature to support the inclusion of fetal movements and auscultated FHR increases as indicators of fetal well-being. An education program was developed to inform maternity care providers of the history, research evidence and guidelines that currently support the use of IA for low-risk women, and to introduce and explain the ISIA framework to potential adopters. Together, the ISIA framework and education program represent a knowledge translation intervention that becomes central to the study. The education programme is detailed in Section Three.

Section One

4.1 The ISIA Framework and the KTA Process

The ISIA framework was designed to provide support for practitioners in their decision-making around the appropriate use of IA for FHR monitoring for low-risk women. This work fits within the KTA action cycle phase of adapting knowledge to the local context and selecting, tailoring, and implementing interventions to promote

knowledge use to undertake a planned change. Adapting knowledge to the local context represents the processes groups or individuals go through as they make decisions about the value, usefulness, and appropriateness of particular knowledge to their setting and circumstances. In this study, the local context is a typical secondary maternity unit in New Zealand. Its specific characteristics are described in following chapter (Chapter Five).

The knowledge may be customised to better suit the needs of clinicians in the local setting, thereby making it more acceptable and potentially encouraging greater adherence. As Rogers 'Diffusion of Innovation' theory indicates, when developing an innovation for the diffusion of knowledge, it is important to address issues of relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). Therefore, I have combined experience from my clinical practice; evidence from research; feedback from clinical midwifery experts locally, nationally and internationally; guidelines for IA; and a review of fetal heart physiology to develop a new framework for IA. To begin, I present the two parts of the ISIA framework (Figure 4.1 and Figure 4.2) and provide a rationale for the inclusion of each component. In particular, I reveal why I have included the assessment of fetal movements.

Figure 4.1. ISIA informed decision-making – Admission Assessment or First Contact in Labour

Figure 4.2. ISIA informed decision-making – Ongoing FHR Monitoring in Active Labour

4.2 The ISIA Informed Decision-Making Framework

The ISIA framework aims to guide women and maternity care providers in their decision making regarding monitoring choice, clinical practice, interpretation, and action on the use of IA of the fetal heart during labour for low-risk women. Along with the feedback from the two yahoo groups of 'expert' midwives, I have drawn on two sources that present and describe in detail the concept of "intelligent auscultation". These are Baskett, Calder, Arulkumaran, and Munro-Kerr (2007), and Gibb and Arulkumaran (2008), who are regarded as authorities and opinion leaders in this area. Baskett et al., (2007) describe IA in the following words:

Intermittent auscultation should ideally commence by asking the mother about fetal movements and recording on the notes the latest time when she felt fetal movements. Then the baseline FHR could be auscultated and recorded. The care giver and mother could palpate the maternal abdomen for fetal movements and this observation recorded. Auscultation at this time should show an increase of the FHR > 15 beats above the earlier baseline. This represents FHR acceleration. Continued palpation allows uterine contractions to be felt. Auscultation immediately after the contraction should reveal if the FHR has a deceleration. Such intelligent auscultation is almost equivalent to a CTG trace and will indicate the baseline rate, accelerations and possibility of 'harmful' decelerations. In the presence of accelerations the baseline variability is likely to be normal and will indicate a non hypoxic fetus. (p.3)

I will return to Baskett et al. (2007) assertion of the importance of including fetal movements and noting fetal heart accelerations or decelerations in a later section of this chapter. The key issue at this stage is to reflect on their description of IA

conducted in this way as “intelligent auscultation”, that is, “almost equivalent to a CTG trace” (Baskett et al., 2007, p.3). Since this is the aim of the ISIA framework it seemed appropriate to include the term “intelligent auscultation” in naming my innovative framework. The incorporation of the term “structured” was also a conscious decision based on the messages I wanted the framework to convey to clinicians.

The word “structured” means having and manifesting a clearly defined structure or organisation, which I have related to the protocol for frequency, timing, and duration that guides the conduct of IA during labour. I acknowledged there is no scientific basis for these IA protocols (RANZCOG, 2006); however, they were used in most clinical trials comparing IA with continuous CTG. As such they represent the only protocols to have been subjected to the stringent requirements associated with RCTs. In the absence of current research, and consistency for how IA is performed I have chosen to include them in the ISIA framework and to indicate their structured application in the title of the innovation.

In the following pages I describe each component of the ISIA framework. I will use the subtitles from both the admission assessment component (Figure 4.1) and the ongoing IA component (Figure 4.2) as the headings to guide the reader. This is also the way the components of the framework are described to clinicians during the education program.

4.2.1 Admission Assessment or First Contact in Labour

Labour is one part of the whole childbearing continuum from conception to discharge at six weeks (Gibb & Arulkumaran, 2008) and risk factors may develop at any stage throughout pregnancy. A thorough assessment by the midwife on

admission to a delivery suite or at the first contact at home will help midwives to determine whether there are risk factors, either previously present or recently developed, that signal potential for fetal compromise during labour. An absence of risk factors, accompanied by findings from the physical assessment, means the woman is suitable to receive IA in labour. Each part of the admission assessment framework will be discussed in some detail.

4.2.1.1 Risk Assessment: Review the Care Plan, Antenatal History, and Social Factors for Increased Risk to Fetal Wellbeing

During labour, there are two key decision points where the midwife and woman discuss and decide on a method of fetal heart rate monitoring (an initial discussion should also take place in the antenatal period). The first decision point is at the time of the birth room admission assessment or during the first contact at home. At this time, the midwife and the woman share information about how she is coping, what supports are needed moving forward, and review of the maternity care plan, as well as information gleaned from a physical assessment of the woman and her unborn baby (NZCOM, 2008; Rattray, Flowers, Miles, & Clarke, 2010)

On admission or first contact in labour, the woman's previous obstetric, family, and medical histories are reviewed and summarised taking into account any factors considered to place the fetus at higher risk during labour. Lists of maternal and fetal conditions considered to place the fetus at risk of compromise during labour are included in all fetal heart monitoring guidelines and are summarised in Figure 4.1. It is also important to consider any social risk factors, such as smoking (Gardosi, 2009), obesity, socio-economic deprivation, and high parity (Stacey, Thompson, Mitchell, Ekeroma, Zuccollo, & McCowan, 2011) that may contribute to an increased

risk to fetal well-being. Women with late stillbirth were more likely to be those women of high parity (≥ 4) and Pacific ethnicity (Stacey et al., 2011). Discussion with the woman about the potential usefulness of vaginal examination to determine cervical dilatation and effacement may occur at this stage. A vaginal examination must always be preceded by an abdominal examination, which is described in the following section.

It is at this admission assessment that some maternity care providers believe an admission CTG is justified; and indeed many midwives and doctors still recommend and use this technology despite a lack of evidence supporting its use for low-risk women (Blix, Reiner, Klovning, & Øian, 2005; Gourounti & Sandall, 2007). As previously revealed by Baskett and colleagues (2007), intelligent auscultation is almost equivalent to a CTG trace (Baskett et al., 2007), and should be considered before the application of the CTG. A result of the inclusion of fetal movements (FM) monitoring and auscultated FHR increases (intelligent auscultation), to be discussed in Section Two, the ISIA framework provides an alternative means of assessing fetal well-being. Therefore, use of the ISIA framework for admission assessment is in keeping with the position of Gibbs and Arulkumaran (2008) who have stated:

Excessive technology should not be applied to those who are manifestly at low risk. It may confer no benefit, can generate both non-medical and medical anxiety, and through subtle effects may cause significant harm. . . the unthinking application of technology is counterproductive. (p.viii)

The following explanations relate to the information gathered through physical assessment and listening to the FHR.

4.2.1.2 Abdominal Palpation

The ISIA framework draws on the basic skills of auscultation and palpation as the means by which the midwife gains information about the well-being of the woman and her baby. The essential midwifery skills of touching, feeling, sensing, hearing, seeing, and knowing are employed. Review of the history, care plan, and examination are supported by abdominal palpation to determine fetal lie, presentation, and position, which also helps the midwife identify the optimal location for IA to be performed (Goodwin, 2000; Feinstein et al, 2008; Morton, 2010), and determine descent of the presenting part and the presence of fetal movements. Measurement of the fundal height from the top of the uterine fundus to the top of the symphysis pubis can be ascertained along with clinical assessment of fetal growth and liquor volume (Gibb & Arulkumaran, 2008). Uterine activity is also palpated taking note of contraction frequency, intensity, and duration along with the resting tone between contractions and the presence of any tenderness or irritability of the uterus.

4.2.1.3 Assess Fetal Movements (FM)

Women are generally aware of the pattern of their baby's movements and this is important information to elicit on admission or at the first contact during labour. This is done by asking the woman to tell you about her perceptions of the pattern of recent FM and recording the last time a FM was felt. Listening to the FHR during a FM is also the best time to determine increases of the FHR above the pre-determined average FHR (called auscultated FHR increases), which reassure fetal well-being. Keeping in mind fetal sleep/wake cycles, if a FM is not felt for around 20 – 40 minutes, stimulation by gentle rocking of the fetus should elicit a movement and

the FHR can be auscultated at this time. A detailed justification for the inclusion of fetal movements in the ISIA framework is provided in Section Two.

4.2.1.4 Assess Uterine Activity (UA)

With the woman's consent, palpation throughout a series of contractions will determine the onset, duration, frequency, and strength of the contractions (Feinstein et al., 2008; Goodwin, 2000, Macones, Hunkin, Spong, Hauth, & Moore, 2008). The presence of any uterine irritability or tenderness and the uterine resting tone between contractions are also determined at this time. Palpation of contractions enables the midwife to accurately time when to listen to the FHR. Contractions are quantified as the number of contractions present in a 10-minute window, averaged over 30 minutes.

4.2.1.5 Assess Fetal Heart Rate (FHR)

Auscultation of the FHR will enable the average FHR and the rhythm to be determined, along with the presence of FHR increases and the absence of FH decreases. According to Goodwin (2000):

Auscultation requires extremely focused listening and counting of each fetal heart beat as it is heard. Using the index finger to tap the beat being heard may increase accuracy of auscultation findings when the rate is rapid. The tapped beat may be counted by a second observer so that the person auscultating can be fully focused on hearing the rapid heart sounds. (p.55)

Because it is easy to hear other sounds when auscultating, such as blood flow through the umbilical cord or the placenta, it is important to differentiate the maternal and fetal heart rates by simultaneously palpating the maternal radial pulse during auscultation (Goodwin, 2000; Feinstein et al., 2008) (also illustrated in Figure 1 in

Chapter One). Fetal heart rate and rhythm, FHR increases and decreases, and normal and abnormal FHRs are described below.

The *average FHR* is determined by counting the fetal heart beats for periods of 30 to 60 seconds between palpated contractions and when the fetus is not moving, over a period of 10 minutes, to obtain an average number. A watch with a second hand or the stopwatch function on a mobile phone can be used to count the FHR for the recommended period (Morton, 2010). The average FHR is expressed as a single number in beats per minute (bpm), that is, 130 bpm.

FHR rhythm is not well defined in the literature nor is its significance known; however, it is possible to hear when the fetal heart beats are regular or irregular (not to be confused with FHR variability). If the FHR is irregular, further assessment is required to determine the type of dysrhythmia present and to rule out possible artifact created by using an electronic device. Irregular fetal heart beats are often benign and require no intervention and usually revert to a normal rhythm after the birth (Goodwin, 2000; Feinstein et al., 2008).

A *FHR increase* (an auscultated acceleration) is when the counted FHR is ≥ 15 bpm above the average FHR previously determined (Gibb & Arulkumaran, 2008) and may be heard with or without a fetal movement. A FHR increase is considered a good sign of fetal health; that is, the fetus is responding to stimuli and displaying integrity of its mechanisms controlling the heart, as explained in Section Two.

An *abrupt or gradual decrease in the FHR* may be detected by listening to the FHR immediately after the end of a contraction and is considered an abnormal finding. The complete clinical situation of woman and fetus should be reviewed in the presence of a FHR decrease after a contraction and measures taken to detect or

correct any causes (Feinstein et al., 2008). These measures are discussed in Section Two.

Normal FHR findings are when the average FHR is between 110 and 160 bpm, the rhythm is regular, there are FHR increases above the baseline FHR with or without movements, and there is an absence of FHR decreases below the average FHR. *Abnormal FHR findings* are when the average FHR is > 160 bpm (tachycardia) or < 110 bpm (bradycardia), the rhythm is irregular, and there are abrupt or gradual decreases of the FHR below the baseline FHR.

4.2.1.6 Documentation of Admission Assessment

Accurate documentation of all assessments made during the admission assessment provides clearly demonstrated clinical decision-making. When all of the elements of assessment have been shown to be normal, the midwife is instructed to make a clear statement that the woman is suitable to receive IA for ongoing FHR monitoring. An example of appropriate documentation is provided in Figure 4.3.

Date and time	G2 P1; EDC 25/9/11 Well woman with an uncomplicated pregnancy admitted at term in spontaneous labour since 0200hrs today, membranes intact. Antenatal history reviewed for risk factors – none found. Non-smoker. Good family support. Care plan indicates a preference for IA of the fetal heart rate during labour.	
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	<p><u>On Examination:</u> Temp: 36.5, Pulse 78bpm, Resps. 20, BP 116/70, urinalysis NAD.</p> <p>(Name of woman) reports regular fetal movements have been felt and the pattern of FMs are unchanged over the past few weeks. The last FM was felt 5 minutes ago.</p> <p><u>Abdominal palpation:</u> Fundus at term and liquor volume is clinically adequate.</p> <p>Longitudinal lie, cephalic presentation, left occipito-anterior position, head 2/5 palpable abdominally.</p> <p><u>Uterine activity:</u> contractions are coming every 3 minutes and lasting 50 seconds, they palpate as strong and the uterus is soft between contractions</p> <p><u>FHR:</u> average FHR is 130 bpm, determined over 10 minutes. The FHR counted during a fetal movement is 148 bpm and there were no decreases in the FHR when counted after the end of the contraction for 60 seconds. FH Rhythm is regular.</p> <p>All findings are within normal parameters and this woman is suitable for IA as on-going FR monitoring during active labour.</p>	Signature and designation
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Figure 4.3. Sample documentation when using the ISIA informed decision-making framework for admission assessment.

The second decision point occurs after the initial assessment has been completed and the risk status determined with a discussion and decision-making around ongoing FHR monitoring (Rattray, Flowers, Miles, & Clarke, 2010). The collective findings from the assessment are discussed with the woman and a decision about FHR monitoring modality can be made and documented on the care plan. In the absence of any risk factors and when all other parameters are normal, it is appropriate to offer and recommend intermittent auscultation for ongoing FHR monitoring during labour, and a statement to this effect is entered in the woman's medical record.

4.2.2 Ongoing FHR monitoring in Active Labour

The second component of the ISIA framework describes the protocol for IA during active labour and the management options when the FHR findings on auscultation are abnormal. It also correlates to the second decision point for decision making on FHR monitoring found in the study by Rattray et al. (2010). There are two main components in the central block for ongoing FHR monitoring using ISIA (Figure 4.2). They are an assessment of risk factors that develop during labour, and how IA is performed and interpreted. A third section describes management options when the FHR is abnormal.

4.2.2.1 Risk Assessment: Assess for Intrapartum Risk Factors for EFM

This assessment is continuous throughout the woman's labour. Fetal surveillance guidelines recommend continuous CTG if risk factors develop during labour. The ISIA framework (Figure 4.2) and fetal surveillance guidelines list conditions that warrant a change of FHR monitoring, so they will not be repeated here.

4.2.2.2 Intermittent Auscultation Protocol

To use IA in normal active labour, the midwife must be able to provide one-to-one care. The Society of Obstetricians and Gynaecologist of Canada (SOGC) have recognised this in their 2007 fetal surveillance guideline by acknowledging that midwives are really caring for two people; the woman and her unborn baby (Liston, Sawchuck, & Young, 2007). Continuous support during labour is upheld by evidence that indicates this practice model reduces intervention (Hodnett, Gates, Hofmeyr and Sakala, 2003; Garcia, Corry, Macdonald, Elbourne, & Grant, 2007).

In this part of the ISIA framework the frequency, timing and duration of IA are described. Current fetal surveillance guidelines vary in their recommendations for IA in the first and second stages of labour (see Table 1, Chapter One). However, the most commonly recommended frequencies for FHR auscultation are every 15 minutes or every 15 to 30 minutes during active first stage of labour and every 5 minutes or after every contraction in second stage. Timing of auscultation is from the end of a contraction and the duration of counting of the FHR is for 30 to 60 seconds, with 60 seconds the most optimal duration. The counted FHR is recorded as a single number. I have chosen to use the frequency of 15 to 30 minutes in this framework because it is the most widely recommend frequency and, from my own clinical practice, more likely to be achievable.

The fetal heart rate is auscultated immediately after the end of the contraction. Historical midwifery textbooks provide a clue as to why. In the first edition of Textbook for Midwives, Margaret Myles (1953) stated that the FHR was never auscultated during a contraction since oxygen to the fetus would be reduced at this time and so this would not be a true reading of the fetal heart rate (Myles, 1953; as

cited in Lewis and Rowe, 2004a). The rationale for auscultation of the FHR after the contraction is twofold. Firstly, the deceleration that returns to the average FHR (baseline) before the contraction abates is unlikely to be harmful to the fetus. In addition it is irritating to the woman if a fetal stethoscope or Doppler is used during a contraction. Thickening of the myometrium during contractions also reduces the ability to hear the FHR clearly. Most of the harmful FHR decelerations are late, atypical, variable, and prolonged decelerations and can be identified by auscultation immediately after a contraction.

As in the admission assessment component, the presence of fetal movements is documented throughout labour as an ongoing indicator of fetal well-being.

4.2.2.3 Normal IA Findings

When the findings from all assessments are normal, continued IA is appropriate. Normal is defined as: the average FHR is between 110 and 160 bpm, there are FHR increases and no FHR decreases, and the fetal heart rhythm is regular. Monitoring of the uterine activity should reveal normal activity and tone. Each individual woman will experience labour differently with a range of contraction frequency from one every three minutes to one every 10 minutes (Thorpe & Anderson, 2010; as cited in Pairman, Tracy, Thorogood, & Pincombe, 2010). Normal contractions are classified as less than five contractions in a 10 minute period, while an abnormal contraction pattern is when there are more than five contractions in a 10 minute period (also known as tachysystole). Tachysystole is further qualified by the presence or absence of fetal heart rate decelerations (Macones et al., 2008).

Documentation of FHR, uterine activity, and fetal movements provide ongoing evidence of decision-making during labour. An example of how this can be documented is provided in Figure 4.4.

Date and time 25/9/11 1030hrs	FHR – 136bpm, auscultated with a Doppler device for 60 seconds from the end of a contraction no decreases in the average FHR heard. FH Rhythm is regular, increases to 155bpm heard with FM Contractions are 3:10, strong to palpate and lasting 60 seconds. Uterine resting tone between contractions is soft. <i>+(Narrative about the woman and how she is coping with her labour)</i>	Signature and designation
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Figure 4.4. Sample documentation when ISIA informed decision-making framework is used for ongoing fetal heart monitoring.

4.2.2.4 Abnormal IA Findings

Abnormal FHR findings include a rise in average rate above 160 bpm or a decrease in average rate below 110 bpm; gradual or abrupt decelerations; and an absence of FHR increases or irregular fetal heart rhythm with consideration given to potential causes. Should risk factors become evident during labour, for example meconium or blood stained liquor, need for oxytocin augmentation, or vaginal bleeding, FHR monitoring should convert to continuous CTG (Baskett, Calder, Arulkumaran & Munro-Kerr, 2007) (Figure 4.2). It is recommended that the FHR be assessed before and after any labour-enhancing procedures e.g., amniotomy, the

administration of medications, analgesia/anaesthesia, spontaneous rupture of the membranes (SRM), vaginal examination (VE), abnormal uterine activity patterns (increased tone or tachysystole), or any untoward event during labour (e.g., maternal hypotension) (British Columbia Reproductive Care Programme, 2005). Excessive uterine activity or increased uterine tenderness and/or tone are both abnormal findings that warrant follow-up.

Factors contributing to these abnormal FHR findings include: maternal or fetal temperature elevation/ infection, dehydration, maternal smoking, medications and illicit substances, maternal anxiety, prematurity or advanced gestational age, maternal anaemia, chronic hypoxia and acidosis, excessive uterine activity, maternal position (e.g., supine), maternal hypotension (related to drugs or regional anaesthesia), umbilical cord compression or cord occlusion, fetal cardiac conduction or structural defect, uterine hyperstimulation or hypertonus, maternal condition affecting the placenta (pre-eclampsia, diabetes), placental changes affecting uteroplacental gas exchange (abruption, post maturity aging, malformation, placenta praevia), rapid fetal descent, vaginal examination, uterine rupture and fetal bleeding (ruptured vasa praevia) (Feistein et al., 2008; Baker et al., 2009). The management options for abnormal FHR findings are considered next.

4.2.2.5 Consider Management of Abnormal Audible FHR during IA

IA requires one-to-one care from a midwife, especially because of the need to meet the frequency requirements of the monitoring. Among the management options to consider if there is an abnormal FHR is continuous care because of its link with a reduction of maternal anxiety. The link between maternal anxiety and fetal distress is clear when one understands the Fear Cascade theory described by several authors

including Foureur, who explains it as: “[fear results in] increased catecholamine (adrenaline) [that] constricts blood vessels, decreases uterine blood flow, reduces placental perfusion, decreases fetal oxygenation and as a consequence increases fetal distress (Foureur (1998); as cited in Fahy, Foureur and Hastie, 2008).

Consideration must also be given to other management options when there is an abnormal FHR on auscultation. These include: repositioning the woman to increase utero-placental perfusion or alleviate cord compression, ruling out fever/infection, dehydration, drug effect, maternal anxiety and/or prematurity, correcting maternal hypovolaemia by increasing fluids, including the administration of IV fluids, performing a vaginal examination to assess for the presence of a prolapsed cord or to relieve cord compression, checking the maternal pulse and BP and administering oxygen at 8 to 10 L/min. The evidence is unclear on the benefits of the use of oxygen in the case of fetal distress. A systematic review of maternal oxygen administration for fetal distress conducted by Fawole and Hofmeyer (2008) reveals no RCTs specifically focused on the use of oxygen for fetal distress. However, there were two trials addressing prophylactic oxygen administration during labour. The authors report conflicting conclusions on the effect of the duration of oxygen administration on umbilical artery pH values between the two trials (Fawole & Hofmeyr, 2003). Despite these findings, maternal oxygen administration during periods of prolonged fetal bradycardia remains a standard practice in many maternity units.

Additional measures include the need to continue to auscultate the FHR and auscultating more frequently. Furthermore, consideration needs to be given to initiating continuous CTG and fetal scalp blood sampling. The recommendation for

managing abnormal FHR findings where corrective measures have not resulted in an improvement is to consider ancillary tests such as FBS, consultation with obstetric colleagues, and expedited delivery.

This completes the presentation and detailed discussion of each component of the ISIA framework. However, an important point of difference between the ISIA framework and other IA practice descriptions (Goodwin, 2000; Feinstein, Sprague, & Trépanier, 2008) and the IA protocols contained in fetal surveillance guidelines from a range of professional organisations (RANZCOG, 2006; NICE, 2007; ACOG, 2007; SOGC, 2007) is the inclusion of fetal movements and auscultated FHR increases (accelerations) as an indicator of fetal well-being. This point of difference requires discussion in order to justify its inclusion in the framework. Using fetal movements seems logical, as we know that the hypoxic fetus does not move actively (Gibb & Arulkumaran, 2008). That is why reduced fetal movements in the antenatal period should trigger an immediate assessment of fetal well-being. There is now a renewed interest in assessing fetal movements to determine fetal well-being and, along with a discussion on basic physiology, the following section examines the role of fetal movements and FHR accelerations in tune with fetal movements to provide a rationale for the inclusion of their assessment in the ISIA framework.

Underpinning both components of the ISIA decision-making framework is an understanding of the physiology of the materno–utero–placental unit and FHR control, and what can be interpreted from detected changes in the FHR. For the intrapartum care provider to be able to quickly and skilfully assess and correct potential fetal compromise, they must have a thorough comprehension of the contributions of the maternal, placental, and fetal circulations to normal fetal

oxygenation (Baker, Beaves, Trickeyn & Wallace, 2009). This knowledge of the physiology and the physiologic responses of the fetus to changes in oxygenation should guide the intrapartum care provider to select the appropriate interventions and/or determine the need for further evaluation (Feinstein, Sprague, & Trépanier, 2008). An overview of the physiological underpinning of the ISIA framework follows in Section Two.

Section Two

4.3 Physiological Basis for FHR Monitoring Model

The purpose of FHR monitoring during labour is as a screening tool to identify whether the fetus may be compromised and becoming hypoxic. Changes in the characteristics of the FHR sounds prompt the maternity care provider to initiate actions that might include expedited delivery. FHR monitoring is a shared decision-making process, ideally thoroughly discussed antenatally between the woman and her family and her maternity care providers, and informed by the best available evidence. All intrapartum care providers, whether using IA or CTG, should have a broad understanding of fetal physiology to support their use and interpretation of FHR monitoring.

Knowledge of the underlying physiology associated with the materno–utero–placental unit, the control of the FHR and fetal responses to hypoxia are important. The FHR responds to intrinsic, or internal, fetal factors (the electrical conduction system of the heart, the autonomic nervous system, and hormonal influences), extrinsic, or external, factors (placental influences, umbilical cord circulation, and maternal issues), and physiological factors (Feinstein, Sprague, & Trépanier, 2008;

Baker, Beaves, Trickeyn & Wallace, 2009). Firstly, the materno–utero–placental unit is discussed, followed by control of the fetal heart.

4.3.1 The materno–utero–placental unit.

The fetus is completely dependent on the properly functioning materno–utero–placental unit for the delivery of oxygen and the removal of waste products. Optimal oxygen delivery to the fetus is dependent on a healthy pregnant woman with adequate stores of circulating oxygen, a healthy placenta, and optimal blood flow through the placenta (Feinstein et al., 2008; Baker et al., 2009).

External factors that can adversely affect the maternal transport of oxygen and nutrient-rich blood to the placenta include maternal hypotension (low blood pressure resulting in low maternal cardiac output, less blood flowing in the uterine arteries, less oxygen to the fetus); maternal hypertension (high blood pressure results from excessive vaso-constriction that reduces the diameter of the uterine arteries, thereby reducing blood flow and supply of oxygen and nutrients to the fetus); and excessive uterine contractions and a lack of uterine rest (shorter resting time between contractions reduces the ability of the blood flow to restore oxygen to pre-contraction levels). Other factors affecting diffusion between maternal and fetal circulations include a reduced placental surface area as found in cases of intrauterine growth restriction (IUGR) and placental abruption (Feinstein et al., 2008; Baker et al., 2009). Extrinsic factors are not always responsible for hypoxia in the fetus; factors intrinsic to the fetus may also affect blood flow.

Fetal factors (intrinsic) affecting the ability of the fetus to get blood to or from the placenta might include umbilical cord events such as a true knot in the cord, or cord entrapment. Fetal anaemia, structural cardiac abnormalities, or heart rhythm

problems that affect cardiac output may also contribute to low or disrupted blood flow. Any decrease or interruption of blood flow to the placenta results in a reduction of available oxygen to the fetus (hypoxia). Most healthy fetuses are able to withstand temporary decreases in oxygen flow and concentration by shunting more blood through the ductus venosus¹⁴ and autonomically triggered hormonal responses (Feinstein et al., 2008; Baker et al., 2009). Control of the fetal heart relies on a complex system of structures, nervous system responses, and hormones.

4.3.2 Control of the fetal heart.

Within the right atrium of the fetal heart, the sino-atrial node (SAN) is the primary pacemaker for regulating the FHR. The average FHR is between 110 and 160 bpm. The SAN is supplied with both sympathetic and parasympathetic nerve endings. These are branches of the autonomic nervous system that influence the FHR by responding to vascular pressure and biochemical changes in the fetus. The sympathetic system is responsible for the fright–flight–fight responses and causes rises in heart rate, cardiac output, and blood pressure from the effects of adrenaline and noradrenaline. The parasympathetic system, whose major pathway is the vagal nerve, reduces the heart rate, cardiac output, and blood pressure through the action of acetylcholine (an anaesthetic agent) on the SAN. The balance between the sympathetic and the parasympathetic systems determines the baseline heart rate and heart rate variability. A well-oxygenated central nervous system is characterised by a heart rate with normal baseline variability (Feinstein et al., 2008; Baker et al.,

¹⁴ In the fetus the ductus venosus shunts approximately half of the blood flow of the umbilical vein directly to the inferior vena cava. Thus, it allows oxygenated blood from the placenta to bypass the liver. In conjunction with the other fetal shunts, the foramen ovale and ductus arteriosus, it plays a critical role in preferentially shunting oxygenated blood to the fetal brain. It is a part of fetal circulation.

2009). Baseline variability is determined by estimating the difference in FHR beats per minute between the highest peak and lowest trough of fluctuation in a 1min segment of trace. Normal is considered to be ≥ 5 bpm (Feinstein et al., 2008; Baker et al., 2009). The SAN and autonomic nervous system are just one part of the picture of control of the fetal heart. Two types of receptors also play a significant role.

Fetal baroreceptors are organs sensitive to stretch or pressure and are located in the carotid artery, the aortic arch, and the brain stem. They respond to changes in fetal blood pressure (BP) and their main role is to protect the fetal brain against excesses in pressure. When the fetal BP increases the baroreceptors respond by stimulating the vagus nerve causing a release of acetylcholine to the SAN, which in turn causes a reflex bradycardia and reduced cardiac output that lowers the BP. When the fetal BP decreases, the baroreceptors stimulate a sympathetic response to increase the FHR (Feinstein et al., 2008; Baker et al., 2009).

Fetal chemoreceptors are also located in the arch of the aorta, the carotid artery, and the brain stem. Fetal chemoreceptors are organs sensitive to changes in blood chemistry (oxygen and also carbon-dioxide tension and acid-base balance). When there are altered levels of oxygen, carbon dioxide or pH levels, the fetal chemoreceptors respond by triggering the cardio regulatory system, which in turn increases sympathetic nervous system stimulation. Catecholamines are released to the SAN, which results in increased FHR and cardiac output (Feinstein et al., 2008; Baker et al., 2009). All of these structural responses by the fetal heart help us to understand the fetal response to hypoxia.

In the first instance, the fetal response to hypoxia is an increase in heart rate and cardiac output to increase the oxygen uptake from the placenta. Blood flow is

redirected from the less vital organs towards the brain, heart, and adrenal glands.

The duration of the insult causing the hypoxia and the interval between hypoxic insults are important and critical factors to consider when determining the ability of the fetus to compensate. Two main mechanisms for compensation are a redistribution of cardiac output and available oxygen, as mentioned previously, and/or a reduction in oxygen consumption. The haemodynamic changes increase the fetal BP, which may result in a parasympathetic response that decreases the BP and lowers the FHR. A reduction in oxygen consumption comes from reduction perfusion of the gut and limbs, including fetal breathing (practice breathing movements in utero) (Feinstein et al., 2008; Baker et al., 2009).

With this understanding of the physiology underpinning fetal heart rate monitoring, I now move on to justify the inclusion of fetal movements and auscultated FHR increases as part of the ISIA framework.

4.4 Fetal Movements

In the ISIA framework, questioning the woman about her perception of fetal movement is incorporated at the admission assessment and during ongoing FHR monitoring. Fetal movements perceived by the pregnant woman, along with fetal heart rate accelerations in relation to fetal movements are regarded as a sign of fetal health and well-being (van Woerden & van Geijn (1994, as cited in van Geijn & Copray, 1994; Gibb & Arulkumaran, 2008). The pregnant woman is encouraged to be aware of the usual patterns of movement of her unborn baby and the midwife should incorporate questioning about fetal movement patterns during routine antenatal care and also during labour. Nijhuis (1994), as cited in van Geijn & Copray, 1994) comments:

The greatest advantage of the fact that the fetus makes body movements is probably the consequence that one can ask the mother “how is your child today” and if she replies “happily moving” then this by itself is probably the most important and reassuring information.” (p.184)

Over the last four decades a body of knowledge has been established around the counting of fetal movements and fetal behavioural states and their role in assessing and understanding fetal well-being during the antenatal period. Returning to the KTA process outlined in Chapter Two, examples of first, second and third generation knowledge that have influenced the practice of maternity care providers around the place and role of fetal movement monitoring are further discussed below.

Formalised counting of fetal movements became popular in the late 20th century with the stated purpose being a reduction in perinatal mortality rates if maternity care providers were alerted to a reduction of FM before the fetus became further compromised. There was a clear understanding that when a fetus is compromised movements may decrease or are absent, with a strong correlation with fetal death. An early systematic review of 24 cohort and case-controlled studies evaluating the outcome of antenatal fetal movement counting found that increased vigilance regarding maternal perception of movements reduced stillbirth rates (Froen, 2004). A more recent systematic review of four RCTs of formal fetal movement counting as a means of assessing fetal well-being (including 71, 370 women) was conducted in 2007 (Mangesi & Hofmeyr, 2007). The only trial from the previous review (Froen, 2004) included in this later systematic review was the RCT by Grant, Elbourne, Valentin, and Alexander (1989) published in the Lancet. The Grant et al. (1989) trial was held responsible for the demise of further FM research when the results of their

large study (68,000 pregnancies) concluded that FM charts did not reduce perinatal mortality (Grant, Elbourne, Valentin, & Alexander, 1989), with very little research in this area continuing after this time.

However, in the Mangesi and Hofmeyr (2007) systematic review, several methods of fetal movement counting were described with the most common being the “count-to-ten” chart (Freda, Mikhail, Mazloom, Polizzoto, Damus, & Merkatz, 1993). The review found four studies (71,370 women) comparing two fetal movement counting methods: fetal movement counting and hormonal analysis, and one that compared routine fetal movement counting with selective fetal movement counting. The trials identified no advantages from using a FM chart. The authors commented that the numbers and the methodological quality of studies were insufficient to assess stillbirths accurately. Further trials were recommended with the inclusion of the assessment of women’s anxieties and views in addition to the ability of the counting to prevent stillbirths (Mangesi & Hofmeyr, 2007).

A further recent study (Haws, Yakoob, Soomro, Menezes, Darmstadt, and Bhutta, 2009) acknowledging the lack of impact of fetal movement monitoring on stillbirth or perinatal mortality, went on to assert that maternal perception of reduced fetal movements still remained an important indicator of the need for immediate assessment by the maternity care provider (Haws et al., 2009). Whilst it is reported that the current evidence on formal fetal movement counting using a chart has failed to establish a strong causal link to stillbirth, maternal perception of fetal movement patterns remains an important clinical resource. Having this heightened awareness also means that the woman and her caregivers are reassured by normal FM patterns and take action when they are perceived to be reduced.

Fetal movements during pregnancy are an indicator of fetal well-being because they indicate the integrity of both the central nervous system and the musculo-skeletal system. In keeping with the notion of maternal perception of fetal movement patterns being an important clinical resource, RCOG (2011) has developed a green-top guideline for the management of reduced fetal movements (Whitworth, Fisher, & Heazell, 2011). In discussing normal fetal movements, the guideline states that most women are aware of fetal movements from around 20 weeks gestation up to and including the onset of labour. Contrary to the understanding of some women and maternity care providers, the frequency of fetal movements does not diminish in the late third trimester (Whitworth et al., 2011). The RCOG (2011) guideline describes normal fetal movements and fetal sleep cycles at term as:

the average number of generalised movements per hour is 31 (range 16-45), with the longest period between movements ranging from 50-75 minutes. Changes in the number and nature of fetal movements as the fetus matures are considered to be a reflection of the normal neurological development of the fetus . . . fetal movements show diurnal changes. The afternoon and evening periods are periods of peak activity. Fetal movements are usually absent during fetal 'sleep' cycles, which occur regularly throughout the day and night and usually last 20-40 minutes. These sleep cycles rarely exceed 90 minutes in the normal healthy fetus.

(p.3)

According to the RCOG (2011) guideline, fetal movements should be assessed by subjective maternal perception of fetal movements and women are encouraged to be aware of their baby's usual intrauterine movement patterns, with advice to contact their maternity care provider immediately if there is a perception of reduced fetal

movements. This also makes the woman the key purveyor of knowledge about herself and her baby.

With this understanding in mind, it seems appropriate to include questioning about usual fetal movement patterns during the admission assessment or at the first point of contact in labour. Although there is no specific research to date into fetal movement patterns during labour, the fetus does continue to make regular movements. The inclusion of fetal movements, as an indicator of fetal well-being, in the ISIA framework is one way in which ISIA differs from other IA practice descriptions and may be controversial. There is less robust evidence for an inclusion of fetal movements in the ISIA framework for ongoing FHR monitoring. In the literature there are a number of studies from 1984 to 2003 looking at the usefulness of intrapartum biophysical profile (BPP), measured by real-time ultrasound, as an adjunct the continuous CTG in the determination of fetal well-being during labour (Sadovsky, Rabinowitz, Freeman & Yarkoni, 1984; Griffin, Caron, & van Geijn, 1985; Yarkoni & Hobbins, 1987; Ash, Morrison, & Manning, 1993; Farrel, Seaton, & Owen, 1998; Kim, Khandelwal, Gaughan, Agar, & Reece, 2003).

The studies were largely observational and had small numbers of low risk women mainly during un-medicated labours. They conclude that fetal behavioral states (1F - quiet sleep, 2F – active sleep, 3F – quiet awake, 4F – active awake) including fetal breathing movements, with and without contractions, and fetal body movements can be observed as part of normal fetal biophysical activity throughout spontaneous labour and these movements are associated with FHR accelerations. According to Yarkoni (1987), the presence of fetal breathing movements and fetal body movements “*indicate that the normal fetus continues with its “routine” activities*

during labour. These fetal activities may prove helpful in the intrapartum assessment of fetal well-being” (p. 321).

These findings are relevant to low risk women experiencing un-medicated labour without interventions such as artificial rupture of the membranes (ARM); the target group of women who are eligible to receive IA during labour. While current intrapartum care of women has not incorporated the use the BPP as an adjunct to continuous CTG, with the evidence that the fetus does continue to actively move, accompanied by associated FHR increases, it seems relevant to include questioning of the woman during labour around fetal movements. By reminding the woman to be alert to her baby’s usual patterns of movement, we are actively including her in the assessment of ongoing fetal well-being and indicating the importance placed by her caregivers on this finding. The use of fetal movement monitoring in the ISIA should be viewed as additional information to support other information gained from the clinical assessments outlined in the ISIA framework. The slowing or absence of perception of fetal movements in labour is not a definitive indicator of the need to change FHR monitoring modality from IA to CTG in the absence of other abnormal findings.

It is my belief that research into women’s perception of their baby’s usual patterns of movement during pregnancy and labour is about to experience a resurgence in popularity. Quantitative and qualitative studies in Dublin and NZ are currently underway, and signal a refocusing on this important clinical indicator of fetal well being. Whilst a return to formal fetal movement counting by use of a kick chart is not called for, increasing women’s awareness of normal fetal movement patterns in pregnancy and during labour, and the appropriate actions required if movements

are reduced or absent is becoming a vital assessment for fetal well-being (Whitworth et al., 2011).

In discussing assessment of fetal well-being during fetal surveillance, it is also necessary to examine FHR variability, a concept associated with electronic fetal monitoring as evidenced on the CTG printout. It is generally accepted by maternity care practitioners that beat-to-beat variability is unable to be determined by listening and counting the FHR during auscultation. According to Tucker (2000):

Auscultation is not EFM without a tracing. It is a counting technique in which the instrument, or listening device, is used to count the number of fetal heart beats occurring in a prescribed amount of time and evaluated at a prescribed amount of time. The rate obtained is utilised, along with other assessment data, to guide management and care of the maternal-fetal dyad. (p. 21)

The inability to determine beat-to-beat variability is one of the hardest concepts for some maternity care providers to accept when using IA and this represents a barrier to its use. However, we need to keep in mind that the use of continuous CTG as a fetal surveillance technique during labour is recommended for women with “high risk” pregnancies. In this circumstance it is acknowledged that there is a potential for fetal compromise and therefore continuous CTG and assessment of the FHR characteristics, such as beat-to-beat variability become important indicators of fetal well-being. The expectations of fetal compromise during the rigours of labour are far less for the well woman with an uncomplicated pregnancy and a well-grown baby, making determination of beat-to-beat variability less critical. However, there are other

ways of determining fetal well-being during labour, and assessing the FHR during FM is one way.

Listening to and counting the FHR during a FM will usually reveal a higher FHR than the previously established average FHR rate. This FHR increase associated with FM represents acceleration, also a term associated with the use of CTG. Therefore, the presence of auscultated accelerations of the FHR with FM is included in the ISIA informed decision-making framework in the admission assessment component and is described further below. The body of knowledge on auscultated accelerations comes from the USA, where it is still used for antenatal assessment of fetal well-being in the place of the non-stress test¹⁵ (NST) performed by CTG.

4.5 Auscultated FHR Increases

Incorporating auscultated FHR increases as an indicator of fetal well-being in the ISIA framework became a continuation of asking the woman on admission about her baby's normal movement patterns. Fetal heart rate accelerations with or without fetal movements are considered to be a sign of fetal well-being. A method of detecting FHR accelerations in the antenatal period, particularly via CTG, is known as the non-

¹⁵ A non-stress test (NST) is a screening test used in pregnancy. A CTG is used to monitor the fetal heart rate. NST is used when there are reduced fetal movements, concerns with placental sufficiency or when the pregnancy goes past the due date. The premise of the NST is that a well-oxygenated, non-acidaemic fetus will spontaneously have temporary increases in the fetal heart rate (FHR). A reactive (normal) NST has two or more fetal heart rate accelerations within a 20-minute period, with or without fetal movement discernible by the woman (Keegan & Paul, 1980). A single FHR acceleration of ≥ 10 bpm in response to a fetal movement was used as the criterion for a reactive non-stress test by Mendenhall, O'Leary and Phillips (1980). This criterion remains in use today.

stress test (NST). The purpose is to determine fetal well-being by watching for a correlation between fetal movements and fetal heart rate (FHR) accelerations. Sometimes the fetus is manually stimulated externally by gentle rocking or vibroacoustic stimulation to provoke a movement in the hope that this movement will be accompanied by FHR acceleration. It is also known that FHR accelerations associated with fetal movements are able to be detected audibly without the use of the CTG machine.

Three decades ago O'Leary, Mendenhall and Andrinopulos (1980) examined the relationship between auscultated FHR accelerations and fetal movements and compared these auscultated accelerations with those evident on a CTG machine printout. They found a 94.6% accuracy of the auditory NST (auscultated accelerations) when compared to the CTG and concluded that this method may eliminate or reduce the need for the use of the CTG machine (O'Leary et al., 1980). A further study exploring the relationship between audible FHR accelerations and those recorded on the CTG was conducted to assess the reliability of audible detection of FHR accelerations (Baskett, Boyce, Lohre & Manning, 1981). In this study, an observer "listened" to the amplified FH sounds during continuous CTG monitoring, while not being able to see the paper print out or the CTG screen; nor were they informed of when a fetal movement (FM) occurred. According to Baskett et al. (1981), there was "remarkable accuracy in the audible detection of accelerations" (p.397). The authors concluded that, in the absence of the availability of a CTG machine, audible detection of FHR accelerations equates with the findings of a reactive NST (Baskett et al., 1981). While both of these early studies have confirmed that auscultated FHR acceleration is a means of reassuring the maternity care provider of fetal well-being, this knowledge appears to have been replaced by

maternity care providers' reliance on technology and the increased presence of the CTG machine in most labour rooms. Inclusion of auscultated FHR increases in the ISIA framework returns maternity care providers to the early evidence-based fundamental skills of listening and counting the FHR. Application of this knowledge and the ISIA framework can also be considered in the context of maternity settings where there is no CTG technology.

Following on from these early studies, four articles were published between 1986 and 1992 in American obstetric and nursing journals reporting research of the auscultated acceleration test (AAT) (Paine, Payton, & Johnson, 1986; Paine, Johnson, Turner, & Payton, 1986; Paine, Johnson, & Alexander, 1988; Paine, Benedict, Strobino, & Larson, 1992). The first study was conducted to assess the reliability of auscultating FHR accelerations with a fetoscope and the accuracy of the documentation of auscultated FHR accelerations (Paine, Payton, & Johnson, 1986). The authors developed a data collection graph for recording the auscultated FH that accurately demonstrated the presence of FHR accelerations in 97% of the cases using the counting method described in the study (Paine, Payton, & Johnson, 1986). Interobserver reliability was established and the findings of this study formed the basis of ongoing studies by the principle investigator. The second study was conducted to determine whether or not a significant difference existed between the results of the electronically monitored NST and the results of auscultation for a single FHR acceleration. The methods of auscultation and counting the FHR were included and the study found no significant difference. Therefore, the authors concluded that auscultation of a single FHR acceleration may be a reasonable and reliable alternative to the electronically performed NST (Paine, Johnson, Turner, & Payton, 1986).

In the above studies, manual stimulation of the fetus was used to elicit a FM in those fetuses not spontaneously moving. However, the third study used vibratory acoustic stimulation to elicit fetal reactivity. While this method improved the rates of specificity and decreased false-positive results, the use of vibratory acoustic stimulation to elicit FM did not improve the validity over previous studies of the auscultated acceleration test in terms of sensitivity and false negative results (Paine, Johnson, & Alexander, 1988). The fourth study compared the validity of the auscultated acceleration test (AAT) and the NST as screening tests to predict selected perinatal outcomes in women with high-risk pregnancies (Paine, Benedict, Strobino, & Larson, 1992). Measures used to predict the validity of the AAT and the NST as screening tests were sensitivity, specificity, and positive and negative predictive value. The results revealed the AAT to be a better predictor of poor perinatal outcomes than the NST, while the NST was a significantly better predictor of favourable outcomes than the AAT. In commenting on the usefulness of the AAT, the authors state, “the technology of EFM and the NST has made it possible to show that auscultation, a method used for centuries, is useful today” (p.90). Although the research on AAT as a screening test for fetal well-being was conducted during the antenatal period for low- and high-risk women, the 1992 study used the NST/AAT test closest to the time of birth (Paine, Benedict, Strobino, & Larson, 1992), and I believe it is possible to extrapolate these findings to the intrapartum context. Clearly, this is an area that warrants further research. The ISIA framework may provide a standardised method of IA that could be used in such studies.

The ISIA informed decision-making framework provides direction and support for midwives around the choice of IA, recommended by evidence-based FHR monitoring guidelines, during labour for low-risk women. IA conducted using the ISIA framework

provides a comprehensive method of monitoring fetal well-being during labour. To ensure the knowledge of the validity and safety of IA is translated to clinicians, an education program was designed to introduce the ISIA innovation to midwives and doctors. The next section contains a description of the education program.

Collectively, the education program and the ISIA informed decision-making framework are the KT intervention used in this research to disseminate evidence into practice.

Section Three

4.6 The Education Program: A Vehicle for Knowledge Translation

In the KTA process, the implementation of knowledge to end users requires a vehicle to ensure the message reaches the target audience. The education program described below was developed specifically to inform midwives and doctors of the evidence supporting the use of IA during labour and to introduce the new ISIA innovation for practice.

Wensing and colleagues (2010) inform us that there are a variety of ways in which interventions can facilitate the uptake of research in the clinical setting (Wensing, Bosch, & Grol, 2010). These include targeted training, use of opinion leaders to influence practice, and providing incentives. Another method would be to provide evidence-based information to the people who receive health care and their families, so they are in a stronger position to make decisions about their care. This is pertinent to a model of care that supports informed decision making, such as midwifery.

In undertaking a search of literature reporting on interventions for KT, it was revealed that there was a paucity of studies using robust methods of evaluation

(Wensing, Bosch, & Grol, 2010). However, those that have been evaluated demonstrate “their impact is variable and on average the effect size is moderate” (p.E85). These authors note that while absolute change in practice often does not exceed 10% on some of the measured outcomes, this by itself might be a clinically or economically relevant finding (Wensing et al., 2010). The key to successful implementation of a knowledge intervention is to determine the sustainability of the change. As demonstrated in Chapter Three, sustainability is “the degree to which an innovation continues to be used after initial efforts to secure adoption is completed” (Rogers, 2005, p.429). Assessment of the barriers to continued use, re-tailoring interventions to those barriers, monitoring use, and evaluating the impact of initial knowledge intervention are the keys to sustained use of the knowledge.

Educational interventions may be described as either passive or active, with active interventions more likely to achieve change (Wensing et al., 2010). Passive interventions include guidelines, lectures, and conferences. When used alone they are unlikely to change behaviour (Wensing et al., 2010). However, when combined with active interventions, there is a greater possibility of success. In the KT context, guidelines represent third generation knowledge in that they are tools developed from the synthesised knowledge of many primary studies designed to support the implementation of evidence into practice. As previously discussed in Chapter Three, guidelines will not always influence changes to the clinical practice of some practitioners. Therefore, active interventions, such as reminders and decision-support tools that bring the information closer to the point of care are required in addition (Wensing et al., 2010). The ISIA framework is an example of a decision-support tool.

The education program was designed as a means of introducing the history, physiology, and evidence for the practice of IA and the ISIA framework to maternity care providers. Together, the ISIA framework and the education program represent knowledge innovation which, in keeping with the knowledge application phase of the KTA cycle, represents dissemination and implementation. From a knowledge transfer perspective, dissemination is where the knowledge message is tailored and targeted at a specific group of people, while implementation is the systematic effort used to encourage adoption of the message

4.6.1 The content of the education session.

The education session content included an initial brief discussion on the origins and history of auscultation of the fetal heart accompanied by pictures of early auscultation devices. This summary of the history of auscultation was included to engage the audience. A basic discussion of fetal physiology, including the intrinsic and extrinsic factors affecting the control of the fetal heart followed. A review of the research evidence related to IA versus EFM and IA versus admission CTG followed. An overview of current fetal heart monitoring guidelines and consensus statements was presented. There was a brief discussion about the role and place of informed decision-making in the context of fetal heart monitoring, followed by the introduction of the ISIA framework. Time was allowed for questions and clarification of any of the concepts of the framework. The DVD contained in Appendix K contains the PowerPoint presentation of each of these components.

4.6.2 Delivery of the education program

Knowledge of the study site and the culture of the organisation prompted me to develop an intervention that could be delivered in a short time-frame (1 hour

duration). This fitted in with the usual timing for the exchange of information, usually during staff shift handover in the early afternoon when the maximum number of staff is available. The education program was repeated on two consecutive days over two weeks to enable the maximum number of maternity care providers to attend.

The visual aid of a PowerPoint presentation was used to deliver the information and the participants were given a handout that included the PowerPoint slides and all the references so they could follow the presentation and make notes (See Appendix K). The detailed handout was accompanied by A4 size copies of the ISIA framework, the New Zealand College of Midwives (NZCOM) consensus statement on fetal monitoring in labour (2005) and a fact sheet describing fetal physiology. The education program allowed time for interaction by those present rather than simply being a teacher-led provision of information.

After delivering the educational program, two DVDs of the interactive PowerPoint presentation used in the education sessions were made available to unit staff so they could look at the presentation during quiet periods and also for the benefit of those who were not able to come to any of the sessions. The DVDs were supported by A3 size wall posters of the ISIA framework, which were displayed in the work room areas on the maternity unit. This strategy was used to keep the momentum of the change process in everyone's minds and to act as a reminder of the current evidence for practice. These processes reflect the active interventions described by Wensing et al., (2010).

Objectives for the teaching session were established with the notion that the degree of implementation of ISIA should be measureable. Therefore objectives of the teaching session were stated as:

At the end of this session, the participants will:

- Apply their understanding of fetal heart physiology to the interpretation of fetal heart monitoring.
- Become critical users of research and evidence-based guidelines for fetal monitoring.
- Adopt the ISIA model for fetal heart monitoring for low risk women into their clinical practice.
- Demonstrate a reduction of CTG use for low risk women, while not impacting negatively on the outcomes for care.

The objectives were included in the PowerPoint presentation and discussed with the workshop participants so there was a shared understanding about the aim of the education program.

Davis and Davis (2010) have written about the selection of educational interventions for knowledge transfer and describe various drivers, particularly in the context of physicians, about how best practice and evidence are incorporated into practice. Two models are presented as a continuum of learning and change, with the first model described by Pathman and colleagues (1996) being Awareness–Agreement–Adoption–Adherence (Pathman, Konrad, Freed, Freeman & Koch (1996), as cited in Davis & Davis, 2010). An example of this model in the context of this study would be that the maternity care provider becomes aware of a new finding or practice, in this case the evidence around use of admission CTG and use of IA for low risk women. Whilst not necessarily a ‘new’ practice, it is a return to fundamental skill that has been updated with new evidence reinforcing its usage as an essential midwifery skill. Moving to a process of agreement with it and then to the adoption of

it either on a trial or irregular basis. Finally, the maternity care provider adheres to the practice and conforms to the guideline recommendations.

The second model is PRECEED (Predisposing, Reinforcing, Enabling Construct in Educational Diagnosis and Evaluation) being the elements of change.

Predisposing elements include guidelines, didactic lectures, and conferences, all of which may *predispose* the health care professional toward change in the uptake of knowledge. Enabling elements include patient education materials and other tools, for example flow charts that might *enable* the change. Both the predisposing and the enabling elements include aspects of third generation knowledge (guidelines and decision aids). Green and Kreuter (2005; as cited in Davis & Davis, 2010) include reminders, or audits and feedback as reinforcing strategies, which are useful in solidifying a change already made.

4.7 Summary of the ISIA: An Example of Third Generation Knowledge

The evidence-based ISIA informed decision-making framework is an example of third generation knowledge. That is, it is a knowledge translation tool to support the application and implementation of evidence into practice around the use of IA as a FHR monitoring method for low-risk women. An understanding of the physiology of the materno-utero-placental unit and control of the fetal heart underpin the development of the framework. Unique to this ISIA framework is the inclusion of fetal movements and auscultated FHR increases, which are assessed on admission and throughout labour as indicators of fetal well-being. The literature reviewed on fetal movements and auscultated FHR increases provided strong justification for their inclusion in the evidence-based ISIA framework.

Having developed a robust, evidence-based ISIA framework and education program to facilitate its implementation in clinical practice, I was keen to explore whether it was actually fit for purpose. Therefore, the questions guiding the study design are:

- Does the ISIA framework assist maternity care professionals' decision-making about appropriate use of IA?
- For eligible women, what are the differences in selection, documentation, and maternal and fetal outcomes of care when the ISIA is used compared with CTG?

The study detailed in the next chapter was designed to test whether the new ISIA framework is an effective KT tool. The steps of the KTA process guided the design of a pre- and post- intervention study using mixed methods for data collection.

Chapter Five: Research Design

5.0 Introduction

The previous chapters provided the research evidence that supports intermittent auscultation of the fetal heart during labour as a safe and effective monitoring modality for low risk women, but have revealed that this evidence is not being translated into current practice. In Chapter Four I described the development of the ISIA informed decision-making framework for FHR monitoring during labour for low-risk women. The research designed and explained in this chapter addressed a new question that emerged as the key focus of this thesis: Is the new ISIA informed decision-making framework for FHR monitoring during labour an effective KT tool? The hypothesis underpinning the quantitative study design was stated as: The ISIA framework will increase the use of IA in practice by 10% whilst having no detrimental effect on neonatal outcome.

5.1 Research Approach and Design

This study used a non-experimental one group, before and after intervention design with a mix of quantitative and qualitative data collection methods. The details of the study design are described in this chapter using three sections representing the phases of the study (pre-intervention, intervention, and post-intervention) and the KTA process. The study design and how it fits with the KTA process are both illustrated in Figures 5.1 and 5.2, with colours used intentionally to indicate the relationships between the elements of the study design and the KTA cycle. These are further described in the next section.

Before-intervention**After-intervention**

Figure 5.1. The non-experimental one-group before and after intervention mixed methods design.

Figure 5.2. The study design related to the KTA process.

5.1.1 The relationship between the study design and KTA.

The study comprised three phases: the pre-intervention phase, the intervention phase, and the post-intervention phase. The pre-intervention phase of the study was exploratory. Using the language of KTA, the purpose of this phase was to collect baseline data to identify the degree of the clinical problem (that the practice of IA is under threat) and to assess the barriers to KT (of the evidence that supports IA as a safe and effective monitoring modality for low-risk women). The post-intervention phase was conducted to determine whether there were changes in FHR monitoring following the intervention.

Quantitative and qualitative data was collected concurrently in both the before and after phases. Quantitative data was collected through a review of FHR monitoring practice as revealed in the medical records of childbearing women at the study site. Alongside this, and in order to determine the barriers to and facilitators of the use of IA, qualitative data was collected through focus groups conducted with the midwives employed by, or with access to, the maternity facilities of the study site.

Following completion of these two data collection phases, implementation of the intervention occurred. The intervention consisted of a formal educational session introducing the ISIA framework to a mixed group of midwives and doctors from the study site. During the post-intervention phase of monitoring use and evaluating outcomes, the retrospective medical record review was repeated to determine the effectiveness of the intervention by looking for changes in practice and an increased use of IA for eligible women. Focus groups with staff were conducted to determine their views on the use of ISIA and to gain further insights into the KTA process. This chapter details each of the three phases, including the recruitment and selection of participants for the focus groups, development of the retrospective medical record

review (RMRR) data collection tool, the data collection processes and methods of data analysis for the RMRR and focus groups, along with ethical considerations.

5.1.2 Use of a mixed methods approach.

The KT literature recommends that the most appropriate study design be matched to the research question and that either quantitative and/or qualitative methods may be used (Straus, Tetroe, Graham, Zwarenstein, Bhattacharyya, & Sheppard, 2010). Since I was interested in determining the effectiveness of the ISIA framework in translating the knowledge of IA into practice and in bringing about change, a mixed methods approach seemed appropriate. The stages of the KTA cycle means it lends itself to a mixed methods approach for data collection.

In the KT literature, Straus and colleagues (2010) state that the use of mixed methods is useful in the evaluation of complex interventions because:

identification of the precise mechanism that may contribute to [the] outcome is difficult because . . . interventions contain a number of different elements that act independently or interdependently. Qualitative methods of evaluation can be helpful in exploring the “active ingredients” of an intervention related to knowledge translation. Quantitative evaluation methods include [the] RCT [which is] logistically demanding . . . and quasi-experimental studies, which can often be implemented more easily (E96).

The qualitative approach provided an opportunity to elicit the perspectives of the key stakeholders involved in implementing the evidence into practice. In contrast, a quantitative approach to the identification of the degree of the problem and potential changes in outcomes of care following the intervention was the most appropriate for assessing the effectiveness of the intervention.

5.1.2.1 Timing, weighting, mixing and theorising in a mixed methods approach.

In planning a mixed methods study four aspects need to be considered at the outset of the research (Creswell, 2009). These include: timing (whether the data collections will be sequential or concurrent), weighting (the priority given to the qualitative or quantitative data), mixing (when and how the mixing of data occurs), and theorising (the theoretical perspective that guides the entire research design) (Creswell, 2009). This study uses a concurrent triangulation design¹⁶ demonstrated in Figure 5.3, where the quantitative and qualitative methods are given equal weighting, integrated at the interpretation phase, and explicitly guided by the theoretical perspective of KT.

Figure 5.3. Concurrent triangulation design in mixed methods research (Creswell, 2009)

¹⁶ Mixed methods notations, labels and symbols, are used to convey important aspects of mixed methods research and provide a way for researchers to communicate procedures. “+” indicates concurrent data collection with both qualitative and quantitative data collected at the same time. Capitalisation indicates the weight or priority on the qualitative or quantitative data collection, analysis, and interpretation, with the abbreviations “Quan” indicating quantitative and “Qual” indicating qualitative (both abbreviations contain four letters indicating equality). (Morse (1991); Tashakorrie and Teddlie (1998); Creswell and Plano (2007) cited in Creswell, 2009)

In a concurrent triangulation design, separate data collection methods are used to balance out any weaknesses or strengths in either the qualitative and quantitative approaches. The mixing in this approach occurs during the interpretation or discussion stage (Creswell, 2009).

5.1.3 Justification for the study design.

The literature recommends that to determine whether the intervention has worked at the local level, observational studies, in which the researcher has no control over the allocation or not of participants to the intervention, are appropriate (Straus et al., 2010). It is acknowledged here that experimental designs, such as randomised controlled trials (RCT), offer the best method to be able to investigate causality by controlling for all threats to internal and external validity. However, Eccles and colleagues (2003) have said:

RCTs are the gold standard, but when evaluating complex interventions they are not without their problems. They can be logistically difficult, methodologically challenging and require a multi-disciplinary approach to adequately plan and conduct, they can be time consuming and expensive. (Eccles, Grimshaw, Campbell, & Ramsay, 2003, p. 51)

Although an experimental or quasi-experimental design, where a control group is used, might have been preferable, because of the practical limitations of time, finances, and team support, I believed a non-experimental (or pre-experimental) before and after intervention approach, a common approach in educational research (Campbell & Stanley, 1963), was useful for this study. Uncontrolled before and after studies measure performance before and after the introduction of an intervention in the same study site, and observed differences in performance are assumed to be a result of the intervention (Eccles, Grimshaw, Campbell & Ramsay, 2003). They are

relatively simple to conduct and are superior to observational studies. An example of the before and after intervention strategy was successfully demonstrated in a study exploring the barriers and facilitators to nurses' use of research in practice by Fink, Thompson and Bonnes (2005).

The non-experimental design used in this study is the "one group, before and after design (one group pre-test-post-test)" (Roberts & Taylor, 1998) (Figure 5.4).

Figure 5.4. One group, before and after design (one group pre-test-post-test) (Roberts & Taylor, 1998).

In this design, the researcher has little or no control over the influence of extraneous factors. It does, however, allow the dependent variable measurement to be compared between the before and after intervention data-sets. Using this design, as demonstrated in Figure 5.4, a pre-test measure of the conditions before manipulation (delivery of the intervention) provides a benchmark against which the post-test measure can be compared. The limitation to the before and after design is that any change in practices or outcomes cannot be causally or directly linked to the intervention. In part, this limitation can be overcome by using mixed methods of data collection to gain insights into what other factors might have influenced changes at the study site.

5.1.3.1. Threats to validity with non-experimental designs.

Internal validity is the extent to which the observed results are due solely to the experimental manipulation. There are a number of threats to internal validity: history, maturation, the testing effect, instrument variation, the selection effect, and the mortality effect (Campbell & Stanley, 1963; Roberts & Taylor, 1998; Parasuraman, Grewal & Krishnan, 2004). The history effect refers specifically to internal or external factors occurring during the research process that may affect the dependent variable or influence the change. This becomes a more relevant threat the longer the time-gap between the pre-intervention and post-intervention phases (Campbell & Stanley, 1963). In addition to the experiment (intervention), physical and physiological changes in the unit that occur with the passage of time may also affect the dependent variable being measured (Campbell & Stanley, 1963; Parasuraman, Grewal & Krishnan, 2004). This is known as the maturation effect.

Where learning or skills are involved, the pre-intervention/post-intervention design can be weakened by the testing effect. It is known that for people being “tested” a second time, the tendency is to do better on the test (Campbell & Stanley, 1963; Roberts & Taylor 1998); Parasuraman, Grewal & Krishnan, 2004). Changes in the instruments or procedures used to measure the dependent variable, called instrument variation or instrumentation decay may produce differences between the pre-intervention and post-intervention measurements (Campbell & Stanley, 1963). In the current study the instrument did not change between the pre-test and post-test phases, but there were more people involved in data collection in the post-test phase. Care was taken to ensure that the data collection tool was understood and inter-rater interpretations were accurate. To do this, I checked every 10th data tool against the medical record to ensure consistency.

The selection effect occurs when multiple groups participating in the experiment differ on characteristics that have a bearing on the dependent variable (Parasuraman, Grewal & Krishnan, 2004). The comparison of the demographics of the before and after participants in Chapter Seven reveals that the selection effect is unlikely to be relevant to the findings. The mortality effect or the drop-out rate occurs when participants drop out of the experiment and, as a result, the number of participants completing the experiment significantly differs from the original set of participants (Campbell & Stanley, 1963; Roberts & Taylor, 1998; Parasuraman, Grewal & Krishnan, 2004). This effect might be relevant in that in the pre-intervention sample I managed to audit 93% of possible medical records, whereas in the post-intervention sample, I only managed to audit 82% of possible medical records because another audit was being conducted simultaneously and some medical records were sent back before I could access them. I am not sure this reduction would have made a difference, but it must be considered a possibility.

External validity is the extent to which observed results are likely to hold beyond the experimental setting, and is therefore a measure of stability across other contexts. It questions whether the findings are generalisable to the whole population or to other settings (Campbell & Stanley, 1963; Roberts & Taylor, 1998).

External validity is threatened by bias: reactive bias, pre-intervention manipulation interaction bias, and non-representative sample bias. In reactive bias, participants exhibit different behaviours simply because they know they are participating in research. Pre-intervention manipulation interaction bias is a special form of reactive bias that is unique to experiments relying on pre-measurement of consumers before they are exposed to the experimental manipulation. It occurs when the pre-measurement increases or decreases the participants' sensitivity to the

experimental manipulation (the intervention) (Campbell & Stanley, 1963; Roberts & Taylor, 1998; Parasuraman, Grewal & Krishnan, 2004). The non-representative sample bias occurs when the participants in an experiment are not representative of the population which the experimental results are to be generalised. Comparison between the demographics of the birthing women in both the pre-intervention and post-intervention sample against the demographics of all birthing women in New Zealand in 2009 and 2010 revealed close approximation and so I concluded that both samples were representative.

Next, I will describe the context (environment) for the study. As previously described in Chapter Three, context has a strong influence on the successful implementation of interventions for the transfer of knowledge into practice. Rogers (2005) told us that diffusion of innovation occurs within a social system where the structure, norms, and opinion leaders influence the adoption of new ideas, while Greenhalgh and colleagues (2004) illuminate the importance of determining the system antecedents and system readiness for change (Greenhalgh et al., 2004). In the PARiHS model, successful implementation (SI) of research is a function (f) of the relationship between the level and nature of *evidence* (E), the *context* (C) or environment into which the research is introduced, and the process of *facilitation* (F) (Kitson et al., 1998; McCormack et al., 2002; Harvey et al., 2002; Rycroft-Malone et al., 2004).

5.2 The Study Site

The secondary level maternity unit where this study was conducted is located in the DHB of a city in New Zealand. The unit caters for approximately 2,200 births per annum, a rate which has been relatively static for the last few years. I chose this DHB maternity unit because of the high number of “primary” birthing women (low

risk) in its birth population meaning that, potentially, many of these women would be eligible for IA during labour. Since the women are low risk, around 70% book for their maternity care with a self-employed midwife LMC.

5.2.1 Staff.

The maternity unit has an establishment of around 28 fulltime equivalent (FTE) staff, but tends to operate at around 24 FTE (about 50 people), with most working part-time hours. This FTE is a mixture of midwives, nurses, and health care assistants. There is a full-time clinical midwife manager (CMM) responsible for a mixture of operational and professional issues. This role is supported by two associate charge midwife managers (ACMMs) and a part-time midwife educator (ME). There are four private obstetricians in the community, two of whom also work in the public system. In recent years, the unit started having obstetric registrars on a rotational basis, from overseas, as well as senior house officers and trainee interns. There have been several changes in head of department over the last few years, from an obstetrician considered to be very conservative to someone who was described as “much more evidence based and pro normal birth” (personal communication, midwife manager, July 14, 2010). This role changed twice more over a two-year period before this research began. At the time of the study, there were 39 LMC midwives with access agreements and no GP LMCs.

5.2.2 Culture.

The unit has experienced many changes to staffing, models of care, and structure. The midwife manager described these changes as unsettling. In regards to the midwives and their requirements for ongoing professional and elective education required for the New Zealand Midwifery Council recertification programme, the culture for learning and leadership appeared to be lacking enthusiasm or drive. The

workload for one part-time midwifery educator was very heavy in my estimation, and the sharing of new research and literature largely absent. The midwives did not engage in the nationally developed midwifery Quality and Leadership programme, linked to the multi-employer contract agreement (MECA) which has a financial reward as an incentive, largely because progression requires engagement in formal post-graduate education. Midwives had access to on-line learning packages, such as the K2 fetal monitoring programme (http://www.k2ms.com/products/fetal_monitoring_training_system_online.html), but were described as needing to be pressured into accessing them.

For management of the quality of the unit, no resourced positions existed to take responsibility for policy and data management. As a result, it was difficult to obtain historical or recent data on clinical outcomes. Policy development and update had fallen behind expected renewal dates. Most of the clinical policies in policy manuals in the maternity unit were written in 2005, with a two year update cycle. When I conducted my research at the end of 2010, the evidence-based intrapartum fetal surveillance policy was three years out of date. Therefore, in regards to the “context” component of the Kitson et al. (1998) PARiHS model, the culture, leadership, and measurement elements in this unit were at the low end of the continuum of characteristics supporting successful implementation of knowledge, presenting challenges for the implementation of evidence into practice.

5.2.3 Engagement with stakeholders.

When doing KT research, it is vital for potential adopters of knowledge to be actively involved in the research and the process of implementing an intervention. This increases the likelihood of the implementation succeeding. Therefore, in the context of this study, engagement with the stakeholders and potential adopters of

knowledge was crucial. The KT literature recommends this engagement occurs at all points along the research journey, from the identification of the clinical problem and setting the research question to selecting the appropriate interventions and implementing and evaluating the effectiveness. Furthermore, developing ways to monitor sustainability of knowledge in practice involves ongoing engagement.

In the context of this study, a relationship that developed over time between the charge midwife manager (CMM), the midwife educator (ME) and me revealed their desire to see practice change within the service. Keeping in mind the desire for active engagement in the research process, midwives who were employed or had access agreements to the DHB were invited to participate in data collection during the retrospective medical record reviews (RMRR). The purpose of this action-oriented approach was to have midwives participate in both research and quality improvement activities, thereby increasing their knowledge and ownership of the processes and the translation of knowledge. Another major driver for midwife participation was to stimulate them to reflect on practice, both their own and of others within the unit. Active engagement with the staff was also planned to motivate increased dialogue between midwives and doctors in translating evidence into practice, particularly as it relates to fetal heart monitoring for low-risk women. Ultimately, engagement with the staff aimed to build both enthusiasm and capacity for future research and practice development. I reflect on the contribution of this aspect of the study in the final chapter of the thesis when considering what may have influenced the outcomes of the study. In the following sections of this chapter I detail the pre-intervention, intervention, and post-intervention phases of the study.

Section 1: Pre-Intervention Phase

5.3 Identifying the Problem and Assessing Barriers to Knowledge Use

The pre-intervention phase was conducted to collect baseline data to identify the degree of the clinical problem (that the practice of IA is under threat) as it related to the group of women deemed to be at low risk of fetal compromise and so suitable for IA during labour. This phase provided the baseline data of IA practice in this setting and assessed the barriers to and facilitators of the use of IA.

5.3.1 Retrospective medical record review.

The medical records of all women who gave birth in the DHB during the months of January, February, and March 2009 were reviewed. There were 2148 births at the DHB in the calendar year 2009 with 188 births in January, 189 in February, and 173 in March giving a potential sample size of 550 births (25% of total births for the year 2009). An online sample size calculator (www.raosoft.com/samplesize.html) was used to determine the number of medical records for the RMRR, accepting a 5% margin of error and 95% confidence. The recommended sample size was 326.

The aim of the RMRR was to establish:

- the proportion of women eligible for IA during labour (i.e., low-risk women)
- the proportion of eligible women who received IA during labour
- compliance with the DHB's IA monitoring guidelines
- the maternal and fetal outcomes when IA was used.

This method of quantitative data collection was chosen because it enabled me to thoroughly explore the documentation of midwives for their assessment of women on admission to hospital in labour and their ongoing fetal heart monitoring practice. Full and accurate documentation is a critical component of care and provides a narrative

of the woman's labour and birth journey and evidence of the woman and midwives' decision-making. RMRR is a technique used in research, case review, and clinical audit. Clinical audit is a continuous quality improvement process used within the health system, providing a mechanism for reviewing and improving the quality of everyday care to patients. The National Institute for Clinical Excellence (NICE) (2002) defines clinical audit as:

a quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change. Aspects of the structure, processes, and outcomes of care are selected and systematically evaluated against explicit criteria. Where indicated, changes are implemented at an individual, team, or service level and further monitoring is used to confirm improvement in healthcare delivery. (p. 1)

As clinical audit is cyclical in nature it is well aligned to the action cycle of the KTA process used in this research study, and is a method for obtaining information about knowledge gaps in practice. Clinical audit steps include: indentifying the topic for audit (identify the clinical problem), identify aspects of best practice that should be included (identify, review and select knowledge), agree standards and criteria against which the data are measured (adapt to the local context, and select and tailor interventions), collect the data, analyse the data to ascertain the degree of compliance with standards (monitor knowledge use), and implement improvements to address practice gaps (sustain knowledge use). The audit cycle and the KTA action cycle continue when consistent compliance is demonstrated (Sinni, Cross & Wallace, 2011). As such, clinical audit is a commonly used method, keeping in mind that gap assessment is not about blaming individual clinicians but more about

determining systems related issues for getting evidence into practice (Kitson & Straus 2010). According to Hakkennes and Green (2006), data collection in the form of medical record audit was used 51% of the time in reported studies evaluating interventions aimed at increasing the uptake of evidence into practice. Therefore, RMRR was a well-supported and appropriate method of data collection for this study.

5.3.1.1 RMRR Data Collection Tool

For the RMRR, a data collection tool comprising 20 questions related to fetal heart rate monitoring was developed and used for this study (Appendix J). The purpose of the data collection tool was to measure the care provided to women in relation to fetal heart rate monitoring on admission to hospital and throughout labour. The standards guiding the development of the audit tool were based on accepted best clinical standards of practice sourced from: New Zealand College of Midwives Handbook for Practice (2008), NZ Primary Maternity Services – Section 88 (Primary Maternity Services Notice, 2007), midwifery practice textbook (Pairman et al., 2010), fetal heart monitoring practice publications (Feinstein et al., 2008; Gibb & Arulkumaran, 2008) and fetal surveillance guidelines (ACOG, 2005; RANZCOG, 2006, NICE, 2007; SOGC and BCPHP, 2008).

Three versions of the tool were produced during its development, with further adjustments made early in the review process following discussion with the midwife assisting with data collection in the pre-intervention phase. The main questions were:

- Demographic details of the birthing women, that is, ethnicity, gravidity, parity and gestation.
- Caregiver (LMC/midwife) during labour and birth.
- Evidence of antenatal discussion regarding fetal monitoring.

- Admission assessment:
 - evidence of any antenatal risk factors that were deemed to indicate that the use of continuous CTG during labour was warranted (Table 5.1)
 - abdominal palpation (fetal presentation, lie, position and descent of presenting part)
 - uterine activity (contraction frequency, strength, duration) and resting tone of the uterus between contractions
 - assessment of how the woman was coping with the contractions
 - assessment of the woman's understanding of her baby's "usual" patterns of movement.
- Admission CTG – data on whether admission CTG was used, the duration of the admission CTG collection and whether or not the application of the admission CTG led to continuous CTG.
- Ongoing fetal heart monitoring – this was included to determine the types of FH monitoring (IA or CTG) used after the initial admission assessment was completed:
 - identification of intrapartum risk factors and whether there was a change of FH monitoring as a result. Risk factors were divided into labour, maternal and fetal as per table 5.1.
 - IA protocol – this section was included to allow determination of compliance with the current unit protocol for the conduct of IA as it related to frequency, timing and duration, along with the recording of the maternal pulse rate and how the IA findings were

documented. This was measured against the hospital fetal surveillance guideline

- mode of birth, neonatal outcomes (Apgar score and admission to SCBU).

To establish which women in the sample were eligible to receive IA during labour, the medical records were reviewed for documentation of any antenatal and/or intrapartum risk factors for electronic fetal monitoring, measured against the criteria in the maternity unit fetal surveillance policy (Tables 5.5 and 5.6).

Table 5.5

Antenatal Risk Factors for Intrapartum Electronic Fetal Monitoring (DHB Fetal Surveillance guideline, 2005)

Antenatal Risk Factors	
Maternal	Fetal
<ul style="list-style-type: none"> - - Hypertension - - Pre-eclampsia - - Diabetes - - Antepartum Haemorrhage - - Other medical disorder which constitute a significant risk of fetal compromise 	<ul style="list-style-type: none"> - - Suspected IUGR - - Prematurity - - Post term pregnancy - - Oligo/ Polyhydramnios - Abnormal Doppler - Abnormal CTG - Rhesus disease - Known fetal anomalies - Multiple pregnancy - Breech - Prolonged pregnancy (>42 weeks)

Table 5.6

Intrapartum Risk Factors for Intrapartum Electronic Fetal Monitoring (DHB Fetal Surveillance guideline, 2005)

Intrapartum Risk Factors		
Labour	Maternal	Fetal
<ul style="list-style-type: none"> - Previous CS or uterine scar - Prolonged SRM (>24 hours) - Induced labour - Augmented labour - Hypertonic contractions - Active 1st stage of labour >12 hours (i.e. regular uterine activity, cervix $\geq$ 4cm dilated) - Active 2nd stage (i.e. pushing) > 1hour 	<ul style="list-style-type: none"> -Vaginal bleeding - Sepsis - Epidural - Pyrexia >38°C 	<ul style="list-style-type: none"> - Meconium or blood stained liquor - Suspicious FHR on auscultation or admission CTG (if performed)

5.3.1.2 RMRR data analysis.

Data from the RMRRs were entered into the Statistical Package for the Social Sciences (SPSS, Version 17). This software package was appropriate for the range of descriptive statistical tests I wished to apply to the data (Pallant, 2007). Simple descriptive statistics were used to determine the proportion (%) of women eligible for IA during labour, the proportion (%) of women who received IA during labour, compliance with the DHB's IA monitoring guidelines, and the maternal and fetal outcomes when IA was used. For categorical data the chi-squared test was used to determine the significance of any differences found between women eligible for IA who did or did not receive it. Fisher's exact test was used if cell values were less

than five. Data entry for the RMRR was completed and checked for accuracy in the first week of April 2010.

5.3.1.3 Definitions of FHR modality

As was the case in the study reported by Cheyne and colleagues (2003), continuous CTG was defined as use of the CTG machine for 75% or more of the labour. For analysis, the electronic fetal monitoring (EFM) category comprised all FHR monitoring performed with the CTG machine that is continuous CTG, intermittent CTG and where both CTG and IA were used throughout the care. Intermittent auscultation was defined as IA with a Pinard stethoscope or a hand-held Doppler device. In some instances, there was an absence of documentation around the type of device used for IA, but the presence of a strip of CTG paper revealed that the CTG machine with the paper running was the method used. Therefore, this type of IA monitoring was included in the category for IA for the purposes of analysis. IA with the CTG transducer produces multiple periods of FH monitoring for around a minute or so.

5.3.1.4 Ethical considerations.

The RMRR was conducted within an ethical framework which included: maintaining patient and staff confidentiality, anonymising information contained in the final report, not collecting unnecessary data, and destruction of data collection forms once they had served their purpose. Anyone helping with the RMRRs was required to sign a confidentiality agreement (Appendix H).

The RMRR data collection tool used the woman's NHI (national health index number – unique identifier) for cross referencing purposes only. This information was not entered into the database. Only the researcher knows the link between the two,

and all NHI information will be deleted at the completion of the study and lodgement of the thesis. Data related to employment category is grouped under specific type rather than linked to an individual that is self-employed midwife, private obstetrician, hospital primary team, and hospital secondary team.

Consultation with Māori representatives from the study site (Appendix E) was carried out in accordance with the requirements of the Treaty of Waitangi, the founding document of New Zealand. With approximately 15% of women birthing at the study site identifying as Māori ethnicity it was likely that there would be a number of Māori women's medical records reviewed in both the pre- and post-intervention samples. The issues around the appropriate use of technology for fetal monitoring are the same for Māori as for other ethnicities.

5.3.2 Focus groups.

Focus groups were conducted to assess the barriers and facilitators of IA use.

The purpose of the focus groups for this phase of the study was to explore: midwives' current practice regarding fetal heart monitoring for low-risk women barriers and facilitators that midwives experience in the practice of IA evidence such as hospital policy and other sources of evidence accessed by the midwives.

Focus groups are group interviews that provide the researcher an opportunity to interface with more than one person at a time to explore beliefs, understandings, and attitudes. Participants are usually small groups of people (six to eight) from similar backgrounds, who are able to interact with one another as well as the researcher to discuss the topics outlined by the interviewer. These group interviews are a means of listening to people and learning from them (Morgan, 1998). In exploring

complexity, Rabiee (2004) has stated that for focus groups, “The main aim is to understand, and explain, the meanings, beliefs and cultures that influence the feelings, attitudes and behaviours of individuals” (p.655). There were two focus groups in the pre-intervention phase with self-employed midwives in one group and hospital employed midwives in the other.

5.3.2.1 Recruitment process.

An invitation to participate in the focus groups was distributed around notice boards within the maternity unit (Appendix A). Invitations to participate were also placed in the mail folders of each of the self-employed midwives who had access to the maternity unit. The maternity unit midwife educator and clinical midwife manager spoke to hospital employed midwives to explain the research and garner support for the process and for midwife participation. A follow-up email was sent to self-employed midwives via the clinical midwife manager. The clinical midwife manager talked to self-employed midwives at the unit’s monthly interface meeting and passed on information sheets (Appendix B) to potential participants. I attended a hospital employed midwives weekly staff meeting to outline the research project, answer questions and hand out information and consent forms.

I also met the maternity unit’s clinical director of obstetrics to discuss the research project and to invite the obstetricians and obstetric registrars to participate in focus groups or individual interviews. I sent an email with information sheets and consent forms to the clinical director, who forwarded them on to the maternity unit medical staff. One obstetric registrar indicated interest in the study, but because of workload was unable to find a suitable time so the interview did not take place.

5.3.2.2 Focus group participants.

All midwives working at the study site were invited to take part in the focus groups for the study. Inclusion criteria for midwives were:

- employed midwives (core midwives) providing intrapartum care to women from 1 August 2009 to 31 May 2010
- self-employed midwives providing intrapartum care to women at the study site from 1 August 2009 to 31 May 2010.

5.3.2.3 Method of obtaining focus group data.

The focus groups were conducted in the education centre at the study site DHB. Participants were asked to think about a time when they provided intrapartum care to a well woman with an uncomplicated pregnancy (sometimes called a “low-risk” woman or a “primary” woman). The following prompt questions were used:

Describe your practice regarding FHR monitoring for low-risk women.

What information guides your practice in relation to FHR monitoring?

Where do you access/obtain this information?

What information do you give women antenatally about the choices, risks and benefits of fetal heart rate monitoring?

What are barriers and facilitators that you experience in the practice of IA?

What does your hospital policy recommend?

How do you interpret what you hear when performing IA?

What are midwives actions when they hear changes to fetal heart rate and rhythm during IA?

What about admission CTG?

The focus groups were audio taped using digital recording devices. The data from the digital dictation machines were downloaded directly onto a computer

connected by means of a modem. The files, in MP3 format, were sent to Sound Business Systems (SBS) Ltd in Auckland using a file upload facility for transcribing into a Microsoft Word text file. This enabled the text to be analysed simultaneously with the sound.

Field notes were maintained throughout the study to aid recollection of critical times and decisions and as a back up to the recording device. At the focus groups, the research assistant kept notes and watched for interactions and body language. This was to be incorporated into the transcripts to assist with interpretation.

5.3.2.4 Data analysis.

There are many tools available for analysing qualitative data in mixed methods research, including constant comparison analysis; keywords-in-context; word count; classical content analysis; domain analysis; taxonomic analysis; and componential analysis (Leech & Onwuegbuzie, 2007). As Hatch (2002, p. 148, as cited in Leech & Onwuegbuzie, 2007), stated:

Data analysis is a systematic search for meaning. It is a way to process qualitative data so that what has been learned can be communicated to others. Analysis means organizing and interrogating data in ways that allow researchers to see patterns, identify themes, discover relationships, develop explanations, make interpretations, mount critiques, or generate theories. It often involves synthesis, evaluation, interpretation, categorization, hypothesizing, comparison, and pattern finding. It always involves what Wolcott calls "mind work" . . . Researchers always engage their own intellectual capacities to make sense of qualitative data. (564)

For the qualitative data from this research, I used the constant comparison analysis method. According to Leech and Onwuegbuzie (2007), “constant comparison can be undertaken deductively (e.g., codes are identified prior to analysis and then looked for in the data), inductively (e.g., codes emerge from the data), or abductively (i.e. codes emerge iteratively)” (p.565). This research uses both approaches. Constant comparison analysis was originally developed to analyse data that were collected over a series of rounds leading to theoretical sampling, which involves the sampling of additional people, groups, events, incidents, activities, documents, and the like, in order to develop emergent themes, to assess the adequacy, relevance, and meaningfulness of themes, to refine ideas, and to identify conceptual boundaries (Charmaz, 2000, as cited in Leech & Onwuegbuzie, 2007). However, constant comparison analysis has since been modified to be used to analyse data collected in one single round, such as interviews or focus groups (Leech & Onwuegbuzie, 2007).

The process for constant comparison analysis begins with the researcher reading through all of the transcribed data and underlining chunks of text that may have some meaning. Following this read through and “chunking” of text, the researcher labels each chunk with a descriptive title or a “code”. After all the data have been coded, the codes are grouped by similarity, and a theme is identified and documented based on each grouping (Figure 5.5). Member checking, where the participants are asked if the researcher’s coding and descriptions of the codes accurately reflect their ideas increases the validity of this method.

Four main categories were identified prior to the analysis (a deductive approach) and then searched for during data analysis. Those four main categories were ‘Personal/Professional’ and ‘System/Organisational’ characteristics related to

knowledge/evidence use (Fink, Thompson & Bonnes, 2005); and the “Barriers” and “Facilitators” to uptake of the knowledge (Harrison et al., 2010). The categories were used to further the codes that emerged from the data (an inductive approach)

Main Categories: **Individual** and **Organisational**: **Barriers** and **Facilitators**

Chunk of Dialogue	Code for each chunk	Code groupings	Emergent Theme
I found it easier when I was doing LMC, because I <u>knew my women</u> , I shouldn't say my women, I <u>knew the women</u> really, really well and knew their pregnancies . . .		Continuity of Care/Caregiver	Model of care
(As a) core midwife, because I don't have that, <u>I don't know</u> that background quite so well . . .

Figure 5.5. Example of constant comparison analysis using data from the pre-intervention focus groups for this study.

5.3.2.5 Ethical Considerations

To ensure informed consent to participate, a letter of invitation to participate and an information sheet were provided to potential participants (Appendices A and B). A consent form (Appendix C) was sent to any midwife who indicated she was interested in taking part. None of the participants required an interpreter and all participants were offered the opportunity to edit the transcripts of the recordings of the focus groups; however, none of them chose to take up this offer.

The identity of the participants in the focus groups was kept confidential by the use of a numbering system. Midwives were classified as 1 (first focus group) + H (hospital or core midwife) or S (self-employed midwife) followed by the letter A-O; that is, 1HA or 1SJ.

The next section describes the Intervention phase of the study, which involved delivering the ISIA informed decision-making framework to the staff at the study site.

Section Two: The Intervention

5.4 The Intervention

The ISIA informed decision-making framework, as described in the previous chapter and the education session to introduce it represent the KT intervention used in this study. The education session included an historical perspective of fetal surveillance methods; the physiological basis for the fetal heart rate; evidence from research and the ISIA framework.

5.4.1 Exposure to the intervention.

Flyers advertising the education sessions were placed around the unit (Appendix F). To enable as many staff as possible to attend, there were four sessions available to staff. For two days a week over two weeks, the education sessions were conducted at the handover time (2.30 pm – 3.30 pm). In total 33 participants attended the education sessions, made up of 15 core midwives (30% of the total number of core midwives), 14 self-employed midwives (36% of the total number of self-employed midwives) and four doctors (33%) including two obstetric registrars and two senior house officers, who are junior doctors undergoing training within the obstetrics specialty. A time slot for night staff was also made available between 9.30 pm and 10.30 pm but this did not go ahead due to small numbers of staff available

on the day. The clinical midwife manager and the midwife educator were proactive in ensuring that as many midwives as possible were able to attend. Any midwives who were not on duty at the time of the teaching session were paid to attend in their off-duty time. Self-employed midwives made their own arrangements for a midwifery colleague to provide them with cover while attending the session.

5.4.2 Delivery of the intervention.

Direct exposure to the intervention occurred during the teaching sessions, which were held in the DHB's Education Centre using oral presentation supported by PowerPoint slides. Participants were given a comprehensive handout consisting of PowerPoint slides, including the references for the slides, and the NZCOM consensus statement on fetal heart rate monitoring, 2005 (Appendix K).

Indirect exposure to the intervention occurred through opportunistic viewing of the PowerPoint presentation, which was put onto two DVDs (Appendix K) and made available to the staff to use during quiet times or independently. In addition, posters describing the ISIA framework were made and placed in the workstations in the delivery suite and the wards.

5.4.3 Reflections on the presentation of the intervention.

The timing of the education sessions to coincide with the handover of staff from one shift to another during the early afternoon (2.30 pm – 3.30 pm) was the best time to attract staff and attendance at the sessions was supported by the midwife educator, who rallied people along and provided cover on the floor. In the first two sessions, the floor was relatively quiet and the junior doctors were encouraged to attend. This was great, as I have always believed that interdisciplinary education improves communication through shared understanding. The length of the session

was a challenge because of the amount of information to share. On reflection, another half-hour would have been useful.

All sessions were very interactive, with many questions and clarifications coming from the participants. This interaction offered me the opportunity to further highlight the evidence around the use of IA for low-risk women. Many of the questions were based on real-life scenarios from practice, so the participants benefitted from hearing the stories and the explanations. One of the obstetrics registrars, a recent immigrant from the UK, challenged me about the routine use of the admission CTG, which is strongly supported by our medical colleagues despite the lack of research evidence in the context of low-risk pregnancy. The scenario she described was of a woman with no known complications to her pregnancy who arrived on the labour ward in labour and underwent an admission CTG. The admission CTG revealed fetal tachycardia, absent variability, and FHR decelerations. An immediate emergency caesarean section followed and a live baby ensued. The registrar relayed this story to support her belief in the importance of routine admission CTG, her reasoning being that we should do them “just in case” there are FHR abnormalities, as was the case for the woman in the story. Her challenge to me was about how the ISIA framework admission assessment component could achieve the same “save” as the admission CTG had? Even before I could respond, she began working through the scenario herself and concluded that the ISIA framework, conducted as I had described, would indeed identify the fetal tachycardia and potentially the FHR decelerations, which would have prompted the midwife to apply the CTG, meaning the outcome would have been the same. This “thinking out loud” exercise by the obstetric registrar was a powerful example for those present who might have had some doubts about the use of IA in labour.

I felt the teaching session was successful and I was aware of a good level of support from both the hospital midwives and the self-employed midwives. I was keen to see if any of this information had made a difference to practice. Three to six months after the delivery of the intervention the post-intervention data collection phase was undertaken. This is described in detail in the following section.

Section Three: Post-intervention Phase

5.5 Monitoring use and Evaluating Outcomes

The aim of the educational intervention was to provide maternity care professionals, in particular the midwives, with knowledge and skills to become critical users of research and evidence-based guidelines for fetal monitoring and to adopt the ISIA model into their clinical practice. Following the delivery of the intervention, it was necessary to establish whether there had been any change in the uptake of knowledge. In the KTA process, monitoring knowledge use and evaluating outcomes are two means of measuring how and to what extent the new knowledge is being used by stakeholders (Straus, Tetroe, Graham, Zwarenstein, Bhattacharyya & Shepperd, 2010). Therefore, in the post-intervention phase of this study, I conducted another RMRR to look for evidence of practice change in the use of IA for low-risk women. As well, post-intervention focus groups were held to explore both behavioural and/or practice changes of midwives directly or indirectly exposed to the intervention.

5.5.1 Post-intervention RMRR.

The post-intervention RMRR was conducted over three months (March, April, and May, 2010). During this period there were 514 births (177 in March, 167 in April, and 170 in May). This represents 24% of total births for the year 2010 at the study site. An online sample size calculator (www.raosoft.com/samplesize.html) was used

to determine the number of medical records for the RMRR, accepting a 5% margin of error and 95% confidence. The recommended sample size was 326. The post-intervention RMRR was timed to commence three months after the educational intervention was delivered. The purpose of the post-intervention RMRR was to determine if there had been any changes in the practice of midwives, especially in relation to their choices and conduct of fetal monitoring for low-risk women and to evaluate the outcomes of care when women received IA during labour.

5.5.1.1 RMRR data collection tool.

The same RMRR data tool as was employed in the pre-intervention phase was employed for data collection in the post-intervention phase of the study. During the re-audit, I also specifically looked for evidence about the woman's suitability to have IA for ongoing FHR monitoring in the documentation following admission assessment.

5.5.1.2 RMRR data analysis.

Data from the post-intervention RMRR were entered into the Statistical Package for the Social Sciences (SPSS, Version 17). Once data entry was completed, data were checked for accuracy prior to statistical analysis being conducted, as was done in the pre-intervention phase. In addition, simple descriptive statistics to determine the proportion of women eligible for and receiving IA on admission to the unit and during labour were calculated. Data detailing compliance with the ISIA framework were similarly described. Data from the pre- and post- intervention phases were compared to determine whether any differences found were significant. Categorical data from the pre- and post- intervention phases were entered into 2 X 2 tables for analysis using Pearson's chi-squared tests, with the results presented as Odds

Ratios and their 95% confidence intervals. Fisher's exact test was used if cell sizes were less than five.

5.5.1.3 RMRR Ethical Considerations

The same ethical considerations as were evident in the pre-intervention RMRR were present in the post RMRR. However, additional staff were involved in undertaking the post RMRR, so it was important to reinforce the need for maintaining the anonymity and confidentiality of the identity of women whose records were being reviewed, along with the identity of midwives who had made the recordings in the medical records. All the reviewing staff signed the confidentiality agreement.

5.5.2 Post-intervention focus groups.

Focus groups were again held following the intervention. The aim was to meet again with the same midwives who had participated in the pre-intervention focus groups, if possible, and to invite additional midwives who had attended the education session. Data collection and analysis for the post-intervention focus groups was managed as previously described. The prompt questions were based around establishing whether there were any personal/professional or system/organsational changes as a result of the intervention.

5.5.2.1 Post-intervention focus group trigger questions.

The purpose of the post-intervention focus groups was to get feedback from the midwives on the value of the educational intervention, and to determine whether there had been changes to behaviour and practice as a result of the session and introduction to the ISIA framework. I began the focus group by going over some preliminary data from the pre-intervention RMRR to stimulate the discussion.

Trigger questions at the post-intervention RMRR included:

What is your response to the preliminary statistics from the pre-intervention RMRR that I have provided, particularly in the context of education session?

Did the education session make any difference to how you practice and if not, what's going on that makes it hard to change what you do?

What changes have you made to your own practice following the educational session?

What changes have you seen, if any, in the maternity unit following the education session?

5.6 Demonstrating Rigour

Demonstrating rigour in mixed methods research involves remaining “true” to the conventions of each method. In a mixed methods approach, qualitative and quantitative research methods are combined in a complementary manner to bring different realities and therefore a different view of the phenomenon under study. Each paradigm has its own “language” demonstrating rigour in research and these are presented in the context of this research (Eccles et al., 2003; Cresswell, 2009; Tashakkori & Teddlie, 2010).

5.6.1 Validity and reliability of quantitative data.

In quantitative research, the term rigour is usually described as validity and reliability. Described as checking processes to increase the probability that the research findings are true, Roberts and Taylor (1998) state:

Validity refers to the extent to which the means used in the research to collect and analyse data do what they are supposed to do. Reliability refers to the extent to which consistent results can be achieved on repeated undertaking of the research project. (p. 172)

According to Onwuegbuzie and Johnson (2006), researchers “have begun to develop a bilingual nomenclature for mixed methods research and have called validity – legitimisation (p.55). Legitimisation of the mixed methods study relates to many phases of the research process, from philosophical issues to inferences drawn, and to the value of the study for consumers (Creswell, 2009).

Retrospective medical record review or audit of medical records is the most common data collection method when evaluating an intervention in the clinical setting. The validity of this method of data collection has been found to be reliable depending on the type of information being extracted. For this study, reliability and validity of data related to electronic fetal monitoring when the CTG was used was done by comparing the midwives’ documentation of the FHR findings on the CTG in the medical record with the CTG trace, which was in most medical records where CTG had been used. CTG paper automatically prints the date and time stamp, making comparison between documentation and the actual recording easy, as long as the date and time are accurately set. The evidence-based guidelines also recommended that midwives annotate the CTG trace with any factors that may affect the FHR, such as vaginal examinations, epidural insertion and usage, IV medications, etc. These annotations were used to further interpret adherence to the IA policy at the study site.

The validity and reliability of data collection tool for the RMRR is unable to be established because it was developed in the context of this research; therefore, it has not been used before.

5.6.2 Trustworthiness of qualitative data and analysis.

Rigour in qualitative research involves maintaining an audit trail including memos, coding entries, storylines, and concept maps to demonstrate the researcher's self awareness about assumptions, values, thinking, and decision-making throughout the process of data analysis (Koch & Harrington, 1998).

Therefore, I have maintained a comprehensive data file containing the details of participants in each phase of the study; transcripts of focus groups and field notes taken during the focus groups; and records of the steps in data analysis, including the development of minor themes and how these were joined into major themes. In particular, I kept detailed field notes of the RMRR processes in both the pre- and post-intervention phases so that decisions made about how to interpret aspects of the medical record in relation to adherence to the unit IA policy were tracked.

5.7 Summary

This chapter has described in detail the study design, the quantitative and qualitative methods of data collection, and associated data analysis techniques. The ethical issues of informed consent to participate and of confidentiality of women and midwives whose notes were audited were discussed. Finally, the issues of validity and reliability of quantitative data and the rigour and trustworthiness of qualitative data were explored. In the following chapters I present the study findings. In Chapter Six, the findings from the pre-intervention phase are revealed. The results of the barrier assessment revealed during focus groups with midwives provides some insights to the barriers to and facilitators of KT in the context of fetal heart rate monitoring for low-risk women at the study site. Chapter Seven presents the findings from data collected after the intervention was implemented compared with the pre-intervention RMRR to determine whether there were changes in behaviour, practice,

and processes; and whether any of these impacted on the outcomes of care.

Chapter Eight presents the post-intervention focus group findings.

Chapter Six: Assessing Barriers and Facilitators to Knowledge Use

6.0 Introduction

This chapter reveals the code groups and themes that emerged from the analysis of the focus groups held with a group of self-employed (SEMW) midwives on one day and a group of hospital-employed midwives (HMW) the following day, during the pre-intervention phase of data collection. Focus groups with midwives were conducted to explore potential barriers that impede or limit knowledge uptake on the use of IA of the FHR during labour for low-risk women, as well as facilitators for IA use. The major themes and code groups from the focus groups provide the context of where, how, and why midwives practice IA and adds greater understanding and appreciation of the descriptive statistics from the RMRR, which are presented in the following chapter. Positioned under four categories, Personal/Professional and System/Organisational, and Barriers and Facilitators, the major themes were: Continuity of Care, Midwifery Practice, IA Conduct, Admission CTG, Evidence, and Technology. Within each major theme there are multiple code groups classified as either a barrier or facilitator to the use of IA in practice for low risk women. These themes and code groups are illustrated in Figure 6.1.

The early analysis of each of the individual focus groups revealed the emergence of similar themes; therefore the data from each group were combined into one. For some of the subthemes, however, it will be apparent that one voice is dominant, either SEMWs or HMWs, but for most sub-themes both voices are in evidence. The midwives' own words are used to expand the main themes of discussion.

Figure 6.1. Barriers and facilitators to midwives' fetal monitoring practice: Personal/Professional and System/Organisational.

6.1 Participants

A total of 14 midwives participated in two pre-intervention focus groups.

Demographic details describing the midwives are provided in Table 6.1. There was an equal mix of hospital-employed midwives and self-employed midwives, with years of experience ranging from 2 to 30 years. Half of the midwives were trained or

educated overseas, with six receiving their pre-registration education at a university or polytechnic. Training programmes varied in length from 6 months to 3 years. Nine of the midwives were registered nurses prior to completing their midwifery education.

When using the words of the midwives to further illuminate the sub-themes within each major theme, I will use the following code: 1 = pre-intervention phase focus group; H = hospital-employed midwife; S = self-employed midwife and the letters A to O = midwife, to identify to which midwife the quote is attributable.

Table 6.1

Demographic information for midwife participants in pre-intervention focus groups

Hospital Employed Midwives Focus Group					
Midwife ID	Year trained/educated	Years of practice	LMC experience	RN	Place of training/education
A	2001	7–8	Yes	No	NZ University, 3yr BMid
B	1985	25	Yes 5 years	Yes	Hospital based training in UK, 1yr
C	2001	8	No	No	NZ University, 3yr BMid
D	2006	3	No	Yes	Australian University, 1yr PostGrad Midwifery
E	1997	12	Yes 7–8yrs	Yes	Hospital-based training in London
F	1981	28	Yes	Yes	Hospital-based training in NZ
G	2007	2	No	No	NZ University BMid

Self-employed Midwives Focus Group					
Midwife ID	Year trained/educated	Years of practice	LMC experience	RN	Place of training/education
I	2001	8	PHO – salaried position, group practice	Yes	UK – an 18 month honours degree
J	1990	19	Group practice	Yes	NZ Polytechnic - 12 month post nursing
K	1978	30	Group practice	Yes	UK – 12 month post nursing
L	2004	5	Group practice	No	Unknown
M	2007	2	Group practice	No	A NZ University BMid
N	1973	20	Group practice	Yes	NZ - 6 month hospital-based program
O	1985	24	Group practice	Yes	UK – 18 month programme

6.2 Pre-intervention Focus Groups Themes and Sub-themes

Four major categories were identified prior to the analysis (a deductive approach). They are named personal/professional and system/organisational, and barriers and facilitators. Within each of these categories several themes became apparent as the midwives talked about their practice and the context/environment in which they provide midwifery care. The themes are: continuity of care, midwifery practice, IA conduct, admission CTG, evidence, and technology. I have explored

these themes from the perspective of the barriers and facilitators to the practice of intermittent auscultation (IA) during labour for low-risk women. Under each of the themes, several code groups are further explored. A visual representation of the two major categories, the themes, and code groups is in Figure 6.1. The code groups will be discussed further with the midwives' own words used to illustrate them further.

What became apparent was that the sub-themes emerging from the assessment of barriers and facilitators to IA existed in the personal/professional and the system/organisational categories and could do so at the same time. Interestingly, from the system/organisational perspective, the midwives did not identify any facilitators for the use of IA for low-risk women within this maternity unit. This fact will be picked up later in the discussion chapter (Chapter Nine).

6.2.1 Continuity of care.

Within this theme the midwives discussed the role of *continuity of care and caregiver* and the impact this relationship-based model had on the decisions they made in partnership with women. From a personal/professional perspective, continuity of care/caregiver becomes a facilitator to the practice of IA as the midwives talked about the importance of *knowing* the woman and the *trust* that is implicit in many of the relationships between the midwives and the women that develop over the time of pregnancy, labour and birth, and postnatally. Midwives practising continuity of care also talked about *intuition*.

I think it is wonderful working the way we do and I always feel quite inspired and more passionate when we're talking about it. When I think about how we work, or how I work, and how I know that my colleagues work [it] is that wonderful relationship that you've built up antenatally, it's such a holistic experience that you know that there are some people that you absolutely

know that their baby is fine . . . you know [emphasis on know]. I practice intuitively a lot (1SN).

Following on from this discussion of knowing, a relatively newly self-employed midwife talked about her own developing sense of “knowing” in the continuity of care model and raised the notion of *connection* with the woman. Both knowing and connection act as a guide to their decisions around fetal heart monitoring.

and I think that [knowing] comes with experience, you know, like all you guys are saying. I’ve only been out two years and sometimes I feel with women I look after I absolutely get that way, it’s like yeah! I get that sense, I know that’s fine. And then some women you don’t have that connection, and then you are listening more carefully and you are approaching the monitoring in a totally different way that you would with another client (1SM).

The groups also saw a lack of knowing, trust, and connection with the woman, as a result of not having the ability to provide continuity of care, as a reason why they perceived hospital-employed midwives might have a tendency to use the CTG for FHR monitoring, and especially admission CTG, more often.

That’s also why the women who come into the hospital and have like core¹⁷ midwives who they’ve never met before, why they do a lot more [CTG] monitoring, cause they don’t have that connection, feeling, knowledge [of the woman] (1SO).

¹⁷ Core midwife is a term used in New Zealand for midwives employed in a hospital maternity setting. The origins of this term are unknown.

Midwives who do not have the opportunity to provide continuity of care as the LMC throughout the pregnancy, labour and birth and postnatal care described “not knowing” the woman as a system/organisational barrier to the choices they make around fetal heart monitoring during labour. Interestingly, midwives who had previously been self-employed LMCs and were now working as employed midwives in the institutional maternity care setting reported that their *practice changed* when they became hospital-employed midwives.

I have to say, I found it easier when I was doing LMC, because I knew my women, I knew the women really, really well and knew their pregnancies . . . but as a core midwife, because I don't have that, I don't know that background quite so intimately, I would be listening in more frequently and, kind of would be more likely to just do an initial trace [admission CTG] as well, just to gauge what's actually going on there. I've actually found that quite interesting, that my practice has changed a little bit because I'm not as aware [of the woman's history] (1HE).

However, from the system/organisational perspective, in talking about continuity of care, some midwives thought that an established *relationship with the women was not necessary*. From their past experiences of meeting women for the first time when they arrived in labour, they felt skilled at establishing rapport very quickly.

From my practice in England, the norm was to meet the woman in labour and do that course of time with her, and you get the rapport you get, which was normalised for what it was in that setting, and I didn't know anything different from that until coming here and meeting women nine months prior (1SI).

In the NZ context, continuity of care refers to a specific model of care based on partnership with women; providing and supporting continuity of midwifery care throughout the woman's childbirth experience. Continuity of carer is also usual in this model of care. Self-employed midwives become the LMC for individual women and coordinate all their care, 24 hours a day, and 7 days a week, from early pregnancy through to 6 weeks after the birth when the woman and her baby are transferred back to primary health care services (Well-Child and GP services). In the hospital setting, although some midwives are employed in teams of midwives providing continuity of care, they rarely provide care in the same manner as a self-employed midwife, that is, full LMC care. This means they mostly do not have an established relationship with women that have developed over time, as is the case for LMC midwives. There are many factors that impact on the "knowing", "trust", "intuition", and "connection", described by the self-employed midwives, for hospital-employed midwives.

From the system/organisational perspective, employed midwives described the influence of a *dominant medical paradigm* within the institutional maternity setting and how this tended to dictate fetal monitoring choices. They described the use of CTG, as the "expected" choice in many instances, as a barrier in the context of continuity of care and the relationship with birthing women. As employed midwives working in a maternity unit they talked about *learnt behaviour*, which was synonymous with a loss of autonomy. The following conversation about the use of admission CTG was an example of how hospital midwives' practice was directly influenced by the doctors at the hospital, some of whom were private obstetricians and others who were employed obstetricians and obstetric registrars.

For me I find . . . the delivery suite [use of] CTG and active management [of labour] is about time management. And that's it in a nutshell. For them [doctors] it's time management, too, they're able to have something documented on the CTG trace that says all the things are fine. And so, we're waiting for that plan of action and I feel like saying, "Yes, sir, we'll do it that way," you know, but at the same time, when you have argued a point [CTG not required because the woman is low risk] then that's the whole point about getting argued down about having no CTG. [It] can be a waste of everyone's energy to be, you know, if it's one of the obstetrician's [private] patients (1HG).

Since I work here, that was very much a learnt skill—do the initial CTG. Sometimes if the labour goes on too long, and I am about finish my shift, I do another CTG, just [to] tell my colleagues, 'Well, I'm off, my CTG's alright.' And that's probably very right, 'cause people keep saying, 'Just cover yourself'. That's not very professional, but [I've] learn[t] that thing, I'm saying the same thing, doing the same thing now, very much like everybody do[es], you know, initial trace later on (1HC).

6.2.2 Midwifery practice.

From a personal/professional perspective, the midwives talked about the discussions and care planning that occurs antenatally as a facilitator to the use of IA, empowering women to make *informed choices* in relation to fetal heart monitoring. Care plans were seen as very important reference documents, especially for the

hospital “primary” care women, as they would receive care from a different midwife during labour.

I would say to people when I talk through the monitoring phase of their care plan, if everything was absolutely normal, if you have no risk factors—and they might ask what the risk factors are, so you would explore that— if you are low risk you could expect that you might just be monitored with the Doppler, like I use here [in the primary antenatal clinic], okay. So, we might just use that (1HF).

In the initial booking, like antenatal booking . . . I think it’s very important that it’s documented that the information [about fetal heart monitoring during labour] has been given to the woman. And the woman’s expectation is that, “Okay, it has been discussed, I’m straightforward, I don’t need a CTG at admission (1HB).

These discussions are interesting because from the retrospective medical record review, I was able to ascertain that only 25% of all medical records contained a maternity care plan. Therefore, evidence of an antenatal discussion between the woman and her midwife/LMC relating to choices for fetal heart monitoring during labour was minimal.

Midwives also used the antenatal discussion about fetal heart monitoring with women to make sure the women understood what they might hear during monitoring. Understanding the potential for increased anxiety related to FHR monitoring, when the woman and her family do not have the skills to interpret what they are hearing, one midwife used this opportunity to have a discussion around second stage monitoring and the presence of FHR decelerations.

I expect to hear decelerations [of the fetal heart rate] when a woman's pushing, I expect that to be the case. [S]o I'll often talk to women about expecting to hear that and that that's normal, because I think that helps her to understand. [Be]cause if the woman hears it, what I don't want to happen is for her to go, "Oh no, that doesn't sound very good, it's gotten slow." So, I usually anticipate her asking why it's got slow and talk to her [antenatally] about the fact that what we probably will hear is that the babies heart rate will slow and it will pick up again between the contractions (1SJ).

Also a facilitator for the practice of IA was the midwives' trust in normal physiology.

And I just want to trust that it's normal and it will present itself to me if it isn't. Because, I think all that angst we feel about looking for trouble, you know, like looking for problems all the time . . . I just believe that it's okay until it obviously isn't. And part of the whole surveillance thing for me is, it just doesn't sit that easily for me because I, I don't know, I've been around a long time and mostly it works just fine. And mostly it's really obvious when it wasn't just fine (1SJ).

However, from the personal/professional perspective, barriers to the use of IA perceived by the midwives included a *loss of tacit knowledge* and *loss of instinct* leading to a *lack of confidence and threatened autonomy*. The following excerpts are from two relatively new midwives discussing the belief that technology interferes with their ability to be intuitive midwives, relying on their skills of feeling, knowing, sensing, and listening.

The more we use the technology, the more we don't learn that [tacit knowledge and instinct]. Because I think, like, in my limited experience, that one birth comes to mind, looking after a woman who didn't want Doppler or anything, and didn't want VE's, nothing. That was amazing learning for me because it was like, Yeah! You know that this is fine, listening to the baby just with the fetoscope, and you're not doing internal examinations, and it does teach you to just really be there and know what's happening on a different level. And you can't document it. But yeah, if there were more women who felt strongly that that's the sort of experience they wanted, and then I feel myself as a midwife, I could learn that more (1SM).

I think as a student I trusted my instinct more. And you know, I used quite a bit of the instinct before I came into this place [the secondary maternity unit] to practice. Ninety percent of the time I think I was correct. But, since then I've had to follow the hospital protocol, and so I'll put that trace on, like I'm told to (1HG).

From the system/organisational perspective midwives referred to the expectations of "others" as a barrier to the practice of IA.

I had this woman, perfectly normal, in latent phase and she didn't want to go home. So I just left her [in her room], you know, the fetal heart was fine. And her supporter came out really mad with me, she say, "It's about time you put that monitor on", because there was a monitor in the room. And I just looked at her and said, "Tell me why I need to put that monitor on?" And she said, "We want to see that the baby's alright." I said, "The baby's okay, I've listened to the baby. And she's not in labour." You see, it's the

expectation [of the women's support people], because she had a trace done before, so the supporter was wondering why I didn't bother to put on the trace. I had to explain to her, because she probably thought it was a normal practice to have the tracing on [continuously] (1HB).

I wonder too, that family and whānau¹⁸ have a much bigger presence in the birthing room in the hospital setting. Like if you're at home, then there's your fundamental belief that birth is normal. But in hospitals it's different because a lot of those families might have been with women where things weren't normal. And so that there was a trace, there was a CTG being used, and there was anxiety about that. And so there's a big body of people out there, lay people, who are exposed to this anxiety about the trace (1HF).

Within the institutional maternity setting, even self-employed midwives choose acquiescence rather than engaging in a battle over the evidence and the implied threat of inaccessible or withdrawn advice and care. In the context of needing to consult with the obstetrician or registrar, the midwives will quickly do a CTG because it is expected by the medical team.

Sometimes you do one [admission CTG] if you know you are consulting, because you know that actually it's easier to do, you don't want to have a stand up conversation or argument or discussion with the person who's suggesting that they won't do anything until you've done it. So, you go, okay. You just acquiesce; it's just easier (1SN).

¹⁸ Whānau, pronounced 'far-no', means family in the language of Māori, indigenous people of New Zealand

6.2.3 IA conduct.

In the self-employed midwife group, there was an extensive discussion around how they actually did intermittent auscultation and where they got their knowledge for this monitoring modality. From a personal/professional perspective, a facilitator for midwives was that they tended to *individualise* the frequency of IA to each woman and her baby rather than follow a prescription of care as stated in fetal surveillance policy. They used terms such as *opportunistic* and *intelligent observation* and described using their *senses, listening and hearing and knowing what a fetal heart sounded like*. They also talked about trusting physiology and the normality of birth as guiding their practice.

The notion of opportunistic fetal heart monitoring came up in a conversation between self-employed members of the focus group. The discussion and definition of this term follows.

And in terms of the timing of listening through the beginning part of labour, probably I don't have a routine about that. A lot of women that I work with labour in water and so it's [listening to the fetal heart] often opportunistic about when she might hop out to go to the loo, or every now and again, when she's kind of seeming open to it (1SJ).

Me: The notion of opportunistic—what does that mean? What do you actually mean when you say “I do this opportunistically?”

I guess when a moment presents that you feel you can just sneak in and listen and it's not going to interrupt what's happening, a little pause (1SL).

I think it's probably – when you're not making her do something special [like changing her position] just so you can listen in. You're trying to get [the fetal heart] whatever position she's in, or something (1SO).

And it's often initiated by the woman, rather than us looking at the watch and saying, "Oh, I haven't listened [to the fetal heart] for a while, I'd better go and do it." (1SJ).

Or it might have been intense and no-one was talking, like the woman's just really focussed and then she goes, "Oh, that was a crazy patch," and you're like, alright, I might just sneak in [and listen to the fetal heart]— rather than getting her out of the zone (1SM)

Me: Yeah. And why is that important, do you think?

To not disrupt the flow the woman is creating on her own, really, to [not] interrupt the process (1SM).

Yeah. Cause it's very delicate, the balance (1SN)

And if you're supporting physiological birth then that's how you support physiological birth, by not interfering constantly. And disturbing the mother, I suppose, I guess the hormone thing as well (1SJ.)

Just letting it happen (1SO).

The notion of opportunistic monitoring was not raised by the hospital-employed midwives, which is an issue that can be explored in further studies. However, in support of the concept of opportunistic fetal heart monitoring for low-risk women, another self-employed midwife used the term *intelligent observation*, which she

believed guided experienced midwives to know when something is happening and a change of FHR monitoring modality was needed.

I think you get early indicators of a major problem going to happen. And the thing about intelligent observation is actually picking up one of those signs early. So, in fact, you don't get to a point where it's a major problem. Some of it is you just have a feeling, something isn't right or something. And so you think – and then something just might start presenting early, and you think, mmmm, yeah, like a little trickle. You get a feeling if it's gone off the normal path. And if you don't act at that point something else will happen, it will present more. And a bit like you're saying, the baby will present more, something will happen to indicate that things are not right (1SO).

The self-employed midwives also reported a lack of *confidence* in performing and interpreting IA as a barrier to its use for low-risk women. They talked about IA as a *dying skill* for midwives that prompted some of them to actively use a Pinard stethoscope both antenatally and during labour.

And sometimes I do both [Pinard and Doppler device] , but it's so that a student can learn to use it, cause I think it gets by and it's, you know, without that skill, it's a dying skill almost (1SL).

The hospital midwives did not comment on this specifically, but talked about the effect of a lack of IA equipment on their ability to do IA effectively. This is discussed under the heading of Equipment later in this chapter.

I asked the midwives to describe how they interpret intermittent auscultation. Interestingly, midwives' *knowledge of electronic fetal monitoring* in the form of CTGs often influenced their interpretation and *documentation of IA* findings.

Well, I think that affects my interpretation of what I hear as what I know about CTGs. So, when I'm listening I'm almost in my head visually plotting out what I'm hearing, in order to somehow relate that to what I know I would be looking for, if I was doing a CTG. And I hate that I do that. I mean, I'd rather just listen to the baby and go, Yeah! This sounds really good. And it's that gets transferred into how I write it down, and I write it down in a way that wants me to have people thinking that, you know, I've listened for a length of time and I'm observing for accelerations and decelerations, and actually I should be counting a number and writing down a number. But I'm aware that I write a range and it's something I've tried really hard to change in my practice, lately, is remembering intermittent is about counting and coming up with a number, not trying to demonstrate that I'm looking for more than that (1SJ).

These comments led to a very interesting discussion between the self-employed midwives around the *need to demonstrate FH baseline variability* by recording the auscultated fetal heart rate as a range of numbers instead of a single number.

I want to come back to that, quickly, cause I never thought that I plotted that out, like you are saying, but interestingly in documenting, if it was 130–145 I'm very wary about what I write because if I write 130–135 then it's saying it's poor variability, that aspect I'm aware of. So, I thought, no, that's not good enough, I need to wait 'til I've got a few more higher beats before I can actually document, so that it doesn't then look, for that three minutes I listened in to, that it was poor—you know. So, it's kind of again maybe a little bit of litigious conscious (1SI).

Well, I don't do that [document FHR as a single number] (1SN).

Me: Don't you?

No. I do a range (1SN).

I do [document FHR as a single number], definitely (1SL).

And if what you heard was the start of acceleration and then the comedown [back to baseline] you don't write 140–130, cause that looks like it's heading into a [deceleration]. So, that's why writing a number is the most protective thing you can do (1SJ).

When did this come in [writing a range], because when I trained we wrote a number (1SK).

Well, that's because when we trained you counted it [for] 15 [seconds] and multiplied it by 4 (1SN).

But when did this 130–145 [writing a range], when did it come in? How did it creep in? (1SK).

Well, I think it's happened because of CTGs (1SJ).

I think it is—because I used to write just a number— (1SI).

And I don't know when that would have changed (1SN).

I don't even remember that creeping in and being the norm to do that (1SK).

And yet, that's the way that I've always done it [writing a range], because that's how we were shown and taught (1SL).

And you should get at least 10 [beats per minute] between the highest and the lowest (1SL).

I wasn't shown that at university, but all the midwives that I went out with, that's always how they did it, so when you're first learning to write notes out, that's what you're seeing, that's what you're automatically doing (1SM).

And it is because of variability, isn't it? (1SO).

Yeah! (1SN).

Like, if you wrote 120 that could be interpreted as—it's just stopping on 120, which isn't necessarily a well baby (1SO).

Yeah. Or could have had a beat to beat acceleration from a period of deceleration— that says nothing, really, does it?—one number (1SI). Except that, as a snapshot, it tells you it's a normal heart rate (1SJ).

For that one beat (1SN).

And maybe that's enough (1SJ).

Like when we take a woman's pulse, it's like right now, it's 85 or something (1SM).

The belief that FHR variability, a concept associated with CTG usage, still needs to be demonstrated when using IA abounds. One hospital midwife described different counting techniques she used when doing IA in an attempt to represent variability.

Or I'm counting it, you know . . . do little 5 second counts [and multiply by 12], or 6 seconds and then multiply it by 10. So, we'd do a series of those, if

I didn't have a [Doppler or CTG machine], couldn't see a printout, then I would just do it that way. Just to see (1HE).

6.2.4 Admission CTG.

When discussing fetal heart rate monitoring, the use of admission CTG inevitably comes up. Whether or not an admission CTG is conducted, especially for low-risk women, is one of the main points of difference in the world views of midwives and doctors, despite the body of evidence that currently exists, and causes much controversy. For some midwives in the study, their practice of assessment on admission has *changed over time*.

You know, I traditionally used to do the admission CTG for years and years and years and years, and struggled with it, but used to do it anyway because it made me feel more comfortable. And then probably about a year ago decided that, no, going to stop, and surprisingly enough the woman and the baby survived. And so, what I tend to do is, you know, come in and have a listen on the Sonicaid . . . And that's been my practice (1SO).

Some of this change in practice in the use of admission CTG related to changes in their *employment status*. One midwife says:

I have to say, I found it easier when I was doing LMC [self-employed practice], because I knew my women, I knew the women really, really well and knew their pregnancies and found that when they came into labour I was . . . very much with the auscultation, you know, the intermittent, I can just rarely put them on [the CTG], I would only ever put them on the monitor if I felt they weren't actually in labour and it was just kind of to buy some time to just watch what was happening and see what was happening (1HE).

The self-employed midwives reported being comfortable not doing admission CTGs for low risk women. I asked them how they managed the scrutiny that inevitably comes with taking a stand on evidence-based practice versus the expectations of others or custom and practice. Their responses demonstrated their clear understanding of *autonomous practice* and their understanding of the *research evidence*.

I mean, a midwife is responsible and accountable for her own practice and that's the way that I would have that, so I don't care if they do look at my notes, actually (1SN).

If it's a well woman, why would they want you to do one anyway? (1SM).

However, autonomous practice was not a fact of life for hospital employed midwives as evidenced by the following quote from an experienced midwife who returned to hospital employment after many years away from the maternity unit.

Okay, well you may have practiced here before, but you know, this is a secondary unit and it's hospital practice to do that [admission CTG] (1HF).

Self-employed midwives used evidence from research to support their decisions related to the use of admission CTG.

I mean, if the evidence doesn't support doing it, so, you know, there is no need to justify not doing one because there is no evidence to do one, with a well woman (1SJ).

I continued on doing it [admission CTG] for a long time knowing it was totally un-research based. Because I felt that I wouldn't be questioned about it. And it was easier to do it that way. Well, at that point current

common practice was to do one at that point, and it was just more comfortable to practice like that, yeah. Even though I knew that it wasn't right, well, it wasn't research based. So, it took a while to actually stop and say, "No, I'm not going to do it" (1SO).

6.2.5 Equipment.

All the midwives commented on the fact that the birthing rooms at the study site maternity unit are setup with a *CTG machine beside every bed*. They believed this sent a message that there was an expectation that the CTG was to be used for every labouring woman regardless of her risk status. The following is one example of what the midwives said.

One of the things about environment in relation to the equipment is, I always smile when I ring ahead to say I'm coming and I get here and the CTG's next to the bed with the straps laid out across the bed. I pack them all up and take the machine out of the room because I'm not anticipating I'm going to be using it. But also, I'm aware that when it [the CTG machine] is in the room, I use it because it's there, and I don't use it continuously unless that's indicated, but if the woman's wandering around then often I will actually use the transducer from the CTG to do the intermittent listening. And I never would do that in any other setting. So it's, you know, we do use what's around us to support the way that we are with women, and you know, if the stuff is there it gets used(1SJ).

Another midwife felt that the availability of the CTG machine in every room was a bonus as the use of a Pinard stethoscope was perceived as old fashioned and midwives no longer had the skills to use them.

These days you don't want to use the Pinard anymore, it's very easy now, you just use a portable thing (hand-held Doppler device], or with the CTG just, you know, just use it to listen every now and then (1HB).

The issue for the hospital midwives was that there were not enough hand-held Doppler devices available and no Pinard fetoscopes. There were concerns that the Doppler devices were either thrown out with the linen or rubbish or stolen. The shortage of Doppler devices meant that self-employed midwives needed to bring in their own and there was a reluctance to do this because of the degree of loss or theft. While the CMM had ordered Doppler devices, the process of actually getting them into the unit and in a form that made it harder to lose or steal was taking considerable time. In the meantime, CTG machines were used to perform IA.

But maybe as well we don't have enough Sonicaids. So, sometimes what I'll do is I just will use the [CTG] to listen in intermittently. But, because . . . I went looking for a Sonicaid yesterday for this woman in the bath, could not find one at all. . . . So, there's not enough Sonicaids to go round. We went through the stage of, you had enough and they were locked away and you had to sign them out, but it became too hard (1HF).

6.2.6 Evidence.

One of the questions to the midwives during the focus group was where they get information to guide their fetal monitoring practice. The purpose was to explore their knowledge of research, guidelines, and policy. One midwife gave this comprehensive response.

I often get information from the woman herself. And again, that's about her talking in labour about the baby's movements, and knowing her, and knowing her baby for months before the labour happens. I'm aware that I

get information from my colleagues about things that, experiences they might have had, and things they might have heard, and those outcomes. I also get information from doing online teaching packages and all of that. But I think often the way that I practice is determined by where I am and so if I'm caring for a woman at home then obviously the only conversation we have around monitoring is that I'll be listening with a Pinard or a Doppler and if I'm concerned we'll be transferring [to the hospital] to use electronic foetal monitoring. And for women who are planning to be in hospital, we'll have a conversation about how the electronic foetal monitoring is there for when things become complex and that would be the only instance that it would be used. And I talk about the limitations of monitoring that I know about from the evidence, really, and the increased incidence of intervention related to the use of electronic foetal monitoring, but that it's appropriate if you're concerned. Yeah, so a variety of sources, yeah (1SJ).

Other midwives debated the *hospital policy* (or lack of hospital policy).

Interestingly, the policy for fetal heart monitoring was an evidence-based policy written in 2005 and due for review in 2007. At the time of the research (end of 2009), the policy had still not been reviewed, so was two years out of date. There was considerable debate around this policy. In the context of evidence-based practice, custom and practice and differing opinions were the main barriers to midwives' decision-making around whether or not to do an admission CTG for low-risk women as evidenced in this short discussion between hospital midwives.

I don't know whether it's a habit or [I have] just been told its hospital policy (1HB).

It is, it is [the policy to do an admission CTG] (1HG).

Yes, the thing is, I think it is requirement (1HA).

I haven't seen it written down; I must have missed that bit (1HF).

It was pointed out to me (1HG).

Some of the midwives had not seen the policy and did not know where it was kept on the delivery suite. I gave a copy of the out of date policy to them to look at during the focus group and the conversation continued.

But then we are constrained, it would seem, like I, when I have seen that now, I know I have seen it before. So, I saw it when I first arrived here two and a half years ago, and that's why I said I had never seen the bit about, you had to do it [an admission CTG]. But, since then I know that other people that I've worked with have said 'it's normal practice here to do that.' (1HF).

But then on there [the policy] it says it's individualised for each one [woman] (1HE).

So, actually everybody's confused. But [the policy] must have been stuck in there [the policy folder] because I saw that when I started— our organisation says it is really not necessary, but we keep doing that (1HC).

But for the self-employed midwives, the lack of up-to-date evidence-based policy facilitated their decision not to do admission CTGs for low-risk women.

Fortunately we work in a place that doesn't have any [policy], so that's quite helpful, really. There's only one that is up to date, so that's quite influential (1SO).

Me: How does that help you?

Well, I can just tag along and do what I want to do. And not have to worry about, I mean, as long as . . . I would take responsibility for my own practice anyway, but, and I'm really happy and confident to do that, but I don't feel that I'm having to, oh, be constrained—is the word—by policies. Yeah, rather than try to be constrained (1SO).

The policies wax and wane in their influential-ness, as well, don't they? I think if you're a really new practitioner then you might stick more closely to them, but actually when you've been around a while you kind of know when it's safe to step aside from them. They sort of, whether it's a guideline or a policy, you develop a sense of when it's okay to move away from it, and you can justify your decision to do that and be accountable for that justification(1SJ).

6.2.7 Technology.

Some of the older midwives trained before the widespread introduction of electronic fetal monitoring and expressed concerns about how intrapartum caregivers and women and their support people have moved away from using the evidence before them, such as fetal movements, and become very *reliant* on what they think the machine is telling them about the condition of the fetus. Some midwives are concerned about the *safety* and *efficacy* of the ultrasound Doppler devices and electronic fetal monitoring.

I actually am quite concerned how much the junior doctors actually rely on those monitors. Because I've actually seen them produce a beautiful fetal heart, and the baby's been in the cot and the monitor's still been going beautifully, you know. And so I'm fairly concerned that people are getting to rely so much on that visual, and actually not listening, you know, with a

Pinard or listening, you know, to whether the mum's still having [fetal] movements. It's just amazing to me that they can't trust their body, that their baby's kicking, so it's got to have a heart beat if it's kicking, they've got to listen to that heart rate with a Sonicaid, and yet I've told them I can't guarantee it's safe (1SK).

As well, some of the older midwives talked about electronic fetal monitoring *creating anxiety* in them and interfering with their innate sense of trusting what they are *hearing* during auscultation and *knowing* what a healthy fetal heart sounded like. The midwives said the following.

If I am in there it [CTG machine] creates anxiety in me, I have to say. . . . I see this thing go on and, "Oh my goodness, am I reading this right?" There's a huge anxiety about— you know. I've done the K2 thing and I've [thought], is there enough? Or maybe I'd better leave this on a bit longer? So, there is a, it does produce an [anxiety] (1HF).

You can hear a tired baby. If a baby is getting distressed and he's lacking in oxygen then the heart begins to sound tired, and you, you can hear it (1SK).

Me: What do you think—tell us what you think that sounds like?

Oh it's hard, er, I think that comes through experience of listening to a lot of babies and listening. When CTGs first came in I had to turn my back to it because I couldn't visualise it, I had to hear it. And what does it sound like? (1SK).

Laboured? (1SO).

Yeah, and slower and—well, it's not so much slower; it becomes a bit dull, doesn't it? (1SK).

Me: So, it's definitely a sound thing for you, then? How it sounds?

Yeah, instead of being that boom-boom-boom [full and bouncy], it's sort of a boom, boom, boom, boom, boom [slower, duller— changes the sound of her voice]. It's a duller sound (1SK).

All the midwives became engaged in a discussion around *societal acceptance of technology* and how they perceive this has led to a loss of trust in *internal knowing*.

I think it's related to that wider societal acceptance of technology, as only ever being a good thing. I think people are really reluctant to think that technology might have some limitations or might have some detrimental thing, because in so many other aspects of our lives it's made life easier and broadened our ability to, you know, have pictures of the baby in America before the placenta's even birthed, you know. I think that it's part of people's, yeah, just their acceptance that that's the world that we're in now, and that we can listen to a baby's heart at 10 weeks, so why don't we? (1SJ).

People are used to learning things externally instead of feeling things internally. And lots of women say, "Oh, now it feels more real," cause they've heard the baby. [This is] even though they've been feeling the baby moving (1SM).

The *availability of technology* in our maternity units means the midwives are more likely than not to use it. Some saw the use of the available technology, such as CTG machines, as *protective* when adverse events occurred.

But it is that thing about the availability of technology and how quickly, how readily we, I think we're a technology loving society, anyway, but I think we very readily adapt to using what's around (1SJ).

It's more as a protection as a hospital midwife, really, I mean, to me, you know, it's there, the technology is there so, you know, I don't want anyone to turn around and say, Look, why didn't you even do a CTG? . . . I think is intelligent (1HB)

One midwife described her experience of working in a primary unit where a decision was taken not to have a CTG machine. She saw this as protective both for the women and the midwives as there were clear decisions about normality and interventions; electronic fetal monitoring for low-risk women being seen as an intervention and therefore not appropriate in the primary birth setting.

When I was a brand new midwife I worked briefly in a primary setting at [name of suburb], and at the time there was a discussion about the purchase of a CTG machine, because women from up the coast would have to go all the way into [name of city] to have a, you know, reduced fetal movements CTG or something like that, so there was a lot of discussion around the purchase of a CTG machine. And the midwives there were absolutely staunch about the fact that it was primary unit and they didn't want a CTG machine. And so they didn't buy one (1SJ).

6.3 Summary

The midwives' words have illuminated our understanding of the barriers and facilitators for IA as a FHR monitoring modality during labour for low-risk women. Despite knowing about and having some understanding of the evidence around fetal monitoring for low-risk women, translating this evidence into practice appears to be affected by the employment status of the midwife. The ability to work in a relationship-based model has a direct impact on fetal monitoring choices and practice. A dominant medical paradigm sees midwives become acquiescent rather than engage in what seems to be a pointless debate. Traditional midwifery skills and tacit knowledge are eroded by the expectations of colleagues, support people, and a technology loving society. Learnt behaviours have replaced intuition. Informed decision-making was regarded as an important concept; however, the phase one RMRR revealed little evidence of this happening in practice.

During the pre-intervention phase of the study, focus groups with midwives as described above and a retrospective medical record review occurred concurrently. Following the pre-intervention phase, the knowledge transfer innovation, which is the teaching session that introduced the ISIA informed decision-making framework discussed in Chapter Four, was conducted at the study site. The next chapter documents the findings from the RMRR undertaken during both the pre and post-intervention phases of the study. The pre-intervention RMRR was conducted to identify the degree of the problem and the post-intervention RMRR was undertaken to evaluate the outcomes of care after the intervention.

Chapter Seven: Findings of the Pre- and Post- Intervention

Retrospective Medical Record Reviews

7.0 Introduction

This chapter presents the findings of the retrospective medical record reviews (RMRR), which were conducted before and after the educational intervention. The results are presented in two sections. The first section presents the pre-intervention RMRR conducted to determine the extent of the knowledge/practice gap as it related to FHR for low-risk women at one DHB in New Zealand. Baseline data describing the intrapartum monitoring experiences of 324 low-risk childbearing women, drawn from a sample of 511 women who gave birth during three months of 2009, were analysed to determine FHR monitoring practice as documented in their medical records. This pre-intervention RMRR accords with the beginning stage of the KTA action cycle, “identify the problem”. This process established evidence of the use of IA for FHR monitoring practices for low-risk women in this location. Four questions guided the pre-intervention RMRR: how many women in this cohort were eligible to receive IA (i.e., low-risk women); how many eligible women actually received IA; were midwives compliant with the DHB protocol for the conduct and documentation of IA during labour; and what were the maternal and fetal outcomes of care when IA was used? The findings are presented in relation to each question.

In the second section, I present the findings from the post-intervention RMRR, conducted three to six months after the educational intervention introducing the new ISIA informed decision-making framework. Data describing the intrapartum monitoring experiences of 291 low-risk childbearing women, drawn from a sample of 422 women, who gave birth during three months of 2010 were analysed to determine

FHR monitoring practice, as documented in their medical records. Data from the eligible women in the post-intervention sample were compared with data from the eligible women from the pre-intervention RMRR.

Statistical analyses (Pearson's chi-squared test or Fisher's Exact) were undertaken to identify whether any significant changes to FHR monitoring practice had occurred following the introduction of the ISIA informed decision-making framework. The pre- and post- RMRR findings focus on four key areas: a comparison of demographic data from the pre and post cohorts of women; compliance with admission assessment criteria; compliance with the IA protocol for ongoing fetal monitoring and associated documentation; and, finally, maternal and fetal outcomes when IA was used throughout labour for eligible women. The pre- and post- intervention RMRR comparison revealed a 12% relative increase in the appropriate use of IA and a 14% relative decrease in the use of admission CTG ($p = .015$ (RR 0.86, 95% CI [1.11, 2.70])) for low-risk women. Clinical outcomes remained unchanged with continued high rates of normal birth and few babies requiring admission to the neonatal unit or with Apgar scores of < 7 at 5 minutes. These findings indicate that the intervention was associated with a change in clinical practice.

SECTION 1

7.1 Pre-intervention Retrospective Medical Record Review (RMRR)

A total of 511 sets of medical records from all women giving birth during January, February and March 2009 were reviewed for this phase of the study using the data collection tool described in Chapter Five (Appendix J). The size of the sample

represents nearly a quarter of all births (2148) at this DHB for the year 2009 and is representative of the total.

7.1.1 How many women were eligible for and received IA?

The maternity records were assessed against the criteria set out in the DHB fetal surveillance guideline describing pregnancy complications or medical conditions affecting pregnancy (see Table 5.2 in Chapter Five). These criteria have been selected by obstetric “experts” as those most likely to be associated with a risk of fetal hypoxia; thereby indicating that continuous CTG monitoring during labour is warranted. In the pre-intervention RMRR, 63.4% (324) of women in this cohort had no documented antenatal risk factors identified in their medical records and were classified by the researcher as “low risk” and therefore eligible for the use of IA during labour (see Figure 7.1). In this sample of eligible women, 48.5% actually received intermittent auscultation (IA), while the remaining 40.1% of eligible women received ongoing FHR monitoring by CTG, either intermittently (48.5%) or continuously (51.5%) . A small group of eligible women (11.4%) had no ongoing FHR monitoring, usually because they gave birth soon after admission as described in Figure 7.1. The following presentation of findings relates to 157 women who were eligible to receive IA during labour and actually received IA, compared with the 130 eligible women who received continuous CTG.

Figure 7.1. Pre-intervention RMRR: sample distribution.

* BBA = Born Before Arrival

** Of these 37 women, 31 gave birth rapidly following admission and five went straight to emergency caesarean section following diagnosis of fetal distress on admission CTG (5) and one for an undiagnosed breech presentation. Admission CTG was still used for 10 of the women admitted in advanced labour or pushing.

† These women started with IA for ongoing monitoring but changed to CTG because of the development of a risk factor during labour – usually augmentation, epidural or meconium stained liquor

7.1.2 Demographic Data for Eligible women.

The demographic characteristics of the eligible women are described in Table 7.1. Women identifying as European make up the largest group of eligible women, with just over one-third experiencing their first pregnancy. The average gestation at admission was 39 weeks and 1 day. The majority of women had a self-employed midwife as LMC who provided the intrapartum care. There were no significant differences on any demographic characteristic for eligible women receiving IA or CTG.

Table 7.1

*Pre RMRR Demographic Characteristics of Eligible Women Receiving IA or CTG
During Labour*

		Eligible Women Receiving IA n = 157	Eligible Women Receiving CTG (Continuous or Intermittent) n = 130	Significance
		Number (%)	Number (%)	
Ethnicity	NZ European	66 (42)	62(47.7)	NS
	Maori	30 (19.1)	18 (13.8)	
	Pacific People	12 (7.6)	7 (5.4)	
	Asian	8 (5.1)	9 (6.9)	
	Indian	3 (1.9)	1 (0.8)	
	African	1 (0.6)	2 (1.5)	
	Other	4 (2.5)	2 (1.5)	
	Not stated	33 (21)	29 (22.3)	
Gravidity	Primigravid	53 (33.7)	59 (45.5)	NS
	Multigravid	104 (66.3)	71 (56.5)	
Parity	Nulliparous	62 (39.5)	77 (59.2)	p = .013
	Multiparous	95 (60.5)	53 (40.8)	
Gestation	Range	36 wks + 1 day to 41 wks + 5days	36 wks to 42 wks	NS
	Mean	278.9 days (39 wks +1 day)	280.1 (40 wks + 1 day)	
	SD	± 7.5 days	± 8.055	
Midwife during labour	Self-Employed Midwife	131 (83.4)	82 (63.1)	p < .001 (OR 2.95, 95% CI [1.69, 5.12])
	*Hospital Midwife	26 (16.6)	48 (37.9)	

*Hospital midwives provide intrapartum midwifery care for hospital primary women and women with private obstetrician LMC

7.1.3 Compliance with DHB protocol for IA during labour.

7.1.3.1 Admission assessment.

Details of the admission assessments performed by the midwives when eligible women presented to the hospital in labour are presented in Table 7.2. The results are divided into intrapartum midwife caregiver categories (self-employed midwife—SEMW, or Hospital midwife—HMW) to determine whether there were any significant differences in fetal monitoring practices between the two groups of midwives. Findings for the admission assessment are also compared between the use of IA and CTG for the eligible women.

Table 7.2 reveals a statistically significant difference in the use of admission CTG, with fewer admission CTGs performed by the SEMW ($p < .001$, RR 0.46, 95% CI [0.04, 0.45]). Overall, there were no differences between SEMW and HMW for any of the other admission assessment criteria (abdominal palpation, fetal movement patterns, uterine activity, and FHR documentation).

Table 7.2

*Pre RMRR Compliance with Admission Assessment Criteria for Eligible Women
Receiving IA or CTG During Labour*

Admission assessment criteria	Eligible Women Receiving IA n = 157		Significance level	Eligible Women Receiving CTG n = 130		Significance level
	SEMW n = 131	HMW n = 26		SEMW n = 82	HMW n = 48	
Abdo.palp						
Yes	71	18	NS	47	33	NS*
No	60	8		35	15	
Fetal Lie						
Yes	58	9	NS	32	27	NS
No	73	17		50	21	
Fetal Position						
Yes	57	15	NS	44	21	NS
No	74	11		38	27	
Fetal Presentation						
Yes	67	16	NS	45	31	NS
No	64	10		37	17	
Fetal Descent						
Yes	52	15	NS	35	26	NS
No	79	11		47	22	
Fetal Movement Patterns						
Yes	20	5	NS	14	11	NS
No	111	21		68	37	
FM palpated						

by midwife and woman						
Yes	0	0	NS	1	3	NS
No	131	26		81	45	
FHR heard during FM						
Yes	0	0	NS	0	1	NS
No	131	131		82	47	
Uterine activity						
Yes	83	16	NS	47	25	NS
No	48	10		35	23	
Contraction Frequency						
Yes	93	16	NS	41	21	NS
No	38	10		41	27	
Contraction Duration						
Yes	31	7	NS	9	9	NS
No	100	19		73	39	
Contraction Strength						
Yes	50	9	NS	18	13	NS
No	81	17		64	35	
Uterine resting tone						
Yes	1	0	NS	0	0	NS
No	130	26		82	48	
FHR as a single number						
Yes	57	10	NS	29	22	NS

No	74	16		53	26	
Maternal pulse noted						
Yes	4	3	NS	5	6	NS
No	121	23		77	45	
FH Rhythm noted						
Yes	1	0	NS	0	0	NS
No	130	26		82	48	
Accelerations						
Yes	49	12	NS	37	23	NS
No	82	14		45	25	
Decelerations						
Yes	32	7	NS	29	19	NS
No	99	19		53	29	
Admission CTG						
Yes	65	23	p < .001 (OR 0.13, 95% CI [0.04, 0.45])	73	48	p = .017
No	66	3		9	0	

7.1.3.2 Compliance with criteria for ongoing conduct of IA and documentation.

Statistically significant differences were found between the two groups of midwives on several aspects of the criteria for ongoing IA during labour as revealed in Table 7.3. Fetal heart accelerations were seldom recorded, but when they were a statistically significant difference between SEMW and HMW ($p = .027$) was found. Similar results were also found with the documentation of uterine activity frequency ($p = .011$), strength ($p = .015$), and duration ($p = .025$) and documentation of the

uterine resting tone ($p = .032$). Although few midwives documented the auscultated FHR as a single number, this occurred more often with Self-employed midwives ($p = .038$).

Table 7.3

Compliance with DHB criteria for IA and documentation requirements for ongoing FHR Monitoring Pre-intervention RMRR

	Eligible Women Receiving IA n = 157		Significance level*
Ongoing IA Protocol	SEMW n = 131	HMW n = 26	
Frequency 1 st stage 15-30 mins			
Yes	62	14	NS
No	69	14	
Frequency 2 nd stage every 5 mins			
Yes	58	11	NS
No	73	15	
Timing (after contraction)			
Yes	36	4	NS
No	95	22	
Duration (for 1 minute)			
Yes	14	2	NS
No	117	24	
Maternal Pulse			
Yes	1	0	NS
No	130	26	
FH Written as a single number			

Yes	29	4	p =.038
No	102	22	
FH Rhythm			
Yes	0	0	NS
No	131	26	
Accelerations			
Yes	6	3	p =.027
No	125	23	
Decelerations			
Yes	10	1	NS
No	121	25	
Fetal movements any time during labour			
Yes	6	2	NS
No	125	24	
Uterine activity frequency			
Yes	34	8	p =.011
No	97	18	
Uterine activity strength			
Yes	22	6	p = .015
No	109	20	
Uterine activity duration			
Yes	6	0	p =.025
No	125	26	
Uterine resting tone			
Yes	2	0	p = .032
No	129	26	

* Fishers Exact test was used where cell sizes are less than 5

7.1.4 Maternal and neonatal outcomes.

A high number of low-risk women (92%) had a vaginal birth (Table 7.4). Over 98% of all babies in this cohort of low-risk women had a 5-minute Apgar score of

greater than seven. Only eight (5.4%) babies in the IA cohort required admission to the special care baby unit (SCBU) or neonatal intensive care unit (NICU) post-birth, while 23 (7.0%) babies in the overall cohort of low-risk women (324) required admission to SCBU or NICU. No significant differences were found in maternal or neonatal outcomes between women cared for by self-employed or hospital midwives.

Table 7.4

Pre RMRR Maternal and Neonatal Outcomes of Care for Eligible Women Receiving IA or CTG During Labour

	Eligible Women Receiving IA n = 157			Eligible Women Receiving CTG (Continuous or Intermittent) n = 130		
	SEMW n = 131	HMW n = 26	Significance level	SEMW n = 82	HMW n = 48	Significance Level
	N (%)	N (%)		N (%)	N (%)	
Mode of Birth						
Vaginal (normal and assisted)	122	23	NS	70	39	NS
CS (acute and elective)	9	3		12	9	
Admission to SCBU/NICU						
Yes	8	2	NS	6	2	NS
Apgar Score < 7 @5 mins						
Yes	1	0	NS	0	1	NS

7.1.5 Establishing the size of the clinical problem.

The phase one RMRR was conducted to provide baseline data for the study and to identify the size of the clinical problem in this hospital's maternity unit. The RMRR revealed that 63.4% of the women were eligible for IA during labour but less than half of them received it. As well, significant numbers (71%) of low-risk women received an admission CTG despite high level evidence from research recommending that admission CTG represents an unnecessary intervention for low-risk women. The documentation provided insights into midwives' practice of IA and compliance with hospital policy and also revealed deficiencies in documentation of clinical decision-making. The findings have identified the knowledge/practice gap as it related to FHR monitoring for low-risk women.

SECTION 2

7. 2 Findings from Comparison of Pre- and Post- Intervention RMRR

This section presents the findings of the comparison of pre- and post-intervention RMRR. The pre and post RMRR findings focus on four key areas: a comparison of demographic data from the pre and post cohorts of women; compliance with admission assessment criteria; compliance with the DHB IA protocol and documentation; and, finally, maternal and fetal outcomes. The aim of the pre and post RMRR comparison was to determine whether practice had changed following the ISIA education intervention. Since self-employed midwives provide care for most women in this setting, the data were analysed by intrapartum midwifery carer (SEMW vs HMW) to determine whether there were any significant differences in practice between these two groups of midwives. This section begins with a description of the sample of women included in the post RMRR.

7.2.1 Post RMRR: How many women were eligible for and received IA?

A total of 422 sets of medical records from women giving birth during March, April and May 2010 (Figure 7.2) were reviewed for this post-intervention phase of the study, using the same data collection tool described in the previous chapter (Appendix J). The size of the sample represents nearly 20% of all births at this DHB for the year 2010. From the cohort of 422 women, 69% (291/422) were identified as low-risk women (cf 63.4%, (324/511) in the pre-intervention RMRR). As before, the women were classified this way because no documented risk factors for electronic fetal monitoring existed (see Table 5.2 in Chapter Five). Of the group of women designated as low risk, 54.3% (158/291) received IA for ongoing FHR monitoring during labour (cf. 48.5%, (157/324) in the pre-intervention RMRR). Figure 7.2 describes the distribution of the sample and reveals that 158 (54.3%) women eligible for IA received it. In addition, of women eligible for IA, 107 (36.7%) received an admission CTG.

Figure 7.2. Post-intervention RMRR: sample distribution.

*23 women gave birth rapidly following admission and three had emergency caesarean section (following diagnosis of fetal distress, augmentation, and epidural). Admission CTG was still used for 11 of the women admitted in advanced labour or pushing.

† These women started with IA for ongoing monitoring but changed to CTG because of the development of a risk factor during labour— usually augmentation, epidural, or meconium stained liquor

7.2.2 Demographic data for eligible women.

The eligible women who received IA and eligible women who received CTG did not differ on any demographic characteristic in the pre or post RMRR samples as described in Tables 7.5 and 7.6. There was a statistically significant difference in the intrapartum midwifery care provider of eligible women receiving IA ($p = .015$) in the post-intervention phase (Table 7.5) and eligible women receiving CTG ($p = .009$) (Table 7.6). Eligible women with a SEMW intrapartum care provider were more likely to have IA.

Table 7.5

Pre- and Post- RMRR Comparison of Demographic data for Eligible Women Receiving IA During Labour

		Pre RMRR	Post RMRR	Sig.
		Eligible Women Receiving IA n = 157	Eligible Women Receiving IA n = 158	
		Number (%)	Number (%)	
Ethnicity	NZ European	66 (42)	73 (46.2)	NS
	Maori	30 (19.1)	28 (17.7)	
	Pacific People	12 (7.6)	12 (7.6)	
	Asian	8 (5.1)	9 (5.7)	
	Indian	3 (1.9)	3 (5.7)	
	African	1 (0.6)	1 (0.6)	
	Other	4 (2.5)	2 (1.3)	
	Not stated	33 (21)	30 (19)	
Gravidity	Primigravid	53 (33.7)	48 (30.4)	NS
	Multigravid	104 (66.3)	110 (69.6)	
Parity	Nulliparous	62 (39.5)	67 (42.4)	NS

	Multiparous	95 (60.5)	92 (58.2)	
Gestation	Range	36 wks + 1 day to 41 wks + 5days	37 wks to 42 wks	NS
	Mean	278.9 days (39 wks +1 day)	279.9(39 wks + 5 days)	NS
	SD	± 7.5 days	± 7.039 days	NS
Midwife during labour	Self-Employed Midwife	131 (83.4)	146 (92.4)	p = 0.015, (OR 0.414, 95% CI [0.20, 0.85])
	*Hospital Midwife	26(16.6)	12 (7.6)	

*Hospital midwives provide midwifery care during labour for hospital primary women
and private obstetricians

Table 7.6

*Pre- and Post- RMRR Comparison of Demographic Data for Eligible Women
Receiving CTG During Labour*

		Pre RMRR	Post RMRR	Sig.
		Eligible Women Receiving CTG (Continuous or Intermittent) n = 130	Eligible Women Receiving CTG (Continuous or Intermittent) n = 107	
		Number (%)	Number (%)	
Ethnicity	NZ European	62(47.7)	51 (47.7)	NS
	Maori	18 (13.8)	14 (13.1)	
	Pacific People	7 (5.4)	6 (5.6)	
	Asian	9 (6.9)	10 (9.4)	
	Indian	1 (0.8)	4 (3.7)	
	African	2 (1.5)	1 (0.9)	
	Other	2 (1.5)	4 (3.7)	
	Not stated	29 (22.3)	17 (15.9)	
Gravidity	Primigravid	59 (45.5)	45 (42)	NS
	Multigravid	71 (56.5)	62 (58)	
Parity	Nulliparous	77 (59.2)	66 (61.7)	NS
	Multiparous	53 (40.8)	41 (38.3)	
Gestation	Range	36 wks to 42 wks	36 wks + 3 days to 42 wks + 2 days	NS
	Mean	280.1 (40 wks + 1 day)	279.5 (39 wks + 6 days)	
	SD	± 8.055	± 9.172	
LMC labour	Self-Employed Midwife	82 (63.1)	84 (78.5)	p = 0.009, (OR 0.462, 95% CI [0.25, 0.82])
	Hospital Midwife	48 (37.9)	23 (21.5)	

7.2.3 Comparison of compliance with admission assessment criteria in pre and post RMRR.

Following the intervention, there was a relative decrease of 14% in the use an admission CTG for low-risk eligible women who received IA ($p = .015$, RR 0.86, 95% CI [1.110, 2.70]). Palpation of the maternal pulse during FHR monitoring changed significantly for eligible women receiving both IA and CTG ($p < .001$). Documentation of FHR accelerations increased following the intervention ($p < .001$) (Table 7.7).

There was an increase in listening to the FHR during a fetal movement following the intervention (Fisher's Exact $p = .015$). However, there was no increase in the recording of fetal movements on admission.

Table 7.7

Comparison of Compliance With Criteria for Admission Assessment Criteria (Pre to Post RMRR) Eligible Women Who Received IA During Labour and Eligible Women Who Received CTG During Labour

	Pre RMRR	Post RMRR	Sig. level	Pre RMRR	Post RMRR	Sig. level
Admission assessment criteria	Eligible Women Receiving IA n = 157	Eligible Women Receiving IA n = 158		Eligible Women Receiving CTG n = 130	Eligible Women Receiving CTG n = 107	
Abdo.palp						
Yes	89	82	NS	80	63	NS
No	68	76		50	44	
Fetal Lie						
Yes	67	56	NS	59	46	NS
No	90	102		71	61	
Fetal Position						
Yes	72	67	NS	65	57	NS
No	85	91		65	50	
Fetal Presenta- tion						

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Yes	83	70	NS	75	57	NS
No	74	88		55	50	
Fetal Descent						
Yes	67	54	NS	61	47	NS
No	90	104		69	60	
Fetal Movement Patterns						
Yes	25	32	NS RR 1.25	25	21	NS
No	132	126		105	86	
FM palpated by midwife and woman						
Yes	0	3	NS	4	3	NS
No	157	155		126	104	
FHR heard during FM						
Yes	0	7	Fisher's Exact p = .015	1	3	NS
No	157	151		129	104	
Uterine activity						
Yes	99	115	NS	71	69	NS
No	58	43		59	38	
Contraction Frequency						
Yes	109	97	NS	61	49	NS
No	48	61		69	58	
Contraction Duration						
Yes	68	36	NS	18	12	NS
No	119	122		112	95	
Contraction Strength						
Yes	59	55	NS	31	30	NS
No	98	103		99	77	
Uterine resting tone						
Yes	1	0	NS	0	2	NS
No	156	158		130	105	
FHR as a single number						
Yes	67	83	NS	50	44	NS

No	90	75		80	63	
Maternal pulse noted						
Yes	7	32	P < .001 (RR 500, 95% CI [0.07, 0.43])	8	27	p < .001, (RR 500, 95% CI [0.08, 0.45])
No	150	126		122	80	
FH Rhythm noted						
Yes	1	3	NS	0	6	Fisher's Exact p = .008
No	156	155		130	101	
Accelerations						
Yes	61	33	p < .001 (RR 0.52, 95% CI [1.46, 3.96])	59	38	NS
No	96	125		70	69	
Decelerations						
Yes	39	26	NS	47	35	NS
No	118	132		83	72	
Admission CTG						
Yes	88	67	p .015 (RR 0.86, 95% CI [1.11, 2.70])	120	99	NS
No	69	91		10	8	

7.2.4 Comparison of compliance with the DHB ongoing IA protocol and documentation in pre and post RMRR.

For eligible women receiving IA for ongoing FHR monitoring, there was a statistically significant increase ($p = .048$) in meeting the criteria for frequency (every 15 to 30 minutes) as stated in the DHB policy. As well, documentation related to the

timing of IA (after a contraction) increased ($p = .009$), as did the recording of the auscultated FHR as a single number ($p < .001$). Changes in the documentation of uterine contraction frequency ($p = .029$), strength ($p = .003$) and duration ($p = .009$) also occurred following the intervention. There were no changes in the documentation of fetal movements during labour.

Table 7.8

Compliance With DHB Criteria for IA and Documentation Requirements for Ongoing FHR Monitoring Pre and Post RMRR

	Pre RMRR	Post RMRR	Significance level
IA Protocol	Eligible Women Receiving IA n = 157	Eligible Women Receiving IA n = 158	
Frequency 1 st stage 15-30 mins			
Yes	76	94	$p = .048$ (RR 1.23, 95% CI [0.40, 0.99])
No	81	64	
Frequency 2 nd stage every 5 mins			
Yes	69	77	NS
No	88	81	
Timing (after contraction)			
Yes	40	62	$p = .009$ (RR 1.56, 95% CI [0.32, 0.85])
No	117	96	
Duration (for 1 minute)			
Yes	16	23	NS
No	141	135	
Maternal Pulse			
Yes	1	5	NS
No	156	153	
FH Written as a single number			
Yes	33	82	$p < .001$ (RR 2.42, 95% CI [0.10, 0.31])
No	101	46	
FH Rhythm			
Yes	0	3	NS

No	131	125	
Accelerations			
Yes	9	17	NS
No	122	111	
Decelerations			
Yes	11	16	NS
No	120	112	
Fetal movements any time during labour			
Yes	7	6	NS
No	150	152	
Uterine activity frequency			
Yes	42	58	p = .029 (RR 0.570, 95% CI [0.34, 0.94])
No	89	70	
Uterine activity strength			
Yes	28	49	p = .003 (RR 1.82, 95% CI [0.25, 0.76])
No	102	79	
Uterine activity duration			
Yes	6	18	p = .009 (RR 3.6, 95% CI [0.11, 0.77])
No	124	110	
Uterine resting tone			
Yes	2	3	NS
No	128	125	

7.2.5 Comparison of maternal and neonatal outcomes in pre and post

RMRR

The rate of vaginal birth was high for all eligible women, regardless of monitoring modality. However, there was a statistically significant finding ($p = .022$) for admission to SCBU for babies born to eligible women who received CTG for ongoing FHR monitoring. The change of monitoring was related to the development of intrapartum risk factors, that is, the use of epidural and augmentation of labour with oxytocin.

Table 7.9

Comparison of Maternal and Neonatal Outcomes (Pre to Post RMRR)

	Pre RMRR	Post RMRR		Pre RMRR	Post RMRR	
	Eligible Women Receiving IA n = 157 N (%)	Eligible Women Receiving IA n = 158	Significance Level	Eligible Women Receiving CTG (Cont or Int) n = 130 N (%)	Eligible Women Receiving CTG (Cont or Int) n = 107	Sig. Level
Mode of Birth						
Vaginal (normal and assisted)	145	151	NS	108	80	NS
CS (acute and elective)	12	6		22	27	
Admission to SCBU/NICU						
Yes	10	8	NS	8	16	p = 0.022 (RR 2.30, 95% CI [0.14, 0.88])
Apgar Score < 7 @ 5 mins						
Yes	1	1	NS	1	1	NS

7.3 Summary

There were three key findings of the RMRR following the intervention. The first two were: a relative increase of 12% in the number of low-risk women receiving IA for FHR monitoring, and a statistically significant increase in not using admission CTG for low-risk women (p = .015 (RR 0.86, 95% CI [1.11, 2.70])), representing a

14% relative decrease. The third of the key findings came in the form of significant changes to the documentation of practice during both the admission assessment, and the ongoing monitoring components of fetal monitoring. In particular, midwives were more likely to do IA every 15 to 30 minutes, as required in the policy, and to document the maternal pulse rate. Significant changes also occurred in the documentation of uterine activity and how the auscultated FHR was written in the women's medical records. These findings indicate that the intervention was associated with a change in clinical practice.

The next chapter reveals the findings from the post-intervention focus groups held with midwives. The major theme that emerged from the analysis was of "doing things differently", which is a reflection of the findings revealed in this chapter in relation to how IA is now being conducted in this setting.

Chapter Eight: Monitoring Knowledge Use – “Doing Things Differently”

This chapter presents the findings of the post-intervention focus groups conducted to gain the midwives' views of what, if anything, had changed in their practice as a result of the new information they had received from the educational intervention and the introduction of the ISIA informed decision-making framework. Monitoring knowledge use is a step in the knowledge application cycle of the KTA process. The aim of the focus groups was to demonstrate to what degree the knowledge around ISIA diffused to the potential adopters, and to ascertain whether the intervention was enough to bring about change, or whether new interventions were required. I have used the constant comparison analysis method where codes emerged from the data inductively (Leech & Onwuegbuzie (2007). The two post-intervention focus groups were much more informal and conversational than the pre-intervention focus groups, which is reflected in fewer code groups. This was because of the smaller number of participants in each group. However, all participants were engaged and enthusiastic about telling their version of how ISIA had impacted on their practice and on the maternity unit culture.

The analysis of the data from the two post-intervention focus groups with midwives again used the two main categories identified prior to the analysis (a deductive approach) (Leech & Onwuegbuzie (2007). Those two main categories were personal/professional and system/organisational characteristics related to knowledge/evidence use (Fink, Thompson & Bonnes, 2005). Chunks of text were coded and then grouped to produce one major emergent theme: “Doing things differently”. Code groupings are illustrated below in Table 8.1 and described further

in the following pages. The midwives' own words are used to expand and illustrate the findings.

8.1 The Midwives

All midwives who attended the pre-intervention focus groups and midwives who attended the education sessions were invited to participate in the post-intervention focus groups. Seven midwives volunteered. Six of these midwives had attended the pre-intervention focus groups and they were joined by one hospital-employed midwife, who had attended the education session but not the previous focus groups. The midwives were a mix of self-employed and hospital-employed midwives.

Table 8.1

Major Themes and Subthemes, by Personal/Professional and System/Organisational Categories, Post-intervention Focus Groups

Major Theme: Doing things differently	
Personal/Professional	System/Organisational
Using IA more	Change the birth environment
Incorporating fetal movements	Think about policy
Change documentation and communication	Supporting practice
Turning the paper off	Confidence and culture
Role modelling/ staff and students	

8.2 Major theme: Doing things differently

The changes midwives have made to their fetal monitoring practice since the pre-intervention focus group and the implementation of the ISIA intervention are revealed in this major theme. The code groupings, under the categories

personal/professional and system/organisational were: “Using IA more”, “Incorporating fetal movements”, “Change documentation and communication”, “Turning the paper off”, “Role modelling staff and students”, “Change the birth environment” “Think about policy”, “Supporting practice”, and “Confidence and culture”, are explored below (Table 8.1).

8.2.1 Code Groupings of the Personal/Professional Category

8.2.1.1 Using IA more.

The midwives reported feeling more confident in their decision-making for *using IA* for both the admission assessment and ongoing fetal heart monitoring for low-risk women. As one hospital midwife said:

I’m actually quite happy just to auscultate every now and then, I think that’s cool. I mix it up. I think I was doing that admission CTG because that’s what I was taught to do. A couple of times when it’s got too busy, I must admit I’ve got lazy [and] used it [the CTG machine] as a babysitter—“I’ll be back in a minute”. But when I see that things are fine I feel confident to just carry on and concentrate more about getting her into the headspace of a good place to get ready to birth I think and making sure that it’s all good (2HG).

The practice of using the CTG machine as a babysitter was also recognised by another participant:

or when people are going off to have a tea break, often it’s the babysitter in the room idea (2SJ).

Another commented on a continued barrier to the use of IA was when midwives were required to interact with medical practitioners involved in the woman’s care.

I know that some core staff grapple with the fact that because the woman they're looking after is under [the care of the LMC] private specialist, the expectation is that they have this admission CTG and that's a dilemma and its whether they take on the fight or they don't, do they don't (2SO).

. . . or even some LMC midwives [feel they are expected to use the admission CTG] and it might be about who's on that day (2SJ).

Participants suggested it was the less experienced midwife who would find this situation a barrier to the use of IA.

[it depends on] which consultant or registrar they're going to have to engage with and what their expectation would be or what will make their life easier (2SJ).

I think that's a lot of the newer grads . . . they haven't got the experience to argue back (2SL).

Or the confidence to say, 'Actually, there are no reasons for me to do it' (2SJ).

8.2.1.2 Incorporating fetal movements (FM)

In keeping with the main features of the ISIA model, some midwives were now incorporating questions to women around their *patterns of fetal movements* prior to and during labour.

Having been to your education session, even if I did do that initial [CTG], I still feel more confident now in leaving it at that. So to me I've made a step sideways perhaps, not a leap forward. It's going back to—is the baby moving? How's the mother's pulse rate? and recording all those things that

you can do to give that clear indication that there was no need to do anything further (2HH).

The other thing which you mentioned in the education session was [to] record also about whether the woman is feeling the baby move which also clinically demonstrates to you that the baby is well. The baby has kicked, the baby has moved, it may not be a big movement but it's showing that it's got enough energy while coping with labour to do this. When you've got your hand on the tummy you can say "baby felt moving prior to contraction" and you've felt the kicking (2HE).

Asking women about their perception of their baby's movements following the educational intervention and introduction to the ISIA framework was also evident in the midwives' documentation in the medical record as evidenced below (Table 8.2)

Table 8.2

Example of changed admission assessment documentation following educational intervention to incorporate fetal movements and other FHR characteristics and equipment (retyped to protect identity, highlighting added by me).

Date	<p>Care by (name of midwife) RM. Gestation 40 weeks +1 day</p> <p>(Name of women and her partner and her support person) in delivery suite with (name of women) in established labour. She has been contracting since 0500, regular 1:5 since 1000hrs. Baby has been moving well today. Membranes intact.</p> <p>O/A: (name of woman) contractions 3:10 mod-strong, scant PC loss.</p> <p>On Palpation: Term, cephalic, ROL, head well down. FHR 142bpm.</p> <p>(Name of woman) has been labouring on all fours at home and also in hospital.</p> <p>FHR: 140bpm with sonicaid for 1 minute, rhythm and rate sound normal</p>	Signed, RM
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In talking about a woman who had received Vaginal Prostaglandin to induce her labour and had then gone home (as is the normal practice in this unit), one midwife described her inclusion of fetal movements as:

if I'm seeing women at home, I might go and listen at 10.00 p.m. at night and then visit again by 2.00 a.m. in the morning and she won't have been listening to the baby but she will have been talking about the movements or something probably and I do sometimes get them to write down if they can feel the baby moving (2SJ).

8.2.1.3 Change documentation and communication.

An important function of the ISIA model was to provide midwives with a comprehensive means of making an assessment of the woman in labour to determine the most appropriate fetal heart monitoring modality. This includes assessing her risk for fetal hypoxia during labour against a list of pre-determined conditions, outlined in fetal monitoring guidelines, known to be associated with an increased risk (Table 5.1, Chapter Five). Other components of the assessment model include abdominal palpation, assessment of uterine activity and fetal heart rate and rhythm. Systematically going through and documenting their findings during the assessment enables midwives to demonstrate their clinical decision-making. One midwife said she now made a clear statement in the women's medical record that would indicate she had made a thorough assessment and reached a decision.

and also actually writing suitable [for] intermittent auscultation. Actually writing that rather than just thinking, they're OK, but actually writing it (2SO).

These changes in documentation were seen in the post-intervention RMRR as evidenced in the reproduced example below.

Table 8.3

Example of Changed Admission Assessment Documentation Following Educational Intervention to Include a Statement of Eligibility for IA (retyped to protect identity, highlighting added by me).

xx/4/10	History of contractions since 0530, now 1x3-4 mod strength. Membranes intact, lots of show. Palpation – 40 weeks, average size - LOL - 2/5 ↓ FH 132 – low risk pregnancy, suitable for intermittent auscultation Mat pulse 72	Signed RM
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Communicating differently, verbally, was also carefully considered as these midwives reported:

One of the ways that the change could happen is when we're doing our handover, say "this is Mrs A, low risk, intermittent auscultation throughout her labour" and bringing in at that point so that it's serving as a reminder (2HE).

Another described how she would communicate the safety of IA to a woman in her care with:

It's a change in shift of thinking so that in the future when someone comes in and says 'why aren't you going to put that [admission CTG] on?' I will say, 1. We don't even have it in the room, and 2. Actually, it's unnecessary. I'm listening in and I'm getting the information that I need that is going to tell me that your baby is OK. We don't need to have that big monitor with straps on" (2HE).

Other subtle changes to documentation were also seen in the notations on pre-printed care plans used by self-employed midwives, and the hospital standard care plan. Below is an example of one self-employed midwife's pre-printed birth plan (reproduced by me to protect identity). In this example, the midwife has now annotated the words "if high risk only" in relation to admission CTG. It was her usual practice to perform admission CTG routinely for all women in her care regardless of their risk status. This midwife's change in practice came after the educational intervention.

Example of Change Made to LMC Pre-printed Maternity Care Plan Following Educational Intervention in Relation to Use of Admission CTG (retyped to protect identity. Change highlighted by me)

BIRTHPLAN			
Antenatal Education	Hospital	Parent Centre	
	Refresher	Other	☒
What to do at home	☒		
When to ring	☒		
Back-up Arrangements	☒		
Delivery site directions	☒		
Support people in labour	☒		
Mobility in labour	☒		
if high risk only			
Monitoring in labour: 30 minutes initially ^ then as necessary. May be increased if meconium liquor present or any other signs baby and mother at risk			

One important message to midwives during the education session and introduction of ISIA was to think about how they documented the fetal heart rate. Midwives were reminded that auscultation is a listening and counting method and they should not be reliant on simply reading the numbers flashing on the screen of

their Doppler. This was one of the major changes to practice noted by the midwives in the phase three focus groups.

Yeah I learnt that lesson; never rely on those numbers, never. Always use your ear (2HG).

I used to write it down in a way that wants me to have people thinking that, you know I've listened for a length of time and I'm observing for accelerations and decelerations, when actually I should be counting a number and writing down a single number. But I'm aware that I write a range and it's something I've tried really hard to change in my practice, lately, is remembering intermittent [auscultation] is about counting and coming up with a number, not trying to demonstrate that I'm looking for more than that (2SJ).

8.2.1.4 Turning the paper off.

Before the education session and introduction of ISIA, it was common practice for midwives at the study site to use the CTG transducer to listen to the fetal heart during labour. This was because of both a shortage of hand-held Dopplers and a lack of Pinard stethoscopes, and the presence of the CTG in every room. It was a convenience factor. However, many midwives using the CTG kept the paper record button on, resulting in a print out with multiple small sections of FHR monitoring on the CTG trace. Midwives tended to document this IA using a range of numbers (this was discussed above in the previous section). The use of CTG for IA continues today, but the midwives have told me they now count the fetal heart rate and record it as a single number and turn off the record button so that there is no print-out.

Not putting the paper on, I don't do that now, but I did (2HG).

Also turning the paper off, which I used to most of the time but made sure I always do now. That's what I do when I've got a woman pushing in second stage because you haven't got Doppler's, so you've got a CTG in the room, so you do that. Now there's no record button [being switched on] (2HH).

One midwife commented that she still used the CTG machine and even left the paper on.

I've sort of tended to flick the monitor on when I've listened but I only do it every so often, you know, so I would class that as intermittent and not continuous (2SL).

This comment was used as another learning opportunity in the focus group as the facilitator commented:

using the CTG transducer, like just holding it on, I'm calling that intermittent auscultation, but . . . people keep the paper on. You know how I showed you that in the education session and how you get a piece of paper like this with a little squiggle here and a little squiggle there (researcher).

To which the midwife responded,

That would be a lot of mine . . . (2SL)

So don't turn the machine on anymore [name], leave the machine off (researcher).

8.2.2 Code Groupings of the System/Organisational Category

8.2.2.1 *Change the birth environment.*

Changes were being made to the maternity unit environment as well, which the midwives saw as a positive step towards creating the sort of environment that supports normal birthing for low-risk women within the secondary maternity unit.

But then also focussing on moving us to those poles with the Doppler's on it and you do take the CTG machines out unless it's absolutely needed and unless its indicated and if you put them in a specific room like you do with oxygen and everything else. People will get the idea that that's what we're meant to be doing [IA instead of CTG] if it's not sitting in the room waiting for us to use them (2HG).

Another midwife also commented about moving the CTG machine out of the birth room:

when someone comes in and says "why aren't you going to put that [admission CTG] on?" I will say 1 [firstly], we don't even have it in the room and 2 [secondly], and actually it's unnecessary. I'm listening in and I'm getting the information that I need that is going to tell me that the baby is OK. We don't need to have that big monitor with straps on (2HE).

8.2.2.2 *Think about policy.*

Some of the midwives believed it was time to update the current old and out-of-date policies and develop new policy that was supportive of the use of intermittent auscultation.

But I think it will be worthwhile actually doing and having an intermittent auscultation as a policy (2HE).

Another participant suggested that the use of IA could become a data point to be discussed in the Midwives Standards Review Process, which is undertaken by all midwives in New Zealand, every two years.

The standards review process might be a potential place, if we added that in as well, as one of the bits of data that was collected, and then people would be forced to have to reflect on that (2SS).

8.2.2.3 Supporting practice.

During the study posters outlining ISIA, and DVDs of the education session were left in the unit for midwives to refer to when they wanted. One senior midwife found these resources useful in her discussions with a medical colleague.

One of the registrars had come up to me because she had been concerned about a CTG and asked me why she hadn't been called earlier. She said, "look, she's [the woman] been in a delivery suite for an hour and a half and there was no CTG done". I said, "No, there wasn't a CTG done because she was a low-risk woman, but you will notice that she had been listened to [IA of the FHR] and that had been well documented". Then I said to her [the doctor], "have you had a look at this chart?" and I pointed her [to the ISIA chart on the wall] and she goes "oh OK". She took a quick glance and it was "oh, oh", so obviously she'd heard about it. I thought that was really interesting. It was this whole thing, 'look, she's been in delivery suite for an hour and a half and there was no CTG' and I said "there was no need for one' and said 'a CTG was put on when the midwife felt that there was a problem' (2HE).

Another participant noted:

I've seen core staff referring students to them [the ISIA posters] which is great (2SS)

8.2.2.4 Confidence and culture.

Several midwives talked about the education session and introduction of the ISIA decision-making framework helping them to gain new confidence to go back to what they knew about fetal heart monitoring in the pre-EFM days. In other words, they felt empowered to trust their fundamental midwifery skills and knowledge. Their involvement in the study and education has encouraged them to reflect on their practice, to shift their thinking and to take a stronger position on changing the culture within the unit.

It's [the education session and ISIA] made me more objective at looking at how I practice (2HH).

It's building up that rapport and having that confidence rebuilt back in Robyn. So to me that's been helpful (2HH).

It's a change in shift of thinking so that in the future when someone comes in and says 'why aren't you going to put that [admission CTG] on?' I will say, 1. 'We do not even have it in the room' and 2. 'Actually, it's unnecessary. I'm listening in and I'm getting the information that I need that is going to tell me that your baby is OK. We don't need to have that big monitor with straps on' (2HE).

Another commented on the kind of information provided in the education session that had helped the shift in thinking to occur.

I think a lot of people really appreciated the refresher of the physiology because I think we forget. We get really focused on what the squiggles are

saying rather than why they're saying what they're saying. It was a re-enlightening of people about what the things mean that they're looking at which was really good (2SS).

Others wanted further and ongoing education around the issue as a normal part of the culture.

I think that's an ongoing education issue as well...if that stuff had been talked about normally, regularly (2SC).

I'm not an academic and science was one of my worst subjects . . . so don't ask me to tell you now because I haven't got a clue . . . it made sense when you were telling me but it doesn't stay, it just goes (2SL).

That's why they want you to do it every year, even if you only retain it for three months of every year (2SS).

say it was just the culture here that every month for an hour there was some sort of meeting surround CTGs, ongoing education, that it's just normal . . . and it just becomes part of the culture to come to that, get an update and that's been when most people change (2SC).

The focus group participants also commented on a newly emerged expectation that every staff member would undertake training on the K2 fetal monitoring package. This was seen as a powerful change in the culture.

The other thing I think is interesting too is there's been an expectation [to do] K2 by March . . . this year, especially the core midwives . . . I think that's interesting as far as changing culture (2SC).

It wasn't an expectation though was it? It was a threat (2SL)

There was a pretty high uptake, I think a lot of people did it on night duty . . . most people were quite positive about it (2SS).

As far as education as well, but also the fact there has been no ongoing education at all, apart from you coming in, there's no run of the daily mill everyday education going on at all pretty much. I think that's interesting as far as changing culture (2SO).

8.2.2.5 Role modeling/staff and students.

The newer midwives in the focus groups were influenced by the talk of the more experienced midwives and looked at this role modelling as a strong ingredient for changing the culture.

I'm a fairly new midwife and I like hearing what you're saying, especially from someone like you [name of midwife], because it's the senior midwives like yourself who are going to show new grads a better way to do things. I think when I first came here it was like "this is what you do, this is what the policy is, you must do a CTG and you must do this and you must do that". In my own mind I knew I didn't have to. I knew it isn't what you need to do to get an ordinary well woman to birth (2HG).

I found it interesting because I probably have heard your work three or four times and I found each time I hear it, I hear something new or different, or I perceive it differently. . . . I remember writing a reflection on the back of the thing the second time I heard it about the changes that I'd made in my practice after the first time, but then I identified even further change the second time. I thought I was pretty well informed before I began so there's a lot of potential for enhancing knowledge I think, yeah (2SS).

8.3 Summary

The midwife focus group participants were clear that the intervention had renewed their confidence in the evidence that supports the use of IA for low-risk women. They described the various ways their behaviour and practice changed as a result of being exposed to an evidence-based decision-making framework. These midwives are the key adopters of knowledge related to IA for low-risk women within the organisation. These midwives have identified the need for ongoing facilitation for change to the culture.

The next chapter is the final chapter of the thesis, where I consider whether the ISIA informed decision making framework was a successful and sustainable KT process.

Chapter 9: Discussion and Conclusion

9.0 Introduction

The clinical problem triggering this study was the knowledge that low risk women birthing in institutional maternity units were increasingly exposed to the use of CTG, both on admission to hospital and continuously during labour. With the ubiquitous presence and availability of technology in the birthing room, and the increased use of epidural anaesthesia and oxytocin in 'normal' birthing women (Luyben and Gross, 2000), the choice and use of IA for low risk women was threatened.

This study explored the clinical practice of IA, a fundamental midwifery skill that is a prerequisite for keeping birth normal, and has argued that IA is a safe and effective method of intrapartum fetal heart rate monitoring for low risk women. Intermittent auscultation is the evidence- based FHR monitoring modality recommended by professional obstetric and midwifery organisations in their fetal surveillance guidelines. On the basis of current evidence there is little clinical justification for the routine use of CTG monitoring for low risk women. Therefore, factors other than research evidence (Luyben and Gross, 2000) must influence decisions regarding choices of fetal heart monitoring modality. It was also known that with an increased reliance on the CTG machine midwives are becoming deskilled (Dover & Gauge, 1995; McKevitt, Gillen & Sinclair, 2011) in the essential midwifery skills of auscultation and palpation. This may be because of a lack of learning opportunities to use these skills.

At the beginning of this thesis, two questions were posed. Those questions were: was it possible to re-establish the validity of IA as a fundamental midwifery skill and could this knowledge be translated into midwifery practice? In this chapter, the

qualitative and quantitative findings from the non-experimental pre- and post-intervention study are blended to enhance our understanding of how evidence is implemented and the consequence of this use in clinical practice. Implications for researchers and the end users of research in the context of change are explored, along with the limitations of the study. As with many research projects, more questions emerge as the inquiry progresses and these implications for further research are identified.

9.1 Summary of the findings

Using the phases of the KTA process described on pages 101-108, I conducted a pre-and post intervention study to answer the research questions. Retrospective medical record review (RMRR), to explore midwives' documentation of their FHR monitoring practice, and focus groups with midwives to assess the barriers and facilitators for the use of IA were employed. The intervention was comprised of a one hour teaching session introducing the history, evidence and guidelines, basic fetal physiology, the role and place of informed decision-making and the ISIA framework for practice.

The ISIA framework was developed following the identification of a gap in the literature around robust practice descriptions for IA that stimulate midwives' critical thinking skills. Discussions via global email discussion with midwife experts (nzmidwives@yahoogroups.com; https://www.Midwifery-Research@jiscmail.ac.uk; https://www.Normalbirth-Research@Jiscmail.ac.uk) helped to inform the ISIA framework.

The pre-intervention qualitative and quantitative findings are presented first followed by the post-intervention and a summary of the main claims.

9.1.1 Pre-intervention Phase

The pre-intervention RMRR was conducted to establish the size of the clinical problem in the study site maternity unit. Baseline data from the documentation of care on admission and during labour in the medical records of childbearing women was collected to determine the number of women eligible for IA (low risk women), the number of eligible women who actually received IA, compliance with hospital policy, and maternal and fetal outcomes when IA was used. Focus groups with midwives explored the barriers and facilitators to the use of IA.

Key findings from the pre-intervention RMRR were that two thirds of the birthing women were classified as 'low risk' in the absence of clinical indicators for the use of continuous CTG monitoring, making them eligible for the use of IA for FHR monitoring. However, just under half of these women actually received IA, while the remainder received CTG for ongoing FHR monitoring , either intermittently or continuously. Compliance with the hospital protocol for IA was very inconsistent, along with documentation of the admission assessment criteria. Maternal and fetal outcomes revealed an expected high number of normal vaginal births (92%) for this group of women and only one baby with a five minute Apgar score less than seven and very few babies (6.3%, 10/157) admitted to the NICU/SCBU.

The baseline RMRR confirmed that the low risk women in this study were exposed to an increased use of CTG monitoring as reported by other authors (Albers, 2001; Lewis and Rowe, 2004a, 2004b; Maude and Foureur, 2009; Rattray,

Flowers, Miles and Clarke, 2010) with over half of all the eligible low risk women receiving an admission CTG. The likelihood of a low risk woman undergoing admission CTG was much higher with hospital-employed midwives providing intrapartum care for eligible women (RR 1.76, 95% CI [0.04, 0.05]). Most hospital-employed-midwives reported using the admission CTGs because they were providing intrapartum care for medical LMCs and believed this to be expectation. However, the RMRR also revealed that hospital midwives were more likely to perform an admission CTG on low risk women receiving hospital based primary care as well. These findings demonstrated that knowledge of the evidence around FHR monitoring and admission CTG was not translated in practice.

At the KTA step of barrier assessment before the intervention was delivered, a number of barriers and facilitators to the use of IA in practice were identified. The model of care, particularly around an ability to provide continuity of care, was both a barrier and facilitator for midwives. For New Zealand midwives, continuity of care in partnership with women in a relationship based on trust and shared understanding and responsibility is a foundational principle (NZCOM, 2008).

For hospital-employed midwives, the inability to provide continuity of care throughout pregnancy was a major barrier for many aspects of intrapartum care including choices regarding FHR monitoring. Hospital-employed midwives said this was because they did not know the women prior to labour and had no connection with them. For self-employed midwives, continuity of care was a facilitator for their FHR monitoring choices.

Continuity of care enabled self-employed midwives to develop a relationship (Foureur, & Hunter, in Pairman et al., 2010) that promotes trust and connection with the woman and her baby (Guilliland & Pairman, 1995; Hatem, Sandall, Devane, Soltani, & Gates, 2008). This continuity of care model contributed to a greater sense of intuitive 'knowing'. Self-employed midwives described their IA practice as individualised to the woman by using their senses of listening, hearing and knowing (Kennedy & Shannon, 2004; Browne & Chandra, 2009). Hospital-employed midwives did not have the ability to form a relationship with women during pregnancy and felt the lack of continuity of care led to a lack of connection with women. Not having in-depth knowledge of the woman, her pregnancy and her expectations and knowledge influenced decisions for FHR monitoring. Hospital-employed midwives who had previously been self-employed noticed their practice had changed since moving to employment in the maternity unit and they would 'go along' with the expectations of colleagues and families supporting women in labour.

In terms of how they practiced, self-employed midwives understood the evidence informing FHR monitoring and the use of informed decision-making in partnership with women. This process is enabled by continuity of care. For hospital-employed midwives, however, loss of instinct, loss of tacit knowledge, and loss of confidence coupled with not knowing the women strongly influenced their ability to use evidence-based practice and informed decision-making. From an organisational perspective, midwives expressed concerns about threatened or actual loss of autonomy as a result of a dominant medical paradigm. Practice was described as being influenced by 'learnt behaviour', meaning that they changed the way they practiced in the hospital as a result of the pressure and expectations of their colleagues and the women and their families.

The availability and use of FHR monitoring technology in the maternity unit also influenced practice for midwives. On a personal and organisational level, there were no facilitators for the practice of IA. The barriers to IA use associated with technology and the environment were apparent with a lack of equipment for doing IA such as Pinard stethoscopes and hand-held Doppler devices. With a CTG machine in every room, this led to more admission and continuous CTG use. Midwives also used the CTG machine to perform IA in the absence of equipment and this was demonstrated in the number of medical records containing strips on uninterruptable FHR monitoring.

Fear of medico-legal consequences had a strong influence on FHR monitoring choices for midwives. They talked about using CTG monitoring as a protection for themselves and the maternity unit. Use of the CTG provided them with 'cover' in the event of an adverse outcome, so they felt safer using it, even when there were no indications for its use. The expectations of 'others' also drove them to use the CTG instead of IA in the medico-legal sense. Some midwives talked about doing a strip of CTG just before handing over to the next midwife at shift changeover and others just before consulting with the medical staff. Their understanding was that having this 'evidence' of their FHR monitoring using the CTG would be protective of their decisions and practice and demonstrate they were safe practitioners.

9.1.2 Post-intervention Phase

The purpose of the post-intervention RMRR was to determine whether midwives' had been influenced by the intervention and made changes to their FHR monitoring practice and documentation. The demographics between the pre- and post-

intervention groups revealed that they were homogeneous and comparisons could be made and differences revealed. Follow-up focus groups also explored practice change and included midwives who had attended the education session. Main changes in practice were revealed in statistically significant findings in relation to the use of admission CTG and ISIA for ongoing labour, along with variables associated with assessment. Changes to documentation, communication and the culture of the unit grouped under the heading of 'doing things differently' provided evidence of successful knowledge translation following the intervention.

Following the intervention, there was a relative decrease of 14% in the use an admission CTG for low risk women. This finding sits alongside a relative increase of 12% in use of ISIA. Midwives reported feeling more confident using ISIA to guide their decision-making for both the admission assessment and for ongoing fetal heart monitoring for low-risk women. Changes to documentation of assessment on admission and for ongoing monitoring were revealed in the frequency and timing of IA, how they documented the auscultated FHR rate (as a single number instead of a range) and how they reported a woman's contraction patterns.

In regard to the inclusion of fetal movements in the admission and ongoing monitoring frameworks, following the intervention there was a 25% (RR 1.25) increase in questioning the woman about her baby's usual patterns of movement leading up to labour (during the admission assessment component of ISIA), but this result was not statistically significant. However, there was also an increase in listening to the FHR during a fetal movement to ascertain FHR increases, a reassuring sign of fetal well-being) following the intervention (Fisher's Exact $p =$

.015). I was interested to determine whether midwives would include questioning around fetal movements in their admission assessments of women in labour and ongoing throughout the labour. Following the focus groups with midwives after the intervention, some midwives said they were actively asking women about their baby's movement patterns on admission and throughout the labour. This was evidenced in their documentation in the woman's medical record.

Maternal and fetal outcomes when IA was used for FHR monitoring demonstrated little change to the already excellent outcomes for low risk women and their babies in terms of normal birth, Apgar scores and admission to NICU/SCBU. One notable finding was that the 10 babies in the pre-intervention phase and 16 babies in the post-intervention phase who required admission to NICU/SCBU came from eligible women who changed from IA to CTG use during labour due to the need for epidural anaesthesia or oxytocin augmentation of labour. In the eligible women who received CTG monitoring instead of IA, the caesarean section rate was significantly higher (RR 3).

In the next section I will provide deeper insights into the implications of several of the significant findings.

9.2 Discussion

Reflecting on the findings has revealed a number of important issues for midwives and the practice of ISIA. These are specifically around the notion of culture, the organisation and the socio-political context in which midwives deliver maternity care in New Zealand in particular and globally.

9.2.1 The effects of culture, organisation and socio-political context

There were a number of issues identified in the focus groups and reflected in the quantitative results that highlighted the influence of culture, organisation and socio-political context of the maternity care environment for this study. These cultural, organisational and socio-political factors all have relevance for the dissemination and implementation of knowledge into practice for FHR monitoring and in particular ISIA.

Returning to the work by Rogers (1995, 2005), and Kitson and colleagues (Kitson, Harvey & McCormack, 1998; Logan & Graham, 1998; McCormack et al., 2002; Harvey et al., 2002; Rycroft-Malone et al., 2004;) provides some insights. Kitson and colleagues' formula for implementing research into practice is: $SI = f(E, C, F)$ - successful implementation (SI) of research is a function (f) of the relationship between the level and nature of *evidence* (E), the *context* (C) or environment into which the research is introduced, and the process of *facilitation* (F). Each element is positioned on a high-to-low continuum, which defines the level of potential success of implementation (Kitson et al., 1998). McCormack and colleagues (2002) have argued "that it is the culture at individual, team and organisational levels that creates the context for practice", in other words, "the way things are done around here" (McCormack et al., 2002, p. 97).

In terms of the effects of culture on midwives FHR monitoring choices and practices in this study, the most significant findings are around the midwives' perceived loss of autonomy and loss of empowerment. Midwives used the word acquiescent to describe their practice and behaviour in the maternity unit. The model of care and in particular the ability to provide continuity of care was a major

influencing factor in midwives' ability to maintain a sense of autonomy and empowerment. Midwifery autonomy is pivotal to the model of care in New Zealand, and it is important to explore any threats to this principle in real-world practice.

In New Zealand, midwifery regained its status as an autonomous profession in 1990, with its own distinct body of knowledge, scope of practice, code of ethics and standards of practice. The midwifery profession provides a complete maternity service to childbearing women on its own responsibility. All midwives in New Zealand are expected to work in partnership with women, providing or supporting continuity of midwifery care throughout the woman's experience. Midwives work collaboratively with other health professionals when necessary to meet any additional medical, health or social needs of mothers and their babies.

Midwives in NZ are provided access to maternity facilities through the access agreement attached to the maternity service specification (Section 88). Whilst they are expected to abide by administrative policies of the facility, they are not required to follow hospital clinical policies or guidelines. There is an expectation, however, that midwives will practice evidence-informed midwifery, informed decision-making in partnership with women and can demonstrate their clinical reasoning.

A recent NZ study revealed that midwives who provided maternity care for first time mothers birthing at home, as well as first time mothers birthing in a hospital, practiced differently in each setting in terms of the provision of evidence-based care despite having a strong 'normal birth' philosophy (Miller & Skinner, 2012). The midwives described being variously constrained or set free by aspects of the place of

birth. Midwives in that study reported differences in the use of time, safety/unsafety of the birth environment, use of space, and the 'being' and 'doing' of midwifery (Miller & Skinner, 2012) . Midwives used time differently at home, with restrictions on time in the hospital environment often leading to greater interventions and less physiological birth. This arose from the presence of protocols and guidelines and medical scrutiny.

Self-employed midwives in this research also alluded to the effects of the dominant medical paradigm and medical scrutiny as factors influencing their autonomy to practice. Acquiescence was a term used of working in the hospital environment. In a discussion around the use of admission CTG, one midwife revealed this notion:

Sometimes you do one if you're consulting because you know that actually it's easier to do, you don't want to have a stand up conversation or argument or discussion with the person who's suggesting that they won't do anything until you've done it. So, you go, okay. You just acquiesce; it's just easier (1SN).

What is it about the institutional maternity setting that fosters this type of submissive behaviour in normally resilient experienced midwives? Walker and colleagues (2001) have stated: “[midwives] who do not feel empowered to exert an influence on their practice environment may contribute to less use of IA and the further entrenchment of continuous CTG” (Walker et al., 2001, p. 397). And yet, midwives are worn down by these daily battles. In contrast, the hospital-employed midwives conformed to the expectations of the medical professions, to the perceived expectations of their own colleagues and to those of the women and families to

whom they were providing care, even if this was at odds with their own beliefs and knowledge of the evidence. This aspect of acquiescence and the impact of the culture and organisation is an area for robust investigation moving forward.

Returning to Kitson and colleagues' formula for implementing research into practice, an exploration of the role of evidence provides some insights. The midwives in the focus groups debated this question of evidence informing practice, with some having clarity around, in particular, the evidence that admission CTG is not recommended for low risk women. Self-employed midwives felt supported by this evidence in their decisions not to use admission CTG. Hospital-employed midwives felt less able to make autonomous decisions around FHR monitoring. This is borne out in the findings around use of admission CTG. This debate brought to light an interesting discussion around the hospital policy.

Many of the midwives in this study referred to the hospital fetal monitoring policy, which was developed in 2005 and based on evidence current at that time. This policy had not been reviewed or updated since that time. There was disagreement between the hospital-employed midwives about whether there was a recommendation regarding the use of admission CTG. Some believed the policy stated an admission CTG was required, even though they had not personally seen the policy for many years (see pages 212-214). Their decisions were based on 'custom and practice' in the unit, colleague's opinions, fear of medico-legal consequences and the expectations of woman and their families. This finding seems to be in line with those found by Luyben and Gross (2000) when they explored the factors that influenced Swiss midwives' choice of FHR monitoring method. Personal experience and

hospital policy were the greatest influences, while evidence-based research results were less important (Luyben and Gross (2000). So even though the hospital policy was old and out of date and had a clear statement to the fact that admission CTG was not recommended for low risk women, hospital-employed midwives, in particular, continued to use this assessment.

Following the intervention, midwives' interest in revisiting the hospital policies and taking responsibility for reviewing the evidence to inform the update of them significantly increased. Nearly two years after the post-intervention data collection phase this process is underway with midwives taking the lead. Midwives recommended writing an evidence-based policy on the use of ISIA. Another recommendation to come out of the focus group discussions was to incorporate data collection on FHR monitoring type in the Midwifery Standards Review each midwife is required to present every two years. By taking command of quality improvement in the maternity unit, midwives are signalling a change in culture, where high quality evidence is used to inform practice. Use of evidence-based guidelines and protocols will break down the 'know-do' gap. This in turn increases midwives' strength to debate care options with our medical colleagues from a position of power, thus moving practice away from 'obstetric personality-based' care to evidence-based care.

Another influence was the place and role of a fear of medico-legal consequences in the event of an adverse outcome. This is particularly relevant in the context of FHR monitoring, which features heavily both New Zealand and overseas maternity related litigation and investigation.

9.2.2 The influence of fear of medico-legal consequences

Midwives and other maternity care providers often refer to a fear of litigation; however, in the context of NZ, fear of medico-legal consequences is more accurate. The legal frameworks for midwifery and obstetric practice in New Zealand are different from those in other countries. New Zealand replaced the tort-based system with a government-funded 'no-fault' compensation system operated by the Accident Compensation Corporation (ACC) in 1974. So while it is not possible to sue for injury, in NZ, ACC requires proof of some physical or mental injury. The Health and Disability Commissioner Act (HDCA) 1994, provides consumers the ability to complain about a provider in accordance with the Code of Health and Disability Service Consumers' Rights.

The most common areas of complaint against midwives is around poor documentation and communication; lack of informed consent, failure to recognise and act on deviations from normal, particularly in relation to FHR monitoring and failure to progress; and to make timely and appropriate referrals for consultation (Newnham & Humphrey, in Pairman et al., 2010). Even though ACC and HDC have made efforts to ensure the processes for complaint and injury investigation are completed in a timely manner, it is not unusual for investigations to take more than two years and longer if the complainant goes from one authority to the next in an effort to find resolution that satisfies them. Doctors and midwives as professional groups both comment on how they are now incorporating defensive practice as a result of ongoing investigation and the scrutiny of the media associated with these investigations.

According to Altaf and colleagues (2006), concise, accurate and contemporaneous documentation of intrapartum events is an important factor in global obstetric litigation. In their study exploring the practices and views of midwives on FHR monitoring, they found a number of deviations from recommended FHR monitoring practice of which 80% were related to the standard of documentation (Altaf et al., 2006). This is concerning in light of midwives' stated reliance on CTG monitoring as covering themselves i.e. using CTG for defensive practice. Midwives in this study practiced defensively in respect to FHR monitoring. Fear of medico-legal consequences was expressed as: *"we're scared of being turfed out or litigated against if there's a bad outcome and getting to court and not having it clinically written. Because at least it's evidence [the CTG paper strip], it's on paper"* (1HB).

Hindley and Thompson (2005) found that midwives' knowledge of the evidence relating to CTG monitoring was superimposed by a perception that using this type of monitoring would provide a legal defence in the event of litigation. This may be at the expense of women-centred care and informed decision-making. The other side of the coin is that midwives are falsely reassured by CTG. Accounts in the literature point to the fact that misinterpretation of CTGs and failure to take appropriate actions are strongly correlated in investigations following adverse outcomes.

A medically dominant culture plays a part in the false reassurance of the protective nature of the CTG machine. Barclay and Jones (1996) said: "technology has been employed to regain power and control over women". This may also be the case for midwives who 'acquiesce' rather than engage in a discussion over the use of CTG, a technology exemplifying defensive practice in a professional environment

marked by risk management and fear of medico-legal consequences (Lewis and Rowe, 2004b). In a discussion of midwives' use of CTG despite the evidence not supporting its continued use for low risk pregnant women, informed by rational choice theory, Greer (2010) has found, "Midwives are not irrational but are hampered in their ability to implement the new guidelines by a fear of practising outside the social norms of the institution in which they work" (Greer, 2010, p47). A reduction of CTG usage will only be achieved if the social norms, such as reducing the fear of litigation are changed.

In summary, this research has illuminated the effects of culture, organisation and the socio-political context on the ability for midwives to utilise their fundamental midwifery skills to promote, facilitate and protect normal physiological birth in the institutional maternity care setting. Despite understanding the basis for evidence-based practice, midwives' autonomy is threatened by a dominant medical paradigm that in turn influences the implementation of evidence into practice. Engagement in the research project and the introduction of the ISIA framework for FHR monitoring for low risk women has given midwives voice to generate change.

9.3 Main claims and key contributions to knowledge that emerged from the research

There are two main claims to emerge from the research. The first claim is an acknowledgement that changing culture in the maternity unit is critical to the implementation of knowledge. The second is that enjoyment in a knowledge translation process has given midwives voice.

Following the intervention, midwives in the focus groups reported changes to their practice around FHR monitoring, in particular the use of ISIA for low risk women both as an admission assessment in the place of the admission CTG and for ongoing monitoring during labour. One midwife's comments provide some insight to the changes she made when she described her practice following the intervention as a step sideways instead of a leap forward:

When I heard your education session, I thought, oh yes, I can be part of this; this is the way I was taught. We know so much more [now] because of the foetal monitoring that we've done since then [when I trained], but the education session put it all in perspective. Even if I do that initial admission CTG, I still feel more confident now in leaving it at that [and using IA afterwards]. So to me, I've made a step sideways perhaps, not a leap forward. It's going back to [fundamental midwifery skills] - Is the baby moving? How's the mother's pulse rate? and recording all those things that you can do to give that clear indication that there was no need to do anything further. It's made me more objective at looking at how I practice. Also, if I'm doing [intrapartum care] for a specialist LMC, I am looking at how they are actually practising as well. You see their defence mechanisms being right up there, especially if they come into [the delivery suite] in second stage. It's building up that rapport and having that confidence rebuilt back in Robyn. So to me that's been helpful. I think also, as you said [name of midwife], when an LMC is working with a woman and knows a woman, as opposed to a core midwife who meets a woman for the first time, you have to try and use all your skills to develop that confidence and that collegiality with that particular person and trust in such

a short space of time and doing something she feels familiar with and tangible and that just might be it and everybody settles down but you can use those other skills. That change came from you [and the education session]. Nothing prior to this has challenged us who are practicing of why we are doing what we're doing in the same way (2HH).

In reflecting on these comments, in particular the reference to a “step sideways” instead of a “leap forward”, I have returned once again to models and concepts that have influenced the tradition of Knowledge Translation and the KTA process. Rogers’ Diffusion of Innovation theory provides insight into how knowledge is diffused (Rogers, 2005). His theory states that diffusion is, “the process by which an innovation is communicated through certain channels, over time, among the members of a social system” (p.5). According to Rogers (2005), the innovation should be perceived to be new by the potential adopters, the change agent must have knowledge about how the new idea is communicated to potential adopters and understand the *time* required for end users of knowledge to make a decision to adopt or reject the innovation and to understand the factors within the social system that influence the adoption of new ideas.

It is the time element of Rogers’s theory that speaks to the process required for potential adopters to journey from first knowledge of an innovation to adoption or rejection. It includes measuring the relative earliness or lateness of adoption by an individual in relation to others in the same social system (Rogers, 1995). The steps of the innovation-decision process are: Knowledge, persuasion, decision, implementation and confirmation (see page 83), which usually occur in a time-

ordered sequence. These steps relate to both the individual and the organisation and explain the rate of adoption within the organisation. The rate of adoption is “the relative speed with which an innovation is adopted by members of a social system” (Rogers, 1995, p.22). This can be visualised by plotting adoption on a cumulative frequency basis which produces an S shaped curve. Rogers, 1995, tells us that most innovations have an S shaped curve representing the rate of adoption of an innovation. However, the rate of adoption can be slow or fast and is measured by the length of time for different groups within the organisation to adopt the innovation. The different groups are called: the innovators; the opinion leaders or early adopters; the early majority; the late majority and the laggards or late adapters. It is innovators and opinion leaders/early adopters who have the greatest influence in the early stages diffusion. Adoption of an innovation may be faster if the innovation is seen to have greater relative advantage, compatibility, complexity trialability and observability (pages 81, 82). In keeping with this notion of the S shaped curve is the understanding of how individuals are influenced in their decision-making around adoption of new knowledge. Rogers, 1995 said:

Diffusion investigations show that most individuals do not evaluate an innovation on the basis of scientific studies of its consequences, although such objective evaluations are not entirely irrelevant, especially to the first individuals who adopt. Instead, most people depend mainly upon a subjective evaluation of an innovation that is conveyed to them from other individuals like themselves who have previously adopted the innovation. This dependence on the experience of near peers suggests that the heart of the diffusion process consists of the modelling and imitation by potential

adopters of their network partners who have adopted previously. So diffusion is a very social process (p. 18).

In the context of this study, there were clear examples from the midwives who became the early adopters and opinion leaders. This was demonstrated in changes in their documentation and decision-making around the use of admission CTG and ISIA for ongoing monitoring. In discussing the value of the education sessions and the ISIA framework, one early adopter midwife said:

I found it interesting because I probably have heard your work three or four times and I found each time I hear it I hear something new or different or I perceive it differently and I remember writing a reflection on the back of the [attendance certificate] the second time I heard it about the changes that I'd made in my practice after the first time but then I'd identified even further change the second time. I thought I was pretty well informed before I began so there's a lot of potential for enhancing knowledge I think (2SJ).

Returning to Rogers, (1995) notion of the importance of modelling and imitation, these sentiments were echoed by the newer midwives during the post-intervention focus groups. These midwives were encouraged by what they perceived to be a shift in thinking by those midwives they considered to be role models in the maternity unit. As well, the midwives identified, with this renewed knowledge of the evidence for IA, that they were now change agents within their maternity unit with ongoing responsibility to keep the momentum for change alive.

I'm a fairly new midwife and I like hearing what you're saying, especially from someone like you [name of midwife], because it's the senior midwives like yourself who are going to show new grads a better way to do things. It's

wonderful for me; here are three senior midwives, who are advocating for normalcy of auscultating the foetal heart in labour. That's the three of you that are going to go and teach other young ones (2HG).

The midwives in this unit acknowledged the need to take a lead in changing the culture of the maternity unit and engagement in this research project has provided the tools and impetus for this to happen. However, they acknowledged that it will take time, which is in keeping with the ideas around the S shaped curve. To change the culture the midwives understood the need to role model practice by using more ISIA for low risk women and to be prepared to defend their decision-making from the strong position of evidence-based practice. They believed that by more of them using ISIA, they would see changes to the interventions low risk women are subjected to and that women, midwives and doctors would become educated about the safety and efficacy of ISIA. In discussing change, the midwives believed their communication with peers, and medical colleagues around low risk women and the safety of ISIA for FHR monitoring would serve as a reminder and normalise the appropriateness of this type of monitoring. ISIA has given midwives voice.

ISIA has provided midwives with a robust means of demonstrating their critical thinking and clinical reasoning and supported their understanding and belief in normal physiological birth. They said that while technology is always changing, the fundamentals of normal birth should really remain. ISIA confirmed them as midwives with essential midwifery skills.

9.4 Implications for practice

The main implications to arise from this study are around addressing the culture of our maternity units and the effects on evidence-informed women-centred care, policy, and workforce. The findings from this research demonstrate a degree of frustration amongst both self-employed midwives and hospital employed midwives around their perceived inability to provide non-interventionist care to low risk women in the institutional maternal care setting. And yet, when supported by an education session and an evidence-based framework for the practice of ISIA they became empowered to return to the essential midwifery skills they were taught in years past or more recently in the education programmes.

Addressing the effects of the culture of the institutional maternity unit is crucial to understanding how knowledge is translated in practice. Communication should be respectful and trust implicit. Power imbalances that see midwives becoming disempowered, acquiescent and their autonomy threatened must be challenged. Changing culture requires acknowledgement of the problem in the first instance. Whilst the midwives can take a lead in changing culture, they cannot do it alone. There must be buy-in by the organisation and the executive leadership team. This starts with transformational leadership.

Transformational leadership enhances the motivation, morale and performance of members of the organisation through a variety of mechanisms. These include connecting the individual's sense of identity and self to the mission and the collective identity of the organisation; being a role model that inspires them; challenging them to take greater ownership for their work, and understanding the strengths and

weaknesses of individuals and groups, so the leader can align them with tasks that optimise their performance.

Midwives in hospital maternity units are faced with the moral conundrum of fetal monitoring practices on a daily basis. Understanding the evidence supporting the use of IA for low risk women and the physiological underpinnings of a framework such as ISIA gives them strength to act as guardians of normal birth. Most fetal surveillance guidelines simply provide a protocol for IA outlining the frequency, timing and duration of IA. I would recommend that fetal monitoring guidelines be amended to include a more comprehensive description of how to use ISIA for admission assessment and ongoing FHR monitoring. Midwives wanted to see the policy updated and to include more detailed information about the use and interpretation of IA. As well, one midwife recommended the inclusion of FHR monitoring modality, and in particular, use of admission CTG, in the Midwifery Standards Review process. This would offer a new discussion point at the biennial peer review process mandated by the NZ midwifery regulatory authority. ISIA should be taught in all undergraduate midwifery programmes and incorporated into formal fetal surveillance education programmes and compulsory ongoing education for practising midwives and doctors.

Incorporating a relationship model of maternity care into the institutional maternity care setting is one way of improving culture and women-centred care. At the heart of this model is the provision of continuity of care. Whilst it is understood that this model of care significantly improves outcomes and satisfaction for women, its availability should not be restricted to low risk women. All women deserve the opportunity to know who will be with them during the labour and birth process.

Hospital managers need to explore the possibilities of introducing continuity of care for women receiving secondary and tertiary care. Where a hospital provides intrapartum midwifery services for private obstetric providers, arrangements should be put into place for these women to have access to midwives who will share their care antenatally and postnatally. This in turn increases midwives' strength to debate care options with our medical colleagues from a position of power, thus moving practice away from 'obstetric personality-based' care to evidence-based care.

The use of IA requires one-to-one care during labour and continuity of care supports this women-centred care practice. Midwives must argue for adequate levels of staffing in our maternity units so they are able to provide evidence based practice for women. We cannot achieve the frequency of IA monitoring if one to one care is not possible. However, if we claim to be using evidence to inform our practice, we must influence the managers about the importance of adequate staffing levels. Studies looking at the economic effects of increased technology and the associated increased interventions should be carried out to support this notion.

9.5 Implications for further research

At the beginning of my research journey, I planned to do an RCT comparing different frequencies for IA. This came from the knowledge that there had been no trials in the past specifically looking at this. It was soon apparent, however, there was a gap in knowledge of how IA is used in practice as well as a lack of a consistent approach to IA. This required a step back, to look at the evidence and to determine the barriers to knowledge translation. I would recommend an RCT, using the ISIA framework for the IA, be conducted. It would need to be a large multi-centre trial

comparing the two most common frequencies currently found in fetal surveillance guidelines i.e. every 15 minute and every 30 minutes in the first stage of labour. A third arm of the trial might be based around a frequency called 'opportunistic'.

As previously mentioned, a follow-up study at the maternity unit where this research was conducted would be useful to gauge whether the changes to practice and culture seen in the post-intervention phase have been sustained over time. This fits with Rogers (1995) notion of the S shaped curve of adoption of an innovation over time, but also the measure the sustainability of the implementation of knowledge to support practice.

Replicating this study in other maternity units national and internationally would build a body of knowledge around the use of IA and add to the literature on knowledge translation and in particular the use of the KTA process.

There needs to be further research on the role and place of fetal movements as an indicator of fetal well-being, especially during labour, is needed.

9.6 Limitations

This research was conducted in only one New Zealand maternity unit, and as such may not be generalisable to other maternity units. However, the idea of fittingness (Guba and Lincoln, 1981) may be more appropriate to consider. Fittingness is described as the findings 'fitting' the context outside the current study site or when the reader/practitioner considers the findings as applicable and meaningful in terms of their own experience (Sandelowski, 1986). This may be true

for any midwife reading the findings of this research in that, the midwives at this study site were similar to all midwives in New Zealand and I suspect anywhere in the world in that they were graduates of a recognised midwifery program as defined by the International Confederation of Midwives (ICM). The recently updated (2011) definition available on the ICM website

(<http://www.internationalmidwives.org/Documentation/CoreDocuments/tabid/322/Default.aspx>) is:

A midwife is a person who has successfully completed a midwifery education programme that is duly recognized in the country where it is located and that is based on the ICM *Essential Competencies for Basic Midwifery Practice* and the framework of the ICM *Global Standards for Midwifery Education*; who has acquired the requisite qualifications to be registered and/or legally licensed to practice midwifery and use the title 'midwife'; and who demonstrates competency in the practice of midwifery.

The hospital where the study was conducted was a level 2 maternity unit which means it had a mix of primary (potentially low risk women) and women requiring a secondary level of maternity care as described in chapter 5. Therefore it is similar to many such units in the developed world. The pre-intervention RMRR conducted in this setting, when compared with a similar smaller audit conducted at another maternity unit in a nearby city, and Muir's (2006) study reveal similar findings in relation to the conduct of IA. This supports my proposal that the findings from my study may have similar results in other settings.

The number of participants who were administered the intervention was only 33 midwives which is around 48% of the eligible midwives of the unit and included the unit midwifery educator who acted as a change agent in the unit. This number may be regarded as small. However those who attended reported significant changes in their practice that created change agents of themselves. There is no reason to suspect this flow on effect may not occur in similar settings and with other midwives.

I could have been more proactive in maintaining the visibility of the ISIA framework to encourage more frequent application of it. I did leave wall posters and DVDs in the maternity unit, but did not follow-up to determine whether staff were accessing the DVDs. However the fact that it made a difference with a 'laissez faire' approach speaks to the power of the framework itself.

By the time I returned to complete the post intervention audit, I was a very familiar face in the unit and midwives were so interested in the process that seven midwives asked to be involved in completing the final audit. This may raise questions concerning a potential bias in the data collection phase of the post intervention audit since the midwives might have been keen to see a change in the recording of a practice which they now supported enthusiastically. The data collection audit tool made this virtually impossible and I also undertook frequent checks of the data to ensure validity.

The use of the clinical record as the source document for the study has several limitations: availability/accessibility, adequacy (the lack of adequacy is not incompatible with practice of a good, or even an excellent quality), veracity (can key

statements be accepted at face value) and completeness (whether, in assessing the quality of the care. However, medical record review is a widely used method of data collection in health disciplines for the assessment of knowledge use and quality improvement in particular.

Length of follow up may be an issue. The post intervention audit was conducted 3-6 months after the delivery of the intervention. A longer follow up would have revealed long- term sustainability; although the final data was collected at 6 months after the intervention and a time series analysis would reveal any decay in the practice over time. This would need to be addressed in any future study of this intervention.

Birth outcomes for low risk women receiving ISIA were marginally improved in terms of vaginal birth outcomes in a unit that experiences high rates of vaginal birth anyway. This increase did not reach statistical significance. Neonatal outcomes were unchanged. Since the unit is very experienced with high rates of vaginal birth it could be argued that the birth outcomes were as good as they were going to be anyway hence the lack of significant findings. The fact that neonatal outcomes were unchanged means that the intervention was successful. Audit of outcomes may not be a sensitive measure to determine the safety of IA in this context. Further studies in different contexts are required.

However, the final step of the KTA process is that of sustaining the use of knowledge. Like any quality improvement framework, the work does not stop with implementation of the intervention or innovation. Evaluation provides feedback on

the effectiveness of the intervention, but also sends us back to the starting position of identifying whether change is sustained or needs to be reassessed for further barriers to knowledge use. With this in mind, follow-up RMRR and focus groups with midwives is recommended.

9.7 Conclusion

This thesis has illuminated the knowledge gap that existed in the provision of the evidence based practice of intermittent auscultation for low risk women. Many barriers to knowledge use were identified and an intervention was developed and delivered to midwives providing them with a new framework for practice. The ISIA informed decision-making framework supported midwives to make changes to their own personal practice and to the organisation where they practice. In many ways, the research has become a catalyst for a changing the culture within this maternity unit. Returning to or engaging with an essential midwifery skill has given midwives voice and new strength to be guardians of normal birth. ISIA offers midwives a robust tool to inform communication between maternity care providers with differing world views.

The KTA process provides an excellent template for future research in maternity units where getting evidence into practice is the key driver. A key to the successful use of this model rests with its recommendation of early engagement between researchers and the end users of knowledge. As well, change agents within the maternity unit can use the KTA process to increase awareness of new research evidence and jointly explore how to incorporate this into practice. The KTA process, as a knowledge tool is suitable not only for identified clinical problems at the grass roots level but also at the level of the financial and policy decision makers.

At the outset of this chapter the research questions guiding the study were repeated and have been established by this research. The ISIA informed decision-making framework has re-established the validity of IA as a fundamental midwifery skill and the KTA process has provided the vehicle for translating this evidence into practice.

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Appendix A Ethics Approval

Central Regional Ethics Committee

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20 November 2009

Robyn Maude
Graduate School of Nursing, Midwifery and Health
81 Fairlie Terrace
Kelburn
Wellington

Dear Ms Robyn Maude

CEN/09/10/077 - An Evaluation of Midwives' Practice of Fetal Heart Rate Monitoring During Labour for Well Women with Uncomplicated Pregnancies

The above study has been given ethical approval by the Central Regional Ethics Committee.

Approved Documents:

- Information Sheet for Obstetricians and Obstetric Registrars, Version 1.11.2009
- Consent Form for Obstetricians and Obstetric Registrar, Version 1, 1.11.2009
- Appendix 3 Research Proposal, Version 1, 2009
- Appendix 4 Audit Proposal, Data Collection Tool and indications for EFM, Version 1, 2009
- Appendix 5 – Letter of Consultation and Support from Maori Health Development Unit, Version 1, 2009
- Appendix 6 – Letter to Hutt Valley DHB Employed Midwives and Access Holders, Version 1, 2009
- Appendix 7 – Information Sheet for Midwives in Focus Group, Version 1, 2009
- Appendix 8 – Email and Letter Invitation for Midwives to Participate the Survey, Version 1, 2009
- Letter of invitation for Midwives to Participate in the Questionnaire, Version 1, 2009
- Appendix 9 – Consent Form: AN Evaluation of Midwives' Practice of Fetal Heart Rate Monitoring During Labour for Well Women with Complicated Pregnancies, Version 1, 2009
- Appendix 10 – Confidentiality Agreement for Transcribing Typist, Version 1, 2009
- Appendix 11 – Confidentiality Agreement for Research Assistance Helping with Focus Groups, Version 1, 2009
- Appendix 12 – Fetal Heart Rate Monitoring Questionnaire, Version 1, 2009
- Appendix 13 – Teaching Plan and Education Package, Version 1, 2009

Amendments approved by the Chairperson of the Central Regional Ethics Committee under delegated authority.

- A3.1 Study Design – Phase Once add no.3 to include one to one or group interviews
- A4.1 Participants – to include in Phase 2, no. 2, Group C – obstetricians and obstetrics registrar;
- A.5.4 Statistical Method – method of analysis – insert the words 'and interview' along side the data from focus groups.
- B8. inclusion/exclusion criteria amended to include obstetricians and obstetric registrars who are employed by HVDHB
- D1. Identification of potential participants to include obstetricians and obstetric registrars who are employed by HVDHB
- D2. Recruitment – an approach will be made to the Clinical Director of Women's Health Service in the first instance and each obstetrician and obstetric registrar will be approached for the obstetric participants.

Accreditation

The Committee involved in the approval of this study is accredited by the Health Research Council and is constituted and operates in accordance with the Operational Standard for Ethics Committees, April 2006.

Final Report

The study is approved until **31 December 2010**. A final report is required at the end of the study. The report form is available on <http://www.ethicscommittees.health.govt.nz> and should be forwarded along with a summary of the results. If the study will not be completed as advised, please forward a progress report and an application for extension of ethical approval one month before the above date.

Amendments

It is a condition of approval that the Committee is advised if the study does not commence, or is altered in anyway, including all documentation eg advertisements, letters to prospective participants.

Please quote the above ethics committee reference number in all correspondence.

The Principal Investigator is responsible for advising any other study sites of approvals and all other correspondence with the Ethics Committee.

It should be noted that Ethics Committee approval does not imply any resource commitment or administrative facilitation by any healthcare provider within whose facility the research is to be carried out. Where applicable, authority for this must be obtained separately from the appropriate manager within the organisation.

Yours sincerely

Sonia Scott
Central Regional Ethics Committee Administrator

Email: sonia_scott@moh.govt.nz

Appendix B: Consultation with Māori

From: Kuini Puketapu [Kuini.Puketapu@(name of hospital)dhb.org.nz]
Sent: Monday, 31 August 2009 2:42 p.m.
To: Maude, Robyn
Subject: Re: Midwifery Research - fetal heart rate monitoring during labour

Kia Ora Robyn

I have now had the opportunity to read your proposal and wanted to respond by adding my endorsement and support for your intended research.

Good luck with your research programme

Regards

Kuini Puketapu

Maori Health Advisor

(Name of Hospital) DHB

>>> Robyn Maude <rmaude@clear.net.nz> 27/08/2009 12:55 >>>

Kia Ora Kuini

I could not find the original email I sent you (probably because I have had to clear my inbox due to overloading). However, I have cut and paste from my draft ethics application to give you an idea of the research I wish to do. I have met with (name of service manager), (name of clinical midwife manager) and (name of midwife educator) to discuss the project and they are all keen to take part and have been talking with some of the medical staff as well.

The first phase of the proposed study is a retrospective medical record review to get a snapshot of what the current practice is around fetal monitoring during labour for women who are well and have

uncomplicated labours. I propose to lead some midwives from **DHB (thereby building their capability to do ongoing audits) to review one month's worth of notes of women who have given birth at **DHB especially looking at how they were monitored and the outcomes of the birth and for the baby. Then I want to meet with midwives in a focus group to explore their knowledge, decision-making around choices for monitoring in labour and any barriers they perceive. This would be followed up with an education package and the introduction to a model for doing intermittent auscultation of the fetal heart rate in labour which is an evidence-based monitoring modality for well women with uncomplicated pregnancies. Following the education package I would like to re-audit at one month and three months to see whether there is an increase in IA being used for this group of women and whether the increase is sustained over time. I have filled in an audit proposal and developed an audit tool – attached.

As you are aware, ethics applications require evidence of consultation and I would greatly appreciate your comments and advice regarding my proposal. The next Ethics meeting is on 8th Sept (and they need the paperwork by 31st August). I understand this is a tight timeframe and it may not be possible for you to comment within this timeframe. The next meeting following this one is in Oct 13th.

Thank you and I look forward to hearing from you.

Naku Noa Na

Robyn Maude

Appendix C: Invitation to Midwives to Participate in the Research

INVITATION TO

(Name of Hospital) DHB

EMPLOYED

and

SELF-EMPLOYED MIDWIVES

To Participate in Midwifery Research

My name is **Robyn Maude**. I am a doctoral candidate at the Graduate School of Nursing, Midwifery and Health at Victoria University of Wellington. As part of my PhD (Midwifery) studies I am undertaking a mixed methods study of midwives' practice of fetal heart rate monitoring during labour for well women with uncomplicated pregnancies

I invite you to take part in Focus Groups to explore knowledge, practice, decision-making, barriers and enablers around fetal heart rate (FHR) monitoring for well women with uncomplicated pregnancies, in particular, intermittent auscultation.

To be a part of this study and to contribute to midwifery knowledge about fetal monitoring for well women with uncomplicated pregnancies, you will need to meet the following criteria. The midwife participants must be:

Employed by **DHB or have an access agreement with **DHB

Providing care to women in the secondary maternity facility, a primary facility or at home

Available for two Focus groups (**last 2 weeks of Nov. 2009 and last 2 weeks of April 2010**)

Available to take part in an education package planned for the **first 2 weeks of Dec. 2009**

If you are interested in taking part in this research project or would like more information, please contact me for an information sheet and consent form by Friday 6th November 2009

The research project has received ethical approval from the Central Region Health Ethics Committee (CREC) (CEN/09/43/EXP).

My contact details are:

Home phone: Thurs/Fri and anytime AH (04) 4769319

Mobile: 0274793826 (Mon, Tues, Wed daytime)

Email Addresses: Robyn.Maude@vuw.ac.nz
rmaude@clear.net.nz

Thank you

Robyn Maude
MA (applied) Midwifery,
RM, RN, BN
PhD (Midwifery) candidate

Appendix D: Information Sheet for Midwives

Information Sheet for Midwives

Focus Groups for Research

Title: An mixed methods study of midwives' practice of fetal heart rate monitoring during labour for well women with uncomplicated pregnancies

My name is Robyn Maude. I am a student at the Graduate School of Nursing, Midwifery and Health at Victoria University of Wellington where I am completing a PhD in Midwifery. As part of my studies for a PhD (Midwifery), I am undertaking a research project to explore midwives' practice and decision-making around fetal heart rate (FHR) monitoring for well women with uncomplicated pregnancies, in particular intermittent auscultation.

Listening to the fetal heart rate (FHR) periodically during labour (auscultation) is an important way to determine fetal well-being. Professional guidelines recommend intermittent auscultation (IA) as the appropriate fetal surveillance for well women with uncomplicated pregnancies. Despite this, electronic fetal monitoring (EFM), which research has demonstrated is linked to increased intervention, is still being used extensively for low risk women. Commonly cited barriers to the use of IA include medico-legal concerns, lack of medical support, the presence on EFM in birthing rooms, limited staff for one to one care in labour and the need to educate or re-educate midwives on the use of IA.

The aim of this research is to explore midwives' decision-making and practice of IA for low risk women. This mixed methods study that will include the implementation of an educational intervention I using an education package introducing a model for intelligent structured intermittent auscultation that I have been developing over the past year. The study design is involves a pre and post medical records review and focus groups to determine the impact of the educational intervention and conducted over three phases. The focus groups are a part of phases 1 and 2. The findings of this study will inform future randomised controlled trials (RCTs) on the frequency, timing and duration of IA.

For midwives who choose to participate in this research, your commitment is as follows:

- Pre-test - Focus group interviews with midwives (up to 2 hour group discussion with 6-8 midwives focusing collectively on intermittent auscultation of the FHR during labour). The focus group will be facilitated by the researcher and a research assistant and will be audio taped to enable accurate transcription of the discussions. Participation is confidential and identity will be protected through the use of pseudonyms.
- Education package consisting of basic physiology related to fetal heart rate monitoring accompanied by the introduction to a model for intelligent structured intermittent auscultation (ISIA) (up to 2 hour)
- Post-test - Focus group interviews with midwives (up to 2 hour group discussion with the same group of midwives from the pre-test group focusing collectively on intermittent auscultation of the FHR during labour). The focus group will be facilitated by the researcher and a research assistant and will be audio taped to enable accurate transcription of the discussions. Participation is confidential and identity will be protected through the use of pseudonyms.

You are cordially invited to be a part of this study and to contribute to midwifery knowledge about fetal monitoring for well women with uncomplicated pregnancies

The focus group research assistant and focus group transcriber will sign a confidentiality agreement to protect your identity. My research supervisors will have access to the audio tapes and typed transcripts but will only be aware of the pseudonym and not your real name. The data will be stored securely and password protected.

After the initial focus group has been completed and subsequently transcribed, I will return the transcript to you to check for accuracy and any other questions that have arisen for you after the first focus group interview. You will be given an opportunity to review your input into the transcript and to add, remove or change any information that you do not wish to have included. The audio tapes of the focus groups will be destroyed at the end of the period of ten years.

I will write a report of the analysis of the documentation reviews and any themes that emerge from the focus groups, which will be included in my PhD thesis and assessed by my supervisors and an external examiner. The findings of the report will be published in professional journals, and will be presented at conferences. A summary of the findings will be made available to you if you wish. A copy of the completed thesis will be lodged in the Victoria University of Wellington Library and at the Graduate School of Nursing, Midwifery and Health.

As a participant you have the right to:

- decline to participate at any time;
- refuse to answer any particular questions, and you may have the video and audio tapes turned off at your request;
- withdraw from the study at any time;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used (you may choose a pseudonym); and
- be given access to a summary of the findings of the study when it is completed.

If you are interested in being a participant in this study, please contact me by 2nd November to discuss the place and time for the focus groups

Home phone: Thurs/Fri and anytime AH (04) 4769319

Mobile: 0274793826 (Mon, Tues, Wed daytime)

Email: Robyn.Maude@vuw.ac.nz or rmaude@clear.net.nz

If you have any concerns about the research processes you can contact my supervisors:
Professor Maralyn Foureur, University of Technology, Sydney; Ph: 0061 2 9514 4834; e-mail:
Maralyn.Foureur@uts.edu.au or **Dr Joan Skinner**, Victoria University of Wellington; Ph: (04)
4636654; e-mail:Joan.Skinner@vuw.ac.nz

The proposed study has been granted ethical approval to proceed by the Central Region Health Ethics Committee (CREC), CEN/09/10/077.

Thank you for considering this invitation

Robyn Maude
MA (applied) Midwifery, RM, RN, BN.
PhD (Midwifery) candidate
Graduate School of Nursing, Midwifery and Health, Victoria University of Wellington

Appendix E: Consent Form for Midwives

Consent form

Title: An mixed methods study of midwives' practice of fetal heart rate monitoring during labour for well women with uncomplicated pregnancies

I have read and understood the information sheet about the above study. Robyn Maude has answered questions I have asked to my satisfaction. As a participant I have the right to:

- decline to participate at any time;
- refuse to answer any particular questions and to have the video and/or audio tape turned off at my request;
- withdraw from the study at any time;
- ask any questions about the study at any time during participation;
- provide information on the understanding that my name will not be used (I can select a pseudonym instead); and
- be given access to a summary of the findings of the study when it is completed.

I understand that my participation in this study is voluntary and will require up to 2 hours of my time on two separate occasions as well as time spent reading the transcripts of the focus groups. I am aware that the focus groups will be audio taped. I am aware that my identity will be protected and pseudonyms will be used and the information will be securely stored. I am also aware that the researcher will use the services of a research assistant and transcriber and they will be bound by a confidentiality agreement.

I understand the findings of the report will be published in professional journals, will be presented at conferences and a copy of the completed thesis will be lodged in the Victoria University of Wellington Library and at the Graduate School of Nursing, Midwifery and Health.

Should issues arise that may cause me to become uneasy or distressed I am at liberty to contact the researcher Robyn Maude, her supervisors **Professor Maralyn Foureur**, University of Technology, Sydney; Ph: 0061 2 9514 4834; e-mail: Maralyn.Foureur@uts.edu.au or **Dr Joan Skinner**, Victoria University of Wellington; Ph: (04) 4636654; e-mail: Joan.Skinner@vuw.ac.nz or the Central Region Health Ethics Committee (CREC) at central_ethicscommittee@moh.govt.nz or on 04 8162405

I agree to participate in this study under the conditions set out in the information sheet, and I agree to participate in the two audio taped focus groups and education package.

Name of participant:

Signature of Participant:

Name of Researcher

Signature of Researcher:

Date:

Date:

Appendix F: Confidentiality agreement for Research Assistant

**An evaluation of midwives' practice of
fetal heart rate monitoring during labour
for well women with uncomplicated pregnancies**

I (insert name) agree not to divulge any information that I may become aware of in the course of my involvement with the focus groups conducted by the researcher Robyn Maude. I will not keep any copies of the video or audiotapes, transcripts or computer disks or any of the data. I also agree to store the video, audiotapes, transcripts and disks securely while they are in my possession.

Name of Research Assistant:

Signature of Research Assistant:

Date:

Appendix G: Confidentiality Agreement for Transcriber**An evaluation of midwives' practice of
fetal heart rate monitoring during labour
for well women with uncomplicated pregnancies**

This is to state that in the process of transcribing information supplied to

-----(*transcribing service*), informants confidentiality will be maintained and that the information will be stored in a secure manner during the stages of transcription.

No data will be retained by -----(*transcribing service*) on hard copy or disc following the successful completion and transfer of the hard disc.

Signed:

Date:

Signed:

Date:

Appendix H: Confidentiality Agreement for Midwife Auditors

**An evaluation of midwives' practice of
fetal heart rate monitoring during labour
for well women with uncomplicated pregnancies**

I (insert name).....

agree to maintain confidentiality of all names and information that I may become aware of in the course of my involvement with the retrospective medical record review conducted for the purposes of the PhD research by Robyn Maude. I will not to discuss or divulge any information to any person other than the researcher for the purposes of clarification only.

Name and Signature of Midwife:

Date:

Name and Signature of Researcher:

Date:

Appendix I: Focus Group Questions

Pre-Intervention

I will ask some prompt questions such as:

- Describe your practice regarding fetal heart rate monitoring
- What information guides midwives' practice regarding monitoring modality
- What are the enablers and barriers midwives' experience in the practice of IA for well women with uncomplicated pregnancies
- How midwives interpret what they hear when performing IA
- Midwives' actions when they hear changes to fetal heart rate and rhythm

Post-Intervention

Trigger questions at the post-intervention RMRR included:

- What is your response to the preliminary statistics from the pre-intervention RMRR that I have provided, particularly in the context of education session?
- Did the education session make any difference to how you practice and if not, what's going on that makes it hard to change what we do?
- What changes have you made to your own practice following the educational session?
- What changes have you seen, if any, in the maternity unit following the education session?

Appendix J: Retrospective Medical Record Data Collection Tool

1.	Research No:		NHI (for audit use only):	
2.	Date (dd.mm.yy):		Midwife initials (for audit use only):	
3.	Time of day at admission to delivery suite (Time in 24hr clock e.g 0125)			
4.	LMC at Booking (please select one)		✓	Comments
LMCbooking	1	Self-employed Midwife		
	2	Private Obstetrician		
	3	Hospital Primary Team		
	4	Hospital Secondary Team		
	5	Not stated		
5.	Caregiver (LMC) during Labour (please select one)- allows for transfer of care		✓	Comments
Caregiverlab	1	Self-employed Midwife		
	2	Private Obstetrician + <u>self</u> employed midwife		
	3	Private Obstetrician + hospital core midwife		
	4	Hospital Primary Team (hospital core midwife)		
	5	Hospital Secondary Team + hospital core midwife		
	6	Other, please specify		
6.	Antenatal Assessment of fetal well-being (tick Yes/No if evidence found in notes of the following)			
			✓	Yes No
ANafw	1	Bio Physical Profile		
	2	CTG		
	3	Fluid Volume Index		
	4	A combination of the above		
	5	Other, specify		
	6	Not applicable		
7.	Antenatal discussion regarding Choices for Fetal Monitoring (tick Yes/No if evidence found in notes)			
			✓	Yes No
ANdiscFM	1	Care Plan/ Birth Plan		
	2	Hospital notes		
	3	Other, specify		
	4	Missing data i.e No care/birth plan		
8.	Gestation on Admission in labour or for IOL (write as weeks and days from LMP i.e 38+5) if missing, please calculate from LMP or scan (only do one)			
Gestwksdys	1	Calculated from known EDC	wks +days	
	2	Calculated from LMP	wks +days	
	3	Calculated from Scan date	wks +days	
	4	Missing data (i.e no LMP)		
9.	Gravidity/Parity (insert below)			
GrPa	1	Gravida:		
	2	Para:		
	3	Mics. (no.)		
	4	TOP:		
	5	Fetal or neonatal loss:		
	6	Missing data		
10.	Ethnicity (insert main choice below as stated on booking form)			
EthnM	1	Main:	✓ if Not stated:	

<p>11. Assessment on <u>Admission</u> to delivery suite in labour or for IOL (this involves reviewing the booking data, any antenatal records available or the notes written on admission) (Tick Yes, No or NA i.e. woman comes in pushing, or if unsure, make a comment)</p> <p style="text-align: right;">✓ Yes No NA Comment</p>					
AdAssRF	Antenatal Risk Factors	Are there and identified <u>Antenatal maternal</u> or <u>fetal</u> risk factors present? (See Table 1)			
AdAssRFm		If <u>Yes</u> , specify the <u>maternal</u> risk factors below and see comment:			
AdAssRFf		If <u>Yes</u> , specify the <u>fetal</u> risk factors below and see comment:			
AdAssRFu		If <u>unsure</u> , record reason for uncertainty in the comments box to the right			
<p>12. Admission Assessment - Is there any evidence in the documentation that the following assessments were made during the admission assessment)</p> <p style="text-align: right;">✓ Yes No</p>					
AdAssFM	Fetal Movements	1	Not applicable (i.e came in pushing) go to abdominal palpation		
		2	Fetal movements recorded		
		3	Fetal Movement palpated by midwife and woman and this is recorded		
		4	Fetal heart rate heard during a FM and the rate is recorded		
AdAssAP	Abdominal Palpation	1	Not applicable (i.e came in pushing) go to uterine activity		
		2	Abdominal palpation performed on admission		
AdPapI		1	Is the fetal lie documented		
		2	Is the fetal position documented		
		3	Is the fetal presentation documented		
		4	Is the descent (abdominally) of the fetal presenting part documented		
AdAssUA	Uterine Activity	1	Not applicable (i.e came in pushing) go to fetal heart rate		
		2	Uterine activity assessed on admission		
AdUA		1	Is the frequency of contractions documented		
		2	Is the duration (length) of contractions documented		
		3	Is the strength (intensity) of the contractions documented		
		4	Is the resting tone of the uterus between contractions documented		
AdAssFHRd	FHR documentation	1	FHR written as one single number i.e. 140bpm		
		2	FHR written as a range i.e. 125-136bpm		
		3	FHR and Maternal HR differentiated i.e maternal pulse noted		
		4	FHR increase from baseline (accelerations) present?		
		5	Absence of FHR decreases from baseline established (deceleration) i.e. no decelerations		
		6	FH rhythm noted i.e regular or irregular		

13. Type of Fetal Monitoring used at Admission Assessment when first admitted to delivery suite in labour if Admission CTG <u>NOT</u> performed i.e. <u>Intermittent Auscultation (IA)</u> i.e. listening periodically to the fetal heart with a device such as Pinard, handheld Doppler or using the CTG machine transducer sometimes with the paper running, sometimes not; <u>Intermittent electronic fetal monitoring (EFM)</u> i.e. using the CTG machine continuously for around 10 minutes in a 30 minute period							
				Please ✓	Yes	No	Comments
AdFMTtype	Fetal monitoring type	1	Not applicable (i.e came in pushing)				
		2	Was an Admission CTG performed?				
		3	Admission CTG duration - length of admission CTG in minutesminutes				
		4	Did Admission CTG remain on to become CEFM				
		5	Intermittent Auscultation with Pinard stethoscope				
		6	Intermittent Auscultation with handheld Doppler device				
		7	Intermittent auscultation device <u>not stated</u>				
		8	Intermittent Auscultation with CTG transducer and paper running				
		9	Intermittent Auscultation with CTG transducer and paper <u>not</u> running				
		10	Intermittent EFM				
		11	Intermittent EFM duration i.e. length of Int EFM per 30 minutesminutes inminutes				
14.Type of Ongoing fetal monitoring i.e after admission assessment until birth of the baby							
				✓	Yes	No	Comments
OFN	Ongoing Fetal monitoring type	1	Not applicable (i.e came in pushing) go to q. 15				
		2	Continuous CTG				
		3	Intermittent Auscultation with a Pinard				
		4	Intermittent Auscultation with a hand held Doppler device				
		3	Intermittent Auscultation - <u>device not stated</u>				
		4	Intermittent auscultation in the 1 st stage using the CTG transducer with the paper running				

		5	Intermittent auscultation 2nd stage using the CTG transducer with the paper <u>not</u> running			
		6	Intermittent EFM in the 1 st stage (strips of CTG for a number of minutes)			
		7	Intermittent EFM in the 2nd stage (strips of CTG for a number of minutes)			
		8	Combination of IA and EFM			
		9	Are all the CTGs in the notes?			
15. Are there any identified intrapartum risk factors in the labour documentation indicating EFM should be started (this involves reviewing the medical records) See table 1 ✓ Yes No Comments						
IPRF	Intrapartum Risk factors		Intrapartum risk factors identified?			
IPRFI			If <u>Yes</u> , specify the <u>Labour</u> risk factors			
IPRFm			If <u>Yes</u> , specify the <u>Maternal</u> risk factors			
IPRFf			If <u>Yes</u> , specify the <u>Fetal</u> risk factors			
IPFMch	Change in Fetal monitoring	1	Was there a change of FHR monitoring to CEFM?			
		2	Not applicable			
ONLY COMPLETE SECTIONS 16 and 17 WHEN <u>INTERMITTENT AUSCULTATION</u> HAS BEEN USED FOR ONGOING FHR MONITORING OTHERWISE GO TO 18, 19 and 20						
16. Intermittent Auscultation Protocol – When used, how is intermittent auscultation performed?						
IAPFFS	Frequency of IA	The frequency of IA in active 1 st stage was on average everyminutes				
IAPFSS		The frequency of IA in 2 nd stage was on averageminutes OR				
		The frequency of IA in 2 nd stage was on average after very contraction				
		✓ Yes No NA				
IAT	Timing of IA	IA was performed after a contraction				
IAPD	Duration of IA	FHR was counted done for one full minutes				

		(60secs)				
IAPMP	Maternal Pulse	Maternal pulse taken each time to differentiate between fetal heart rate				
IAPFM	Fetal movements	The presence of fetal movements were noted				
<p>17. Ongoing intermittent auscultation (IA) fetal heart rate monitoring documentation - is there any evidence of the following in the ongoing medical record documentation during labour?</p> <p style="text-align: right;">✓ Yes No Comments</p>						
		1	Not Applicable			
OFMd	IA documentation	2	FHR written as one single number i.e. 140bpm			
		3	FHR written as a range i.e. 125-136bpm			
		4	FHR rhythm (regular or irregular)			
		5	FHR accelerations are noted			
		6	FHR decelerations (gradual, abrupt or prolonged) are noted			
		7	Evidence that specific actions (interventions) i.e maternal position change, taken when changes in FHR occur			
		8	Evidence of Maternal and fetal responses to interventions			
		9	Evidence of the time that return to normal findings after intervention			
		10	Maternal Pulse - each time FHR recorded			
	Fetal movements documentation	11	Fetal movements at any time during labour			
	Uterine activity documentation	12	Uterine contractions frequency			
		13	Uterine contraction strength (intensity)			
		14	Uterine contraction duration (length)			

		15	Resting tone between contractions			
	Maternal vital signs documentation	16	Maternal Vital signs			
18. Mode of Birth ✓ Yes No Comments						
MoB	Birth	1	Normal or spontaneous vaginal birth			
		2	Assisted vaginal birth			
		3	Caesarean section			
19. Apgar Score (enter scores below)						
APGAR1	Apgar	1	1min:			
APGAR5		2	5min:			
APGAR10		3	10min:			
20. Admission to SCBU or NNU						

Appendix K: Educational Intervention (DVD) (in envelope)