Enablers and barriers to midwives' acceptance of technology in maternity care

Karin Birkner

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By

Karin Birkner

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Associate Professor Yvonne Parry

Liz McNeill

Declaration

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signature: Karin Birkner Date: 19 July 2023

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Abstract

Background:

Efforts to improve morbidity and mortality for both women and babies is contributing to the development of medical technology in maternity care. As midwives comprise the majority of the maternity care workforce, caring for women through pregnancy, intrapartum and into the postnatal period, the acceptance of any technological advances by midwives is important to ensure it is satisfactorily implemented. The research question for this study is: what are the enablers and barriers to midwives' acceptance of technology in maternity care?

Method:

The method for this study was Interpretive Phenomenology. Semi-structured interviews were conducted with 11 midwives. Themes were identified using thematic analysis.

Results:

Themes for both enablers and barriers to the acceptance of technology were identified

Barriers were:

- a fear of loss of clinical skills,
- poor specificity and overuse of current technology available and
- reduced time spent with women while attending to technology.

Enablers were:

- a risk adverse culture
- women's expectations
- a desire for medico-legal protection and
- a desire for accurate prediction of fetal wellbeing.

Conclusion:

Overall midwives accepted that the development of technology was inevitable and that it had to potential to improve maternal and fetal outcomes while providing medico-legal protection for clinicians. There were, however, concerns that technology would be adopted without proven benefit, and that midwifery skills would be lost as dependence on technology increased. Technology use was seen as reducing time spent with women as it was often cumbersome for women and midwives.

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Chapter 1

1.1 Introduction

Childbirth is, for women, a transformative rite of passage, the experience having long lasting physiological and psychological implications for a woman's wellbeing in both the short and long term (Larkin et al., 2017). How a woman is cared for during her labour and birth is critical to her postnatal wellbeing, impacting on her relationship with her baby (Patterson et al., 2019; Reed et al., 2017). In Australia, and most western societies, birth gradually has moved from the home to hospitals due to a combination of factors that include efforts to improve maternal and neonatal morbidity (Monk et al., 2013), as well as the emergence of obstetrics as a profession (King, 1998; Martin, 1992). Contrary to expectation, the emergence of institutional births has not been the dominant factor in improved patient outcomes (Scamell, 2014), and in some countries has led to the identification and tracking of iatrogenic harm as an independent issue, including increased maternal morbidity and mortality (Dahlen et al., 2019; Dahlen et al., 2014; World Health, 2019). The institutionalisation of birth has been associated with widespread research findings of disrespectful and abusive care (Lokugamage & Pathberiya, 2017; Miller & Lalonde, 2015) and frequent well documented claims of obstetric violence (Garcia, 2020; Williams & Meier, 2019). Birth trauma and the resultant post-traumatic stress disorder responses have been cited as a common feature in why women choose to birth "outside of the system" (Jackson et al., 2020). Despite this, and regardless of growing reports of consumer dissatisfaction along with rising rates of birth trauma due to increasing intervention in labour (Cole et al., 2019), institutionalised birth dominates, resulting in 99.5% of births in Australia occurring in hospitals (Australian Institute of Health and Welfare, 2020a). The phenomenon of intervention leading to more intervention, "The cascade" has been well researched and documented (Dahlen et al., 2019).

Technological advances in the care of pregnant women, along with medical dominance, have transformed the experience of childbirth for many women worldwide (Wong et al., 2017). The resulting medical model presents childbirth as being a medical problem, filled with risk, rather than a normal physiological process (Healy et al., 2017; van Teijlingen, 2017). Risk has become a predominant concern, and one that shapes the practice of health professionals, reduces women's confidence in their bodies to birth normally, and encourages them to seek care in high-acuity settings (Coxon et al., 2016). Technology is presented as a solution to reduce risk (Prosen & Krajnc, 2016), and is viewed by prospective parents as having the ability to make birth easier (Hauck et al., 2016). However, many argue that the use of technology in childbirth, especially in acute hospital settings, increases the rate of intervention and likelihood of complicated births (Coxon et al., 2016; Dahlen et al., 2012; Small et al., 2020).

Increasing use of technology to improve productivity and assist in everyday tasks contributes to the notion that technology is in some ways superior to human efforts. This belief translates to healthcare where professionals who have experience to technology are open to its use and accepting of its implementation into practice (Ruiz Morilla et al., 2017). Additionally, research indicates that expectant parents are already using technology to replace or compliment traditional care antenatally and in many cases are not averse to, and indeed expect, its use in labour and birth (Lupton & Maslen, 2019).

1.2 Problem statement

As technological advances occur, the development of medical devices for use in maternity care will continue to rise, and the integration of the new technologies into clinical practice needs to be considered by midwives. Midwives are an integral part of the clinical team and their acceptance of any processes or innovations is central to their successful implementation, as midwives can limit its success by use of subterfuge if they believe women

will not benefit (Catling et al., 2017; Hawke, 2021). To understand this professional conundrum the research question for the proposed study asks: What are the enablers and barriers to midwives' acceptance of technology in maternity care?

1.2 Background

1.2.1 A history of midwifery and the rise of obstetrics – "how did we get here?"

Worldwide the birth of a child is a celebrated and cherished event with cultural practices and knowledge developed to improve outcomes (Sargent & Davis-Floyd, 1997). Throughout history and across all cultures, childbearing women have been supported by a caregiver, someone who is *with-woman*, from whence the term Midwife is derived (Najafi et al., 2017). The concept of being "with-woman" remains central to the midwifery philosophy (Newnham et al., 2018) as described by the Australian College of Midwives (Australian College of Midwives, 2021) and is central to the concept of *women centred care* (Homer et al., 2009). In the Lancet series on Midwifery, midwifery is defined as "Skilled, knowledgeable and compassionate care for childbearing women, newborn infants and families across the continuum throughout pre-pregnancy, pregnancy, birth, postpartum and the early weeks of life" (Renfrew et al., 2014, p. 1130).

Midwifery knowledge has evolved from beginnings of experiential, embodied and oral history knowledge, which was been both appropriated by medicine in the Middle Ages and then, paradoxically, labelled unscientific, before being displaced by the emerging profession of obstetrics (Davis-Floyd, 1994; Newnham, 2014). In Australia, at the time of colonisation, midwives provided birthing services to women who were of means, only calling upon doctors if necessary and if the woman could afford the extra fee (Peters, 1985). The welfare of women and children was considered an individual responsibility and the provision of maternity care to the poor was reliant on the charity of philanthropic organisations (Thame, 1974).

According to Monk et al. (2013) financial responsibility for childbirth was avoided by the State, leading to more doctors becoming involved in maternity care through the establishment of lying-in homes, which led to competition between doctors and midwives over the provision of care and the potential profits to be made. This process created a system in which the ability to pay for a service was viewed as preferable and therefore, superior to the existing system which was previously either free or moderately priced (Tew, 2013). Autonomous Midwifery persisted and provided care to women and families all over the world, until the Midwifery Act of 1902, whereby it became illegal for Uncertified Midwives in the UK to practice, unless they were under the supervision of a medical practitioner or were male, until the legislation was changed in 1926 demanding that all midwives be certified to practice (Thompson & Lewis, 2013).

Worldwide the professionalisation of medicine and the emergence of the scientific enquiry into birth and its control, combined to discredit community midwifery and to promote institutional birth (Newnham, 2014). Birth in Lying-in homes moved to hospitals which were emerging as places of teaching, and midwifery shifted from a position of independent practice to one that was aligned educationally with nursing, keeping midwifery in a place of subordination to medicine (Murphy-Lawless, 1992; Newnham, 2014). A variety of financial and political incentives have collaborated to ensure that childbirth has become predominately hospital based and midwifery practice kept firmly under the dominance of obstetrics and the technocratic paradigm (Dahlen et al., 2014; Homer et al., 2009; Monk et al., 2013).

1.2.2 The technocratic and humanistic paradigms of childbirth

According to Davis-Floyd (2001) the two paradigms of health that have most influence on childbirth are the technocratic and humanistic paradigms. The technocratic model sees the body as a machine and stresses mind and body separation, pursuing a positivist epistemology

dominated by a premise that there is a "truth" that can be identified through statistical and scientific measurement (Thomson et al., 2012). Early scientific examination of birth describes the pregnant body as a machine that must expel the fetus during birth, a description that is the epitome of the technocratic paradigm and one that pervaded early medical and obstetric enquiry (Martin, 1992; Reed, 2021).

Alternatively, the humanistic model is focused on the mind-body connection, seeing the body as an organism under the influence of the mind, and is the paradigm most aligned with the philosophy of midwifery, where birth is viewed as a normal biological function influenced by the physiological, emotional, and sociological domains (Newnham, 2014).

The modern western medical system, where the technocratic paradigm prevails, views birth as a risky endeavour best handled within the hospital system where the doctor is decreed an authority figure and the birthing woman without responsibility (Shaw, 2013). In the technocratic paradigm the midwife, whose place was historically in close contact with the woman, may spend more time with monitoring devices and diagnostic tests (Najafi et al., 2017). However, midwives possess a unique role in the field of childbirth, as they strive to accommodate a wide range of women's preferences, encompassing both technologically advanced hospital births and unhindered home births. The significance of midwives lies in their expertise in fostering a conscious connection between care and autonomy, leading the path towards comprehensive healthcare that should define and support the future of humanity (Davis-Floyd & Johnson, 2006).

1.2.3 Current Midwifery practice in Australia

An examination of Australian health workforce data indicates that 57% of the Australian maternity workforce are Nurses and Midwives (n=404, 896 with 26, 387 registered as midwives) (Australian Institute of Health and Welfare, 2020b). Midwives work across all

areas of maternity care in Australia and can practice independently or as part of a maternity care team that includes obstetricians, paediatricians, and anaesthetists. The dominant place of practice for midwives in Australia are hospitals, either public or private, where most babies in Australia are born (Australian Institute of Health & Welfare, 2020a). In a hospital setting, midwives may work in various models of care but in many cases must practice in subordination to medical practitioners. Midwives who provide women with continuous care throughout pregnancy, labour, and the postnatal period, whether through a local health service or hospital, do this under the supervision of an obstetrician, as do privately practicing midwives (Monk et al., 2013). The benefits of continuous care for women are well documented, however few Australian women are, or have been, afforded this opportunity (Dahlen et al., 2022; Gamble et al., 2020; Homer, 2016; Keedle et al., 2020; Tracy et al., 2013). Women who choose private obstetric care are still cared for during their labour by a midwife, the obstetrician appearing when the birth is imminent or medical intervention is required. Consequently, midwives working in a hospital setting are often unknown to the women they care for, regardless of public/private status making it important that they are able to quickly develop a relationship with the woman and her support people at a time that is, for the women, one of vulnerability and transformation.

A core tenant of midwifery practice is the provision of woman centred care, where bodily autonomy, informed consent and the woman's voice are preserved and protected. Hawke (2021), affirms that Australian midwives are impeded in supporting women to make informed choices, have their voices heard and to maintain bodily autonomy within a healthcare system that has been founded on an inherently sexist epistemology, where rigid policies and protocols dictate the provision of care. This medical paradigm, which focuses on risk and risk mitigation, is not supportive of a midwifery philosophy, leading to midwives feeling

disempowered and fearful of reprisal and litigation if they stray from the technocratic model (Catling et al., 2017; Kruger & McCann, 2018; Small et al., 2021a).

The rise of the technocratic model of obstetric care has been compounded by childbirth risk conceptualisation, where discussions of risk with women are often unbalanced, frequently focusing on the potential for adverse outcomes (Coxon et al., 2016). The practice of discussing risk in childbirth, presenting potential outcomes based on numerical data (Van Wagner, 2016) is highly influenced by the interpretation of the health professional and their inherent bias and medico-legal concerns (MacKenzie Bryers & van Teijlingen, 2010; Small et al., 2021a). According to Dahlen (2010), discussions of risk between women and midwives and obstetricians, have the potential to offer reassurance or to increase medical intervention, depending on how notions of risk are presented. Van Wagner (2016) describes strategies used by midwives and some obstetricians to keep risk in perspective, promoting discussion that is risk tolerant, and building on the establishment of trusting relationships and open communication.

A shared goal of obstetricians and midwives worldwide is a reduction in the rates of perinatal mortality (Schramm et al., 2018b). The death of a baby before thirty-four weeks gestation or within the first month of life is not uncommon, even in high resource countries such as Australia, where the current perinatal mortality rate (PMR) was reported as being 7 per 1000 deaths (Australian Institute of Health & Welfare, 2020b). Perinatal loss can be attributed to multiple factors, such as congenital abnormality, problems with intrauterine growth and placental insufficiency, however, a large proportion of foetal death occurs without known causative factors (Australian Institute of Health & Welfare, 2020b; Brown et al., 2014). Complications may arise during labour, although rarely for women who do not present with any risk factors (Small et al., 2020). Assessment of risk, and the identification of risk factors

in individual women is an essential part of maternity care. Previously clinicians relied on individual insight and experience in conjunction with limited scientific data and a knowledge of physiology and pathophysiology. However, current maternity care is now afforded increasing precision in the identification of risk in childbirth and pregnancy as a result of clinical trials, technological advances, and statistical analysis of vast data collections (Bisits, 2016). In an era of almost unlimited access to information and data, research studies, meta-analyses, and statistical knowledge it would appear that we are no closer to minimising the uncertainty that many women and their care providers seek. Control over the pregnancy outcome is often sought from the use of technological advances without the adequate assessment of the short- and long-term implications of introducing said with limited evidence of their efficacy (Small et al., 2020).

1.3 Current technology for use in maternity care

Technology used in maternity care is mainly focused on foetal surveillance. Routine ultrasound to assess foetal growth and wellbeing, identify abnormalities and offer reassurance, is experienced by most women receiving maternity care in developed countries, including Australia (Åhman et al., 2019; Kim et al., 2018; Siddique et al., 2009; Williams et al., 2018). Tests and screening tools used throughout pregnancy, for example screening for Gestational Diabetes, can also be considered technology, however the most widely used technology in maternity care is assessment of the foetal heart rate (FHR).

It is widely argued that FHR monitoring is crucial in determining foetal wellbeing (Ayres-de-Campos, 2015; Kamala et al., 2018) and that for high-risk pregnancies it constitutes an essential component of maternity care (Graatsma et al., 2009). Assessment of the FHR can be either intermittent or continuous, with both methods most commonly using an ultrasound transducer to auscultate the FHR via the maternal abdomen (Pairman et al., 2019). In recent

years research into the use of fetal electrocardiograph (fECG) as a more reliable method of identifying and recording fetal heart has led to the development of fetal monitoring systems that have the ability to monitor pregnant women with varying body habitus, where doppler technology is limited (Knupp et al., 2020). This new technology also has the capability to allow for monitoring of pregnant women away from the hospital environment, including in remote areas, however, testing of this emerging technology is still being performed (Alves et al., 2020; Schramm et al., 2018a). The regulatory comparator remains the Cardiotocograph, or CTG, for continuous FHR monitoring. The CTG records patterns of heart rate and uterine activity and has been the most used method for over 30-years (Stampalija et al., 2012). Unfortunately, interpretation of CTG is limited by its subjective nature and its use has been associated with an increase in obstetric interventions, while having limited effect on perinatal outcomes (Al Wattar et al., 2021; Ayres-de-Campos et al., 2015; Small et al., 2019; Stampalija et al., 2012). Although these limitations have been apparent, and the validity of the technology has never been proven, research has focused on devices that provide the same information – FHR and uterine activity (UA) – just in new ways. For example, FHR and UA can be assessed by way of a Pinard fetoscope, or a hand-held doppler, and a hand placed on the pregnant woman's abdomen where the UA is palpated, as has been done by midwives for centuries (Maude, 2017) and is called intermittent auscultation (IA). Able to be used throughout pregnancy and labour, IA is low cost, affords freedom of movement for labouring women and is supported by the evidence as safe for use in low-risk women (Alfirevic et al., 2017), however, there are some concerns that this skill is becoming an endangered practice as CFM is used more routinely in high to middle income countries (Engelhart et al., 2022; Maude, 2017; Maude et al., 2014).

The rise of CFM as the dominant form of foetal monitoring, especially for women in labour has not been successful in reducing perinatal morbidity and mortality, but has been

linked to increased intervention for women, including high rates of caesarean section (Small et al., 2019). It is standard practice for use in high-risk women, or when abnormalities of FHR are detected during intermittent monitoring (Ayres-de-Campos, 2015). CTG is the most common form of CFM, and in Australia it is used in more than half of all births (Australian Institute of Health and Welfare, 2020a). CTG is associated with reduced mobility due to its design (the transducer for FHR and strain gauge to detect FM are held in place on the maternal abdomen via two belts and connected to the machine via electronic cables). Reduced mobility in labour increases requirements for pain relief (Smith et al., 2021), increases length of labour (Priddis et al., 2012) and increases the risk of assisted birth, including caesarean section (Prosser et al., 2018). More modern technological advances have resulted in wireless CTG machines, which allow for maternal movement, however, many women in Australia are not afforded access to this technology (Fox et al., 2021). The introduction of Central Monitoring systems, where the CTG can be viewed from a central area, or even remotely in some cases, has been adopted by many hospitals following claims that this would improve the detection of intrapartum fetal distress (Jepsen et al., 2022). In the United Kingdom, the Ockenden report (Ockenden, 2020) recommended that centralised CTG be mandatory in all UK obstetric units, despite a lack of evidence of the benefit of intrapartum CTG use (Alfirevic et al., 2017). In fact, recent research by Small et al. (2021) has indicated that centralised CTG monitoring has not helped to reduce perinatal or maternal morbidity or mortality and has instead had an effect on workplace culture within birthing units (Small et al., 2022).

Continuing advances have meant the development of new and innovative methods for foetal surveillance (Georgieva et al., 2019; Petrozziello et al., 2019). The scientific benefit of these technologies is determined by clinical trials, however according to Schramm et al. (2018b), the acceptance of new technology, by pregnant women and clinicians, is essential for its successful clinical implementation.

Despite recommendations that maternity care be 'woman centred' (Australian Department of Health, 2009), the reality is that maternity care in Australia leaves many women with little control or choice during birth (Cole et al., 2019), and increasing levels of medical intervention and subsequent emotional trauma (Jackson et al., 2020). Indeed, an examination of neurohormonal events during birth by Olza et al. (2020) noted that the positive effects of hormonal activity that facilitate physiological birth can be impacted by the presence of monitoring technology. According to (Taherdoost, 2018) user acceptance and confidence in technology is necessary for successful implementation of technology and for user engagement. The acceptance of technology use in maternity care by women is closely tied with maternal satisfaction and increased medicalisation of birth and is well researched. The acceptance of technology use in maternity care by midwives however is not, and the gap to be explored in this research.

1.4 Aims and Objectives

Aim:

> To identify the enablers and barriers to midwives' acceptance of technology in maternity care in Australia.

Objectives:

1. To ascertain midwives' feelings about the use of technology in maternity care,
2. To understand which factors might influence an individual midwife's feelings about technology use maternity care.

1.5 Summary

This section has provided an historical overview of the emergence of technology in use in maternity care and the adaptation of midwives' practice to the medical model. Although technology use in maternity care, and its implementation into routine practice, has shown minimal benefit for women and babies, technological advances continue in hopes of reducing

perinatal morbidity and mortality. The acceptance of developing technology by midwives is not well researched and is the focus of this research.

The following section will present the literature review, where the barriers and enablers to the acceptance of technology by midwives will be explored. The methodology for this study is presented in chapter three and the results are discussed in chapter four.

Chapter 2 - Literature review

2.1 Introduction

This review will provide an explanation and discussion of search strategies to locate relevant literature, and methods used to determine the inclusion of literature in the review. The critique and analysis of the literature determined the themes. A detailed analysis of the articles reviewed will support the emerging themes. The aim of this review is to examine the literature and identify the themes of either barriers or enablers to the acceptance of technology in maternity care.

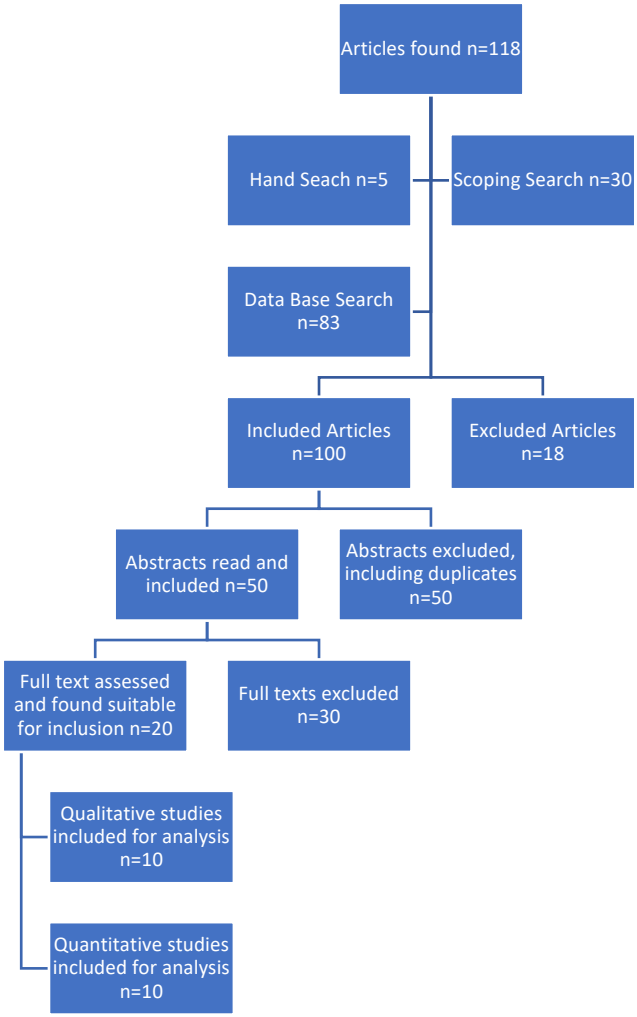
2.2 Literature Search

A search of the literature began with a scoping search using Google Scholar to assess the extent of literature available. Scoping reviews provide a broad yet targeted review of the literature pertaining to an area, allowing for the inclusion of grey literature and policy documents that may be useful for areas with a dearth of information (Peters et al., 2020). Inclusion criteria for the initial search included a time frame 2014-2022, and articles in English. The scoping search yielded 30 articles. Terms searched included: Maternal acceptance of foetal monitoring in labour; Midwives perceptions of technology use in labour; Midwives acceptance of technology in pregnancy and labour; Enablers to technology in childbirth; Barriers to technology in childbirth. These terms were based on the findings of the scoping search.

Data bases CINAHL, MEDLINE and Science Direct were searched using the search terms: Health, attitudes; Technology assessment, biomedical/or biomedical technology/or technology; Infant, Newborn/or Midwifery/or hospitals/maternity/or pregnancy/or delivery, obstetric/or pre-natal care/or maternal health services. Initial searches placed a limitation of five-years since publication, but this was expanded due to low search results. Articles were

excluded if they did not meet the following criteria: peer reviewed, primary research articles, published within the last 10 years and written in English. Research by Graatsma et al., (2008) and Kornelsen, (2005) were both included as they represent foundational work on the attitudes to intrapartum technology. A hand search of articles cited in the reference lists of appropriate articles yielded a further five articles for critique and have been included in the literature review. During assessment of the available articles, a theme of childbirth fear and technology was noted. Another search strategy was commenced using the search terms: fear of childbirth; technology acceptance in childbirth. The result was 52 articles. The same exclusion criteria applied to these articles. Figure 2.1 below illustrates the findings of the search.

FIGURE 1 - PRISMA DIAGRAM



2.3 Analysis of the Literature

Articles retrieved that met the search criteria were critiqued before inclusion. In determining how best to appraise the trustworthiness and relevance of the articles retrieved, The Critical Appraisals Skills Programme (CASP) was utilised. The CASP tools are user friendly for the novice researcher (CASP-UK, 2019) and endorsed by Cochrane and The World Health Organisation (WHO) for use in the qualitative analysis (Burls, 2014; Long et al., 2020). The CASP tools comprise between 10 and 12 questions, each with a focus on different methodological aspects of quantitative and qualitative studies, enabling the researcher to consider whether the research methods used in each study are appropriate and provide meaningful insight (Burls, 2014; Long et al., 2020). For the purpose of this study, multiple CASP Checklist tools were used, including those for qualitative research, randomised controlled trials, systematic reviews, case control and case studies (CASP-UK, 2019).

The CASP checklists, analysed the studies for strengths, weaknesses, and relevance to the research question (Appendix A and B). All 20 studies included in the review were assessed for rigour, which was found to be acceptable to excellent. The most notable limitations of the quantitative literature included reduced generalisability. A total of 20 articles are included in this review and are presented in Appendix A and B. The literature is presented in two tables and arranged according to method (qualitative and quantitative) and then alphabetised. Appendix A summarises qualitative articles and quantitative articles are presented in Appendix B. This arrangement assisted with assessment and analysis of the articles.

2.4 Themes

Several themes emerged when searching for enablers and barriers to technology acceptance in the literature. Increasing use of technology, medicalisation of birth, increased perception of risk and fear of birth were identified as potential enablers to technology acceptance for both clinicians and consumers. Barriers identified included the protection of physiological birth by midwives, and the desire for a natural birth by some mothers. Both women and midwives who viewed birth as a physiological process, preferred to avoid technology in the birth space. These themes, in relation to the literature will be explored below.

2.4.1 Enablers

2.4.1.1 Increasing Technology

The views of professionals regarding the potential development of a device to provide long-term assessment of the fetus was examined by Brown, Johnstone, and Heazell (2016). This study examined professional's views on longer term foetal monitoring via an online survey. It demonstrated strong internal validity and consistency and identified the acceptance of a potential device capable of long-term monitoring, by obstetricians and midwives. Due to limited literature addressing the views of professionals on increasing technology, this was the only article discovered and highlights a current gap in the literature.

The feasibility of new technologies was better represented with four studies identified (Arya et al., 2015; Graatsma et al., 2009; Kamala et al., 2018; Stampalija et al., 2012). Three of the four compared foetal electrocardiographic (fECG) monitoring with industry standard CTG (Arya et al., 2015; Graatsma et al., 2009; Stampalija et al., 2012) and found them to be feasible for clinical use. Comparison of signal quality compared to CTG was undertaken. Maternal acceptability was not addressed in any study, nor were the views of midwives or obstetricians. A discussion of the implementation of the Moyo device, that continuously

monitors FHR, in Tanzania by Kamala et al. (2018) showed feasibility of the device and demonstrated improvements in foetal outcomes. Their study was limited by a lack of randomisation and the fact that only low risk women participated, reducing the generalisability of the results. Had the study been randomised and women of all risk included, the results may have differed.

Maternal acceptability of fECG was assessed in three studies (Kapaya et al., 2018; O'Brien et al., 2013; Schramm et al., 2018b) with different methods used by all researchers. Kapaya et al. (2018) used both a questionnaire and a focus group, the transcript of which was analysed using content analysis. O'Brien et al. (2013) used thematic analysis of their semi-structured individual interviews to examine the experiences with remote foetal monitoring. The study was limited by potential cognitive bias (a positive view of the experience due to happiness with the outcome), as the interviews took place after the birth of healthy babies. Schramm et al. (2018b), used questionnaires to access the acceptability of fECG and maternal attitude of remote monitoring. The quantitative nature of Schramm et al.'s study limits the significance of the results, a qualitative approach potentially better assessing the views of participants. All the studies mentioned identified high levels of maternal acceptability of the presenting technologies, with only one study identifying skin irritation as a barrier (Schramm et al., 2018b) and one identifying increased maternal anxiety (O'Brien et al., 2013).

Rivenes Lafontan et al. (2018) conducted a qualitative study using semi-structured individual interviews to explore the attitudes of Tanzanian women using continuous FHR monitoring using the Moyo device. Open ended questions were used about their impressions of the care they received and their comfort while wearing the device. Participants were interviewed whilst in hospital, limiting the potential validity of the study as the women may not have been truthful in their answers due to fear of repercussion. Further, findings are not

transferrable to as the sample size was small and demographically non-representative to an Australian population.

2.4.1.2 Medicalisation of Childbirth and Increased Risk Perception

Benyamini et al. (2017) examined the attitude of women to the medicalisation of childbirth, and its associations with planned and actual modes of birth. This longitudinal observational study had limited external validity as the participants were not representative of an ethnically diverse population. However, assessment of attitudes to the medicalisation of childbirth, planned birth choices and fear of birth via questionnaire showed high to very high internal validity. These findings indicate that women who showed favourable attitudes to technology were more likely to be defined as high-risk. Additionally, planned manner of birth was associated with attitudes to perceived risk, and this had an effect on actual mode of birth (determined by a phone call after the birth).

Knowledge of, and attitudes to, birth technology were examined in a study of 1318 pregnant women (Klein et al., 2011). Convenience sampling of women in the early antenatal period, via distribution of advertising material at a pathology laboratory, reduced selection bias. Surveys were completed by women attending either obstetricians, midwifery clinics or a family doctor for pregnancy care. Women attending obstetricians were more likely to express a perception of increased risk, as well as an acceptability of technology for birth than any other group. Women attending the family physician were more likely to answer, “I don’t know” to questions regarding the necessity of technology in birth, whereas women attending a midwifery clinic expressed less favourable attitudes to medical intervention. Regardless of the care they attended, all women expressed an uncertainty of the benefits of technology in labour, yet the women attending obstetricians were more likely to be accepting of medicalisation.

High levels of childbirth fear, and an associated acceptance of medical technology, was observed by Stoll et al. (2015), who examined fear of childbirth and preference for caesarean section among young American women. This online survey (SS 254) examined the birth preferences of young childless women attending university in America and found that high levels of childbirth fear were associated with preference for caesarean birth. Supporting these findings is a quantitative cross-sectional online study conducted with Western Australian university students (Hauck et al., 2016). Due to the nature of participants as university students in all studies, these studies are limited by reduced external validity as they are not representative of all prospective parents. Despite the lack of validity, the survey instruments in these studies displayed good convergent validity and established that positive attitudes to interventions were associated with greater childbirth fear, increased perception of birth as being high risk, less confidence in the birth process and a belief that technology makes childbirth easier.

Stoll et al. (2019) subsequently collected data via an online survey (SS 752) distributed to university students, of both sexes, in eight countries, attempted to examine attitudes to childbirth technologies and interventions. All participants were childless but planned to have children in the future. Participants were overwhelmingly accepting of technology, with men more likely to value interventions than women. Attitudes in this study did vary across the countries represented, however, participants from countries with high intervention rates did not necessarily have correlating attitudes to the use of technology. In all groups, a high perception of pregnancy and birth as risky, or increased reporting of childbirth fear, was associated with greater acceptability of technology and intervention in labour and birth. Interestingly, in the category of caesarean birth without medical necessity, a strong predictor of technology acceptance, was the belief in a woman's right to choose her mode of birth (Hauck et al., 2016; Stoll et al., 2019; Stoll et al., 2015).

Attitudes to technology were also linked to the rate of technology use in labour in a study of 50 low-risk women in Canada (Kornelsen, 2005). This study was included as it is a foundational work on the attitudes towards intrapartum technology. In this study half the women planned to have home births and the other, hospital births. This exploratory qualitative study found that the total number of interventions experienced by women in labour was linked to their acceptability of medical technology, which demonstrated flexibility on the part of the hospital group. Conversely, resistance to technology was shown in the homebirth group. Interestingly, the homebirth group did not outright reject technology, but made conscious decisions based on the appropriate use of technology instead- for example, consenting to intermittent foetal monitoring. All interviews were conducted with rigour, however, results are potentially limited by cognitive biases due to the notion of a negative experience being mitigated by a good outcome, when discussing childbirth. This is also noted by O'Brien et al. (2013) in their study as previously discussed.

The perspectives on the use of technology and subsequent medicalisation of childbirth were explored in two qualitative and phenomenological studies (Healy et al., 2017; Prosen & Krajnc, 2019). Both studies used semi-structured and in-depth interviews, both studies examining the perspectives of professionals on the medicalisation of childbirth. Healy et al. (2017) explored the perception of risk on care practices by midwives and obstetricians for low-risk women and concluded that many of these professionals perceive that woman are increasingly viewing pregnancy and childbirth through a “risk lens”. This view leads women themselves to expect pregnancy and birth to have a high degree of medical input. The domination of obstetric services in western pregnancies was seen by both obstetricians and midwives to be a factor in this attitude (Healy et al., 2017). The participants also conceded that fear of litigation was a strong motivator in the acceptance of technology use in the care of low-risk women. These results were reflected in the conclusions drawn by Prosen and Krajnc

(2019) who found that the biomedical model, where pregnancy and childbirth are compared to illness, justify the use of medical intervention.

An examination on the views of Australian midwives regarding the use of ultrasound by Edvardsson et al. (2015) highlighted that ultrasound could potentiate improved pregnancy outcomes and increase bonding with the fetus, however it was also seen as a leading contributor to the increasing medicalisation of pregnancy and led to complex decision-making dilemmas for parents. The midwives also felt that although the use of ultrasound was instrumental in confirming clinical findings, it's use was becoming increasingly considered superior and more trustworthy than clinical skills, particularly when assessing estimated fetal weight, which was linked to increased pregnancy intervention like induction of labour. The midwives conceded that a difficulty with ultrasound was that it was considered by women and clinicians as an accepted and normalised examination, one that was highly valued by prospective parents, who may not fully comprehend the potential implications it might lead to (Edvardsson et al., 2015).

Increased acceptance of everyday technology has resulted in the general acceptability of technology in childbirth and may also mean that women are more likely to demand it. Healy et al. (2017) found that the midwives and obstetricians who participated in their study believed that many women view childbirth as a medical experience, expecting to have high medical input, and that the organisation of hospitals, and their various models of care compound this. This study found that the expectation of medical technology use, and the perception that it improves care, are enablers to maternal and professional acceptance of an innovative technology in a maternity setting. However, with every enabler there will also be barriers to the acceptance and use of technology in the maternity care setting.

2.4.2 Barriers

Literature to support barriers to the acceptance of a new technology in maternity care focuses mainly on the support of normal birth. It should be noted that supporters of normal birth do not necessarily reject technological innovation, especially in high-risk women (Kornelsen, 2005). Studies supporting normal birth were plentiful, but those with any specific mention of technology use were not. The experience and perspective of midwives supporting and facilitating normal birth that identified the acceptance of a new technology as a barrier, were addressed in Carolan-Olah et al. (2015) and Aune et al. (2017).

Aune et al. (2017) conducted in-depth interviews with nine midwives, working in a home birth setting in Norway, to explore the ways midwives promote normal birth. Their qualitative and phenomenological approach with a small sample size (SS 9) is limited by a lack of transferability. The views of home birth midwives may not be applicable to all midwives, however, the participants noted that the building of a trusting relationship with women and the safe environment of home, were facilitators to the process of normal birth. This was also previously identified by Carolan-Olah et al. (2015).

Carolan-Olah et al. (2015) state that the homebirth environment is completely at odds with a hospital environment, where the medical model is dominant. The midwives identified allowing labour to progress naturally and possessing an ability to listen to the instincts of the mother – as facilitators of normal birth, was contrary to the highly medicalised environment of a hospital. Carolan-Olah et al. (2015) conducted a qualitative study using an interpretative phenomenological approach, where experienced midwives (SS 22) working in Australian hospitals participated in in-depth interviews. Their perceptions of what facilitated or impeded normal birth were examined. The data was analysed with rigor, and the findings showed high external validity indicating good transferability to the Australian context. The results of the

analysis were in support of Aune et al. (2017) with regard to facilitators of normal birth being a supportive environment, and a perception from mothers and midwives of birth as a natural process. Barriers to normal birth, and enablers to the acceptance of technology, were identified as: increased perception of birth as risky by mothers and policy makers; creating an environment of fear of litigation; and a lack of confidence in birth, resulting in subsequent increased fear and decreased support for the process of normal birth. These findings are reflective of those in articles previously reviewed above.

More recently, Fox et al. (2021) conducted a survey of midwives in Australian (SS 187) and New Zealand (SS 21) hospitals on the use of continuous foetal monitoring technology that enables freedom of movement during labour and birth for women with complex pregnancies. This study identified both barriers and enablers to the acceptance of new technology by midwives that correlate to the previous literature in this chapter. The authors identified that the use of wireless technology was preferred and supported by midwives to traditional wired options that reduce mobility and contribute to maternal discomfort. An interesting observation was that the midwives anticipated that technological advances would result in an improved product that would reduce the need for constant device repositioning and provide better monitoring ability in women with varied bodily habitus. Barriers to their use was more related to institutional lack of resources rather than clinician preference.

2.5 Discussion and summary

The use of a scoping review provided an in-depth literature search to support the research topic, *Enablers and Barriers to Midwives' Acceptance of Technology in a Maternity care*, identifying several themes. An environment of increased medicalisation, and subsequent increased perception of birth as risky, had an effect on the acceptability of technology use in professionals, mothers and future parents (Benyamini et al., 2017; Carolan-Olah et al., 2015;

Healy et al., 2017; Prosen & Krajnc, 2019). Increased levels of childbirth fear made mothers and future mothers more accepting, and often demanding, of childbirth technology as well as more vulnerable to intervention (Hauck et al., 2016; Stoll et al., 2019; Stoll et al., 2015). Fear of litigation was a factor for professional acceptance and use of technology, even in low-risk women, as was an increasingly medicalised environment (Healy et al., 2017). Women who actively seek to limit technology in childbirth acknowledged that technology was essential for high-risk women and agreed that judicious use of obstetric intervention was necessary (Aune et al., 2017). The feasibility of continuous long term, remote monitoring was proven, and maternal acceptability was assessed (Brown et al., 2016; O'Brien et al., 2013). Newer technologies, like fECG, were seen by midwives as less invasive and impactful on physiological birth, enabling midwives keep women at the centre of their care (Fox et al., 2022).

Although the technology researched was scientifically validated, the acceptability of the technology by professionals was not examined. There was an identified gap in the literature with this regard. Literature assessing maternal acceptance of technological innovations lacked generalisability. Successful clinical implementation of any technological innovation into a maternity setting will only occur if careful consideration is given to both maternal and professional acceptability. The research question *Enablers and Barriers to midwives' acceptance of technology in maternity carte* aims to address this gap in the literature. By conducting in-depth interviews with the key stake holders, midwives, who have exposure to various maternity care environments and considering their lived experience of using the technology available, enablers and barriers to their acceptability may be identified. The result of identifying factors that will either impede or facilitate the acceptance of new innovations in technology, will mean further consideration of the device utilisation, the end goal being the development of a technology that is not only clinically feasible but is also acceptable to all

users. The identification of the enablers and barriers to the acceptability of technology is essential if its eventual adoption into policy is to be a consideration. This is important as the goal of all technological innovation in health care is not only proving its scientific validity and feasibility, but crucially, its eventual adoption into policy to ensure it has the opportunity to improve outcomes.

Chapter 3 - Methodology

3.1 Methods

The paradigm, methodology and method chosen to examine a research question impact on the quality of data obtained and therefore, may play a role in whether the findings are incorporated into practice (Dew, 2007). The establishment of rigour in research is important to ensure legitimacy of findings (de Witt & Ploeg, 2006). The following chapter details the choice of paradigm, methodology and method chosen for this research, and a discussion of methods to ensure rigour for the chosen methodology follows.

3.2 Paradigm

This study did not aim to test any treatment modality or to quantify variables but, instead to understand the feelings and experiences of midwives, making it suited to a qualitative methodology (Moser & Korstjens, 2017). Qualitative research aims to examine the multifaceted aspects of the human experience and does not utilise statistical methods of analysis (Ingham-Broomfield, 2015). A constructivist inquiry paradigm, the understanding of the individual in their natural context (Moser & Korstjens, 2017; Polit & Beck, 2017) - in this case the midwives and the model of care they work in and appreciating the multiple interpretations of their reality - is central to the research question.

3.3 Methodology

There are many qualitative research traditions, and as with all research, resources, time and researcher experience are factors that may influence what tradition is chosen (Moser & Korstjens, 2017). In designing this study, an examination of qualitative research traditions revealed that potential suitable methodologies included: ethnography, grounded theory, and phenomenology.

Ethnography is a methodology where the focus is on the culture of a group of people, or individuals in the group (Ingham-Broomfield, 2015; Polit & Beck, 2017). The researcher becomes immersed in the group being studied, enabling the observation of the group and an understanding of their world view (Korstjens & Moser, 2017). With respect to the current study, the researcher would ideally have become immersed in the culture of more than one midwifery model of care to observe differences in place of practice. This methodology was excluded for this study due to the advent of the Covid -19 pandemic and the subsequent minimisation of non-essential personnel present in hospitals.

Grounded theory has the aim of developing theories using methods like observation, interviews and field notes (Ingham-Broomfield, 2015). In trying to understand the actions of the participants being studied, grounded theory is an important research tradition for nursing, having contributed to many nursing theories (Polit & Beck, 2017). In researching grounded theory as a methodology, it was noted that as a novice researcher with limited recourses, grounded theory may be problematic due to its complexity (Munhall, 2012; Polit & Beck, 2017; Schneider et al., 2018) and Covid-19 restrictions. The midwives' perception of technology, its usefulness or otherwise, is of interest, and it is this perception that is important. As a result, the research question is fitting of a phenomenological approach (Munhall, 2012). Phenomenology seeks to comprehend, define, and explain behaviour and the individual's understanding of their experiences (Richardson-Tench et al., 2018; Thomson et al., 2012). Phenomenology allows the researcher to engage the participant hoping to expose and understand their experience (Miles et al., 2015), allowing for a richer understanding of the subjects' perspective (Thomson et al., 2012). Further, this research project utilized interpretive phenomenology as the methodology, as the research question "What are the enablers and barriers to midwives' acceptance of technology in maternity care?", asks for meaning of a phenomenon (acceptance of technology) to understand the experience of the midwives (Crist

& Tanner, 2003; Starks & Brown Trinidad, 2007). Interpretive phenomenology involves the close examination of an individual's experience, how they make sense of that experience, and how important it is to them, as well as how they construct meaning to the experience (Charlick et al., 2016; Schneider et al., 2018).

3.4 Data saturation

Phenomenological studies often have very small sample sizes- approximately 10 participants (Charlick et.al., 2016; Polit & Beck, 2017; Schneider & Whitehead, 2016). Boddy (2016) explores the issue of sample size in phenomenological research and discusses the idea of a pre-determined sample size being at odds with the concept of information power (Braun & Clarke, 2021). Data saturation is seen to have been achieved when no new information is extracted from the data (Moser & Korstjens, 2017). The concept of data saturation may therefore influence sample size (Polit & Beck, 2017). In the case in point, the total number of participants was 11.

3.5 Setting

A phenomenological study demands that the setting where sampling is to be undertaken is described in detail to enable the reader to determine transferability (Moser & Korstjens, 2017). Initially, the setting for this study was determined to be a large tertiary hospital based in Sydney, NSW, Australia. The hospital has approximately 5000 births per year (NSW Ministry of Health, 2021) and services a large metropolitan population. This setting was chosen due to the diversity in models of care and options for a variety of scope of midwifery practice, including home birth, birth centre, birth suite and operating theatres. Unfortunately, the Covid-19 pandemic meant that recruiting from a physical site became impossible and non-essential personnel were no longer permitted at the hospital. Many research projects have been impacted

by the pandemic, and for studies to be able to be carried out, recruitment methods had to be rethought.

With physical recruitment no longer possible, the author created an advertisement for the study that sought participation from midwives and was shared via social media on Facebook, Instagram, and LinkedIn (Appendix C). The same advertisement was distributed nationally by The Australian College of Midwives (ACM) via an email to all members. The social media advertisement was shared widely on all three platforms allowing for a nationwide snowball effect, complemented by the ACM member wide email. The result was a participant pool drawn from a variety of settings, including rural, remote, and large tertiary institutions, as well as diverse models of practice and philosophies. For example, the philosophy of a midwife who chooses to practice in a home birth model of care may potentially differ from that of a delivery ward midwife or a midwife who works in bereavement care. Indeed, the changes imposed by Covid-19 has meant that participants were recruited from multiple settings, all with different perspectives and philosophies that underpin the acceptance of technology by the midwives who work within the different models of care. Multiple sites contributed to data source and contextual triangulation, which enhances trustworthiness, validity and reliability of the findings (Morse, 2015).

3.6 Sample

According to Korstjens and Moser (2017), the deliberate sampling of participants is key to a qualitative study. For this study, a purposive sampling strategy was, where participants that most benefited the study were chosen (Schneider & Whitehead, 2016). Purposive sampling has multiple strategies, but maximum variation sampling was chosen for this study. Maximum variation sampling involves the deliberate selection of participants who may have a variety of perspectives relevant to the topic of interest (Polit & Beck, 2017). Etikan et al.

(2016) further propose that the researcher chooses the participants based on their particular qualities, for example, workplace experience and place of employment, and their willingness to participate. This method of sampling is non-random and allows for the inclusion of participants who may have differing viewpoints of the phenomenon being studied (Moser & Korstjens, 2018).

The sample consists of midwives who responded to the advertisement, with participants drawn from each of the available models of care and birthing place options. According to Polit & Beck (2017), a guiding principle of phenomenology is that the participants selected must have experience of the phenomenon of interest and must be able to explain what it is like to have lived that experience. Inclusion criteria ensures that the sample of participants is homogenous – helping to uncover what the experience of the phenomena of interest means to the particular group (Crist & Tanner, 2003). Therefore, the inclusion and exclusion criteria are illustrated in Table 3.1 below.

Table 3. 1 – Participant Inclusion and Exclusion Criteria

Inclusion Criteria	**Exclusion Criteria**
Previous or current experience working with technology in maternity care. For example: use of electronic fetal monitoring. Currently working as a Registered Midwife Currently working in one of the following models of care: homebirth, birth centre,	No previous or current experience working with technology in maternity care. Not currently working as a Registered Midwife Not currently working in one of the following models of care: homebirth, birth centre, MGP, delivery suite.

MGP, delivery suite, privately practicing midwife Willing to sign and date a consent form	Not willing to sign and date a consent form

In table 3.1 above the participants characteristics are outlined. These factors guided the inclusion of the participants in this research. All participation was voluntary and consensual.

3.7 Data Collection

Interpretive phenomenology most commonly utilizes interviews, either in-depth or semi-structured, for data collection (Polit & Beck, 2017; Schneider & Whitehead, 2016). The interviews may be conducted face-to-face or over the telephone and are transcribed verbatim (Charlick et.al., 2016; Moser & Korstjens, 2017). Semi-structured interviews were conducted with participants via a secure on-line platform as a result of the Covid-19 pandemic requiring social distancing measures. The interviews were recorded and then transcribed for analysis by dedicated software 'Descript'. Semi-structured interviews allow for guidance in the issues that are to be covered, but also encourage the participant to include issues that may not have been identified by the researcher but that are important to their experiences (Dew, 2007). As the goal is to obtain rich data, the semi-structured interview allows for the inclusion of follow-up questions to facilitate this (Moser & Korstjens, 2017). As the aim is not to test a hypothesis, but to explore the participants perspectives (Ingham-Broomfield, 2015), the interview questions are presented in table 3.2.

3.8 Limitations of the methodology

Although phenomenology has been chosen as the methodological approach for this study, it is not without limitations. A criticism of phenomenology, and indeed all qualitative

research, is researcher bias (Johnston et al., 2016). A researcher's subjectivity has the possibility of impacting on the interpretation of the data, especially when the researcher may draw on their own experience of the phenomenon being studied (Cypress, 2017; Johnston et al., 2016). Bracketing, the process of recognising one's own beliefs about the phenomenon being studied and keeping it aside, is a common strategy to prevent contamination of the data (Polit & Beck, 2017). Interpretive phenomenology does not usually subscribe to the idea of bracketing, instead the researcher's assumptions and preconceptions are integrated into research findings (de Witt & Ploeg, 2006). The probability of the researcher clouding the interpretation of the data is proposed by Cypress (2017) as contributing to the scepticism of the scientific community to the validity of qualitative research. The researcher and author of this master's study has over 20 years' experience as a midwife which no doubt impacted the results of this study. In the spirit of interpretive phenomenology, the values and subjectivity of the researcher are acknowledged. (de Witt & Ploeg, 2006; Johnston et al., 2016). Table 3.2 below outlines interview questions asked to participants by the researcher.

TABLE 3.2 - INTERVIEW QUESTIONS

In your opinion, what constitutes technology in maternity care?
What would you consider optimal use of this technology?
Do you think that midwives and obstetricians have different feelings around the use of technology in maternity care? Why do you think this?
If research indicates that prospective parents often view technology as making birth easier and safer, where do the views of prospective parents sit in decisions around technology in your opinion?

What is your understanding of risk management?
Do you think your perceptions of risk management influence your use of technology? If so, in what way?
Who do you think benefits most from technological advances in maternity care? Why?
Technological advances are proposed to improve outcomes by potentially reducing stillbirth rates, however, increased fetal surveillance is linked to increased intervention, including caesarean section. What is your opinion in this regard?
If there were limitless resources to produce the ideal technology for use in maternity care, what would that look like to you?

3.9 Data Analysis

In phenomenological studies, data analysis most commonly occurs following data collection, with a focus on the entire data set (Schneider & Whitehead 2016). Thematic analysis was used in this study to identify themes that recurred in the transcribed interviews. Richardson-Tench et al. (2018) suggest that the aims and objectives of the study be at the forefront of the researcher's mind when examining the transcripts for emerging themes. Polit and Beck (2017) state that themes emerge from the data and may develop within categories of data, revealing commonalities and variations. The analysis of phenomenological studies may benefit from a team effort, where more than one researcher is used (Schneider & Whitehead, 2016). The data analysis of this study was undertaken by the author and the author's academic supervisors to increase the validity of the findings. The table 3.3 below illustrates the analytic phases as described by Braun and Clarke (2006) used in the analysis of the interviews.

TABLE 3.3 – ANALYTIC PHASES

Analytic Phase	**Description**
Familiarising with the data:	Data immersion phase. For the author, familiarity with the data began during the interviews which were followed by reviewing the interview footage while checking the transcript, which was generated using transcription software, for accuracy. The transcripts were then re-read. Analytic notes were taken after each interview and during the review of the transcripts.
Generating codes:	With the research question in mind, a detailed process of identifying and coding data began. This allowed for the capture of single ideas that would translate to themes.
Construction of themes:	In this phase the single ideas were examined to identify recurring patterns of meaning in the data that were related to the research question. These constructed themes were consistent across the interviews but might not be reflective of the most mentioned issues brought up during the discussions.
Revision of themes:	This phase was conducted by reviewing all the identified themes to ensure that they related to both the data and the research question. The transcripts were re-examined, along with the notes taken during the previous phases, to ensure that the themes were relevant to the research question and relevant to the data.
Defining and naming themes:	In this phase each theme was examined to ensure that it was a description that accurately reflected the interviews and provided a

	framework to describe the story of the data and that the name given to the theme was adequately descriptive.
Subjectivity and Reflexivity report:	This phase involved the writing of the narrative that connects the themes identified and relates them to the existing research. Following this phase further revisions were undertaken and the author's subjectivity and was assessed. Examining the interviews reflexively allowed the author to critically reflect on her own bias and assumptions. The nature of the semi-structured interviews guided the discussion while encouraging the participants to speak freely with minimal interruptions.

3.10 Rigour

Rigour, or the quality of being thorough, accurate and precise is an important aspect of research design Rigour in interpretive phenomenology is important for legitimacy of findings. However, it is at odds with the philosophy of multiple interpretations and lived experiences of participants and phenomenon being studied (de Witt & Ploeg, 2006). A long-standing criticism of qualitative inquiry in general is a perceived lack of scientific credibility (Sandelowski, 1986), especially when it is compared to quantitative research where a rigid design with prescribed methods produces results that are numerically representations of the findings (Cypress, 2017; Polit & Beck, 2017). A criterion to ensure rigour, or trustworthiness, in qualitative research was designed by Guba and Lincoln (Moore, 2015; Polit & Beck, 2017). Credibility, dependability, confirmability, and transferability are the four criteria that, although thoroughly debated, were selected as a guide to ensure the trustworthiness of this study.

In this study, credibility is achieved through the triangulation and prolonged engagement. Triangulation was achieved by data and investigator triangulation. Data

triangulation in the use of more than one site, and investigator triangulation in the use of more than one researcher for data analysis (Daniel, 2018). Credibility is also obtained as a result of prolonged engagement with participants occurring during the semi-structured interviews of 60-90 minutes, helping to build rapport between researcher and participants (Polit & Beck, 2017).

The concept of member checking, where the analysed data is shared with the participants of the study, is another method to gain credibility (Korstjens & Moser, 2017). However, there is considerable debate as to whether member checking is useful to the research process. Morse (2015) suggests that member checking may be problematic if the participant does not agree with the analysis, perhaps rendering the research useless. Sandelowski (1993) suggests that member checking may undermine the trustworthiness of a qualitative research project as the participants attempt to identify themselves in the analysis, not considering that multiple realities are present. Transferability implies that the findings may be transferred to another setting (Morse, 2015). In this study, the use of site triangulation facilitates the concept of transferability. The provision of rich description also allows the reader to determine if the findings are transferrable to another setting (Polit & Beck, 2017), and purposive participant selection and the inclusion of particular demographic characteristics (place of work, years of experience and age), enhance the notion of transferability (Daniel, 2018).

Dependability and confirmability, whereby the findings are reflective of the participants opinions and not biased by the interviewer, was achieved through the use of investigator triangulation (Polit & Beck, 2017) and the keeping of an audit trail, whereby all decisions, and pathways to decisions are documented, reflective notes were kept, as were notes taken during data analysis meetings (Korstjens & Moser, 2018).

The writing of the research report itself can be a method to ensure rigour or trustworthiness. This may be achieved by the inclusion of verbatim quotes from interviews

and the inclusion of the audit trail (Johnston et al., 2016) both of which have been included in this thesis.

3.11 Ethical considerations

Ethics for research project was sought and approved by the Flinders University Social and Behavioural Research Ethics Committee in South Australia (Project number HEL1926-3). This study was conducted according to The *National Statement on Ethical Conduct in Human Research (2007)* (National Statement (2007).

3.12 Summary

This chapter has described phenomenology as the chosen method for this study, utilising semi-structured interviews to collect data and thematic analysis to identify the emerging themes. The next chapter will discuss the results.

Chapter 4 – Results

4.1 Introduction

Phenomenological study aims to understand the lived experience of the participants and the perceptions this experience gives rise to (Norlyk & Harder, 2010). Spatiality, corporeality, temporality and relationality are the four aspects of lived experience that phenomenologists seek to understand by use of in-depth interviews with participants who have experienced the subject of interest (Polit & Beck, 2017). Beginning this chapter are the participant characteristics, which provide the relationality aspect of their lived experience. The themes identified in the interviews are presented next.

4.2 Participant characteristics

At the commencement of each semi-structured interview, participants were asked to provide the following demographic data:

- Age
- Practicing registrations (Registered Nurse, Registered Midwife, or both)
- Length of practice as a Registered Midwife
- Highest level of educational attainment
- Current place of practice (both model of care and geographic location)
- Length of employment in current practice setting

All 11 participants were registered as both registered nurses and midwives, two being hospital trained and nine having tertiary qualifications, including four with graduate diplomas and four with master's degrees. Most worked in birth suite (8) with one alternating between birth suite and a birth centre. One participant worked in a midwifery group practice and one in a community health capacity. Three participants also worked in an education role. Ten of the participants worked in public hospitals and one was employed by a private hospital. Three

participants worked in rural/remote settings and eight were employed in urban/teaching hospitals. All names are pseudonyms. Participant characteristics are outlined in table 4.1 below. Three participants worked in rural/remote settings and eight were employed in urban/teaching hospitals.

TABLE 4.1 - DEMOGRAPHIC CHARACTERISTICS

Age (years)	Mean 50.8	SD 8.67	Median 49	Range 36-61
Years as Midwife	Mean 21.9	SD 8.94	Median 20	Range 5-35
Time in current setting (years)	Mean 8.45	SD 8.18	Median 5	Range 1-30

4.3 Themes

The interviews revealed that the participants identified technology as anything that was an extension of their "eyes, ears and hands", and included methods of fetal surveillance, tests, and screening tools as well as electronic medical records. There was an acceptance that technology was developed with the intention of providing more certainty and reliability in the provision of maternity care and that the improvement of outcomes for mothers and babies was a core tenement of technological advances. There was general recognition that the many technological developments used in maternity care had led to decreased morbidity and mortality, however participants also felt that technology was overused in maternity care and had contributed to unrealistic expectations in health professionals and parents, interfering with

physiological birth even before labour began by contributing to increasing rates of induction of labour and caesarean sections.

The following themes were identified as enablers for the acceptance of technology:

(1) a risk adverse culture

(2) women's expectations

(3) a desire for medico-legal protection

(4) a desire for accurate protection of fetal wellbeing.

The following themes were identified as barriers to the acceptance of technology:

(1) loss of clinical skills

(2) poor specificity and overuse of the technology currently available

(3) reduced time spent with women while attending to technology.

4.4 Enablers

4.4.1 Risk averse culture

Participants not only described that they worked within a risk adverse culture at an institutional level, but that risk aversion had become part of the wider culture and included women and their families.

> *"I've actually heard obstetricians say, you know, like, oh, yes, we could wait another couple of days, but you know, that increases your risk of stillbirth…. It increases your risk of birth traumas. Can you live with that?"* ***Leanne***

There was an acknowledgment that the use of technology had become necessary for medico-legal protection, even though the currently used technology was frequently described as inaccurate.

> *"By using fear, and statistics and, and people think they understand statistics, but really, if doctors wanted to give proper statistics, they'd have to talk about what was it like in real life? You know, if you had a hundred women, how many of them would have a stillbirth.... you'd have to get a hundred or more women in before you'd have one person that you know, who had a stillbirth."* ***Belinda***

4.4.2 Increasing exposure to technology in society led to expectations of technology use in childbirth by women

The increasing use of technological advances in everyday activities was acknowledged by participants as having an influence on the expectation of technology use in maternity care by many women and junior practitioners. Participants believed that as more generations grow up with daily use of technology, they will continue to be at ease with its use and expect it to be part of their birth experiences.

> *"I think, I think people expect that there's going to be monitoring and technology and equipment. Even though, you know, the consensus is that pregnancy, labour and birth is, is not, uh, a sickness and it should be low intervention. And, and that there shouldn't be a lot of technology and monitoring, but I think they also accept that there will be."* ***Ella***

"I think generally the younger people that come through technology as part of their lives so they tend to embrace it more than the more sort of older, older generations." ***Fran***

"But you know, a lot of people are focusing on the machine [CTG] and I say that in labour too, the partner focuses on the machine, the woman focuses on the machine. What, what is it all about? The technology takes over the whole process and no one else sees this. They're just going about their business". ***Leanne***

4.4.3 A desire for medico-legal protection

A strong theme was that the use of technology, particularly CTG and electronic medical records, might afford a degree of medico-legal protection, both for themselves and for doctors. Adherence to policies and procedures around technology use, particularly for CTG, was seen as providing legal protection, even if it was in contradiction to the woman's wishes and in violation of her bodily autonomy.

"*So, I think that's what drives us with technology. We get that reassurance that we're, um, we're doing everything we possibly can and that's our job to keep that mother and baby safe. Um, so it's that fine line of, of respecting parents' wishes of their birth experience. Um, and I get, and I get that that's, that's even more so now…. you know, that is what I want to give to people, but it is that fine balance of keeping them safe and keeping me safe and out of the court."* ***Fran***

"Um, and going back to, I don't care if somebody is not monitored and I'm covered, but there's so many loopholes that lawyers can find that we are constant, we are quite fearful as birth suite midwives, working in a high- risk unit when a couple like that,

come in and say, I don't want to be monitored. And you're like, well, you had a stillbirth before, or you got preeclampsia or like these aren't just little risk factors. These are big risk factors. And they're saying to you, well, that's, that's our choice and it is their choice, but there's always that background fear as the birth suite, midwives that in court, that's just not going to stand up." ***Ella***

4.4.4 A desire for accurate prediction of fetal wellbeing

Although implicitly trusting in the birth process, but in acknowledgment of the culture of fear and risk in childbirth, the participants expressed a desire for the development of technology that did not interfere in physiological labour and was able to accurately predict fetal wellbeing while reducing fear in both women and practitioners.

"I want a monitor that's not those big things. I want a little patch that you put on a woman's tummy that is going to pick up her heart rate, her body temperature, her baby's heart rate and the tightening's, while she is in labour. So, she doesn't have to be encumbered by all this stuff and she can shower and the water's not going to affect the reading and she can get into the bath and the water's not going to affect the reading. She can be standing on her head, if she wants to, and it's not going to affect the reading". ***Jane***

"I think if something that could, could more accurately look at what they fetal heart and what the baby was really up to. So whether or not there was some way of knowing what the blood gases were, rather than as just jumping on this age old technology of a CTG." ***Fran***

"I don't know what it would be, but I guess looking at why some women can have babies normally and other women take three hours to push the baby out and ended up being a forceps delivery. That's the biggest thing, isn't it? They get stuck at fully [fully dilated

– end of second stage labour] and then they can't push the baby out. And then I get fetal distress and then they either have a caesarean or a forceps delivery. That would be, I think the most beneficial thing, but I don't know how you'd do that." **Belinda**

4.5 Barriers

4.5.1 Loss of clinical skills

The data revealed a considerable emphasis on concern from participants about loss of clinical skills and judgment. Participants overwhelmingly identified that reliance on technology was contributing to a loss of clinical skills and judgement ability in both midwives and doctors.

That equipment is for when there's something not going so well, you can take them to a room where they'll get that done, not be in the room for every single person, that person who's doing it, their whole skill, ability and everything is going down the tube. ***Leanne***

There was concern that this over-reliance was also contributing to a lack of collegial respect between doctors and midwives, as doctors increasingly preferred quantifiable data generated from machines over the clinical judgement of midwives.

And they don't trust our knowledge and our, and our skills, a lot, a lot of people, but it's like, and they're nervous, they're new obstetricians and they're nervous. So, they're like, oh, I can't let this go on or intervene too early or intervene too late, you know? I know we have to learn, but I don't think, you know, you're on about technology, but you, you shouldn't be bringing in people that don't have enough training to do the job either. ***Cath***

There was acknowledgment of the increased pressure on doctors who were responsible for the "management of the board" (Belinda), but also the observation that there seemed to be less management of the woman as a whole person rather than just data from a machine.

> *I think you need to look at it from what does this woman need. What is best for her? Um, individualizing her care is greater risk management than using a new piece of technology. Um, because she will feel more satisfied. She will feel listened to. Those are the biggest things that we miss in modern, um, obstetrics and, you know, in, in the health maternity health system that exists right now, the biggest things that we do miss is trust with the woman and the continuity that builds the trust.* ***Olivia***

The interviews revealed that this was compounded by the introduction of central monitoring systems. Previously CTG technology required observation from the bedside whereas central monitoring allows the data to be reviewed from the midwives' station. The introduction of central monitoring had led to an increased incidence of other staff, most commonly doctors, observing the data in isolation of the woman's labour progress resulting in an incorrect assumption of fetal distress and subsequent interference in the birth process for that woman. Interpretation of fetal distress by clinicians transiently involved in the woman's care on observation of heart rate decelerations during fetal head compression are problematic for both midwives and women in labour.

> *One is that there was scrutiny without context. So, there are people sitting at the desk, the residents, registrars, and this person in charge sitting there going, Oh, I don't like the look of that, but they don't actually know what was happening with the woman or at her stage of labour or anything to do with the actions that were occurring in the room.*
>
> *And also, that it disempowered the clinical midwife who was looking after the woman because people were coming in. Um, unsolicited at times to give their opinion on what*

they could see at the desk. Um, and so there's those constant intrusion based on the technology, which was being broadcast, as I said, without context. ***Cath***

4.5.2 Poor specificity and overuse of the technology currently available

The participants expressed that there was an increasing overuse and over-reliance on the currently available technology, which was seen to be unreliable and contributing to increased birth interventions and a resulting decline in physiological birth.

It's a difficult one. It's difficult because there's not a real sort of solution, uh, you know, again, it depends. On the individual, the individuals 36 weeks scan, what we're finding from that, you know, they are finding a lot of reasons to induce women. I think we are getting to a point within the next five years where, you know, the ah, induction rate will be up to about 80%. ***Fran***

Overuse and over reliance on CTG and late term ultrasounds were identified by the participants as most frustrating, yet there was recognition that neither technology had an acceptable replacement.

When we monitor babies, there are some that have traces and come out, boom, awesome, perfect. And then others that are perfect [the CTG] and baby will come out flat and you're like, that's just great. ***Olivia***

And if you've got something that's sort of saying to you, there's an issue here. It doesn't come down to technology at that point, it comes down to you being aware of what's going on. We've had a lot of people come through that their babies are small, and they've been small for weeks and they end up having an issue in delivery ward in labour, when it should have been something that maybe could have been picked up earlier. Um, you know, we've had stillbirths that have come through that have a day before had an

ultrasound. So it, it, it's not a cure all, it's certainly not something that is going to fix stillbirths that still has to be a conversation with the parents. ***Jane***

4.5.3 Time interacting with the technology reduced time spent "with woman"

Participants identified that not only was CTG increasingly deemed necessary for nearly all women regardless of their risk status, but that ensuring maternal comfort and data accuracy from the machine was time consuming and often resulted in restricted maternal movement. Adding to this, the introduction of electronic record keeping, rather than traditional paperwork, meant that their attention was more frequently on the technology than the labouring woman.

I don't think doing a lot of stuff on the computer benefits women. I think it takes all your attention away from them onto the computer…. even when they're pushing, and you write your fetal hearts down every five minutes. And I think all of that sort of stuff takes the focus away from the woman…The focus should be on the woman, and they should feel that you're with them rather than doing all your paperwork. Even after the baby is born you are like on the computer doing all this stuff…. you know like…Oh yeah….. Just like quick little help with the breastfeeding, back to the computer. It's not that I think that all that benefits is, you know, your records. Susan

4.6 Summary

The midwives were able to identify both enablers and barriers to the acceptance of technology in their care of women, with enablers being slightly in the majority. The next chapter will discuss these results in more detail, outlining where the themes are supported by the literature.

Chapter 5 – Discussion

5.1 Introduction

During the interviews presented in the previous chapter, both enablers and barriers to technology acceptance by midwives were identified. This chapter will discuss these themes further in relation to the current literature.

5.2 Enablers to the acceptance of new technology by midwives

5.2.1 Risk adverse culture

The first theme to emerge as an enabler to the acceptance of new technology by midwives was the concept of a risk adverse culture, both in society and within their institutions. The most authoritative practice paradigm in most western countries is based on the belief that research, when conducted with rigor and enough participants to ensure generalisability, can reasonably identify the benefit or danger of a specific element of health, bringing a degree of certainty to practice. It is interesting to note that from its inception, evidence based health care was described as good quality data combined with practitioner experience and skill interlaced with patient's beliefs, knowledge and values (Sackett et al., 1996). This implies that best practice involves a consideration of the evidence as applied to the individual. The demand for certainty, especially in maternity care, has over-ridden this concept, creating instead health systems that do not assess the individual needs of their users and often impose restrictions based on risk management strategies that impact the experience of many as a result of the experience of few. This has led to the development of policies and protocols that contribute to an intervention cycle that, according to Reed (2021), becomes embedded into practice in an attempt to avoid complications, but in reality, causing potential problems that need to be managed. This reinforces the technocratic paradigm that women need medicine to birth (Newnham et al., 2017). This further contributes to the culture of fear and risk that pervades

maternity care and the search for certainty that leads to the development of technological advances.

5.2.2 Increasing exposure to technology in society led to expectations of technology use in childbirth by women

The acceptance of technology in everyday life was noted as an enabler of technology use by midwives in this study. The use of mobile phone apps and internet sites to source pregnancy information and the rise of telehealth during the Covid-19 pandemic (Almuslim & AlDossary, 2022; Townsend et al., 2021) has brought the use of technology to the fore in healthcare and healthcare education (Wedler, 2015). Many pregnant women are open to the use of technology, especially during the antenatal period (Lee & Cho, 2019). The use of technology in childbirth is expected by many women and their partners and welcomed by some but not all. The role of the midwife is to ensure that the risks and benefits of using the technology, or not using it, are made clear to the woman before such technologies are utilised (Sinclair, 2011). A survey of childless university students by Stoll et al. (2019) revealed that young women expect and welcome the use of technology in childbirth and view it as making birth easier. Overwhelmingly, media representations of labour and birth often depict women in medicalised environments reliant on technology to save them from the dangers of birth (Hundley et al., 2019; van Teijlingen, 2019; Vitek & Ward, 2019), contributing to the expectation of technology use in birth (Smith, 2021b).

5.2.3 Desire for medico-legal protection

The conversation of risk continued into the next theme; the risk of medico-legal implications. Technology, mainly CTG, was identified by the participants as potentially providing some legal protection for both midwives and doctors if neonatal outcomes were not favourable following a CTG which was reassuring.

The CTG, despite considerable debate over its specificity, sensitivity, and continuous contention internationally over FHR pattern classification, remains a tool of evidence in many obstetrical lawsuits (Sartwelle et al., 2016; Schifrin et al., 2016). This concept of the CTG as being able to prove what had occurred during a birth, or providing confirmation of a live fetus, are replicated by Jepsen et al. (2022) who examined the overuse of CTG in low risk women by midwives to mitigate potential litigation. Like any other maternity care provider, midwives provide care in systems where medico-legal and medico-ethical tensions exist (Deshpande & Oxford, 2012). Midwives must be able to manage the paternalistic and technocratic demands of the health care system with the right to self-determination of women they care for (Edwards et al., 2011). In the current medicalised culture of childbirth in Australia the needs of the institution in the shape of policies and protocols, has evolved into rules that if broken must be defended in court, regardless of the woman's position (Begley et al., 2021; Downe, 2010). Midwives may find themselves in a tenuous position of wanting to be with woman, enabling her to have the birth experience she desires, and practicing defensively to protect themselves.

5.2.4 A desire for accurate prediction of fetal wellbeing

All participants expressed a desire for reliable, accurate and safe technology which can provide the certainty demanded by women and society, while improving outcomes for women and babies. Whilst all participants were advocates of physiological birth and were fearful of the impact of rising intervention rates, they were accepting of the need for improved fetal surveillance for women with high-risk pregnancies. There was also a desire to replace the current technology that was seen as problematic. According to Bichel-Findlay (2021), midwives must embrace technology to improve patient care, but also this technology must be proven to be reliable.

5.3 Barriers to technology acceptance by midwives.

5.3.1 Reduced clinical skills

Most of the midwives participating in this study expressed concern that increasing use of technology, including CTG and ultrasounds were contributing to a lack of clinical skills in new practitioners – both midwives and doctors, and a loss of skills through underutilisation in more senior practitioners. Although neither of these technologies are new advances, their use has increased considerably in the last 10 years, and this has significant implications for clinicians (Jepsen et al., 2022; Small et al., 2021b; Williams et al., 2018).

With regard to ultrasound, over the last 30 years the number of routine ultrasounds offered to, and accepted by, pregnant women has dramatically increased from an average of one scan, a minimum of four scans during a normal healthy pregnancy (Westerneng et al., 2019). This is despite there being no known demonstrable benefit to late term surveillance ultrasound in women without clinical indication (Smith, 2021a). There is considerable current concern from midwives, and some women, at the increase in ultrasound use during pregnancy (Moncrieff et al., 2021), including increased rates of intervention for incorrectly labelling babies "too big or too small" (Baddington, 2021). Abdominal palpation to assess fetal size and position is a skill that was seen by the midwife participants to be at risk as technology was replacing these fundamental skills. As technology use increases, mistrust in these non-technological assessment skills is compounded and contributes to technology reliance (Keable & Crozier, 2018). Edvardsson et al. (2015) had earlier examined the attitude of midwives in Australia to the use of obstetric ultrasound and found that increased reliance on this technology reduced clinical skills and increased the medicalisation of birth. Their results are mirrored in this study.

The adoption of CTG into practice occurred without clinical trials, as the auscultation of the fetal heart and identification of contraction presence were not new concepts, they were merely automated by the machine (Sartwelle et al., 2015). The evolution of this technology into prominence was paradoxically supported by the growth of bioethics that demanded informed consent, patient autonomy and nonmaleficence, none of which is a characteristic of CTG usage (Sartwelle et al., 2019) in that consent is often not sought and the repercussions of the output and the reliability of said not discussed. As previously discussed, the use of CTG without clinical indication is not associated with improved perinatal outcomes but with increased intervention (Alfirevic et al., 2017). Aside from having no benefit for most women, the traditional CTG reduces maternal mobility in labour and restricts pain relief options (Gibson, 2021). Wireless CTG, that improves maternal mobility in labour, has somewhat improved the experience of intrapartum monitoring for some women, however, Fox et al. (2021) state that although embraced by midwives, access to this technology for most women remains poor due to lack of availability. A concern that technology use in maternity care is eroding clinical skills and midwifery knowledge, with midwives preferring the use of a Pinards stethoscope over a CTG in many aspects of midwifery care, was a theme identified in recent research by (Engelhart et al., 2022).

The introduction of central monitoring, where multiple CTG readings can be seen from a central area by multiple people (as opposed to being in the birth space) has created even more concerns for midwives, as raised by the participants in the current study. Participants noted that the introduction of central monitoring had led to interruptions and disruptive entry to the birthing space by colleagues, both midwifery and medical staff, who have viewed a trace without an understanding of the clinical context. This is supported by research undertaken by (Small et al., 2021a), who noted that these interruptions contributed to midwives experiencing reduced confidence in their ability to care for women as their judgement was constantly being

undermined. The public display of the CTG trace reduces midwifery autonomy and confidence in their practice, increasing collegial discord in many situations (Brydges et al., 2021; Small et al., 2022). It is also interesting to note that many institutions have integrated central monitoring without a single clinical trial to support its benefit (Small et al., 2020).

5.3.2 Poor specificity and overuse of the technology currently available

Although benefit is shown only in high-risk women, the use of multiple ultrasounds and CTG during labour have become common in women with low or negligible risk (Al Wattar et al., 2021). Late term ultrasounds are often used to determine fetal size, however, their specificity is poor (Baddington, 2021; Caradeux et al., 2019). There is some evidence that a last trimester scan may assist with the detection of fetal abnormality, however, it can also increase maternal anxiety unnecessarily (Åhman et al., 2019; Edvardsson et al., 2015). The implication of this technology is that women are often told their baby is "wrongly sized" for safe birth or might have an abnormality that possibly requires intervention like induction of labour or caesarean section and is supported by Smith (2021a) who reports no real benefit to either mother or baby of late pregnancy ultrasound in low-risk pregnancies. The participants in this study identified that women are increasingly being labelled high risk, exposing them to more intervention (Brown et al., 2016; Reed, 2021). Even when not required by hospital policy, there is a growing trend for some midwives to preference CTG in their care of low-risk women. According to research conducted by (Jepsen et al., 2022) some midwives will rely on CTG as a "babysitter" to allow them to attend to other patients. The concept of the CTG machine being used to monitor women without a midwife in attendance is disturbing but observed by researchers in both the developed and developing worlds with research in Namibia, showing similar results (Uusiku et al., 2022) to research conducted in the UK (Jepsen et al., 2022).

5.3.3 Time interacting with the technology reduced time spent "with woman"

Midwifery skills encompass woman centred care across pregnancy, labour and birth and the postnatal period. These holistic skills put women at front of mind, considering her physical, psychological, social and emotional needs as part of her care. Time spent with women is the cornerstone of midwifery care. The final barrier to the acceptance of new technology by midwives in this study was that interacting with the technology was time consuming and took away from the time spent providing direct care to women. The participants felt that interacting with the technology detracted time spent in direct care from women but also affected their ability to use their observational skills combined with clinical knowledge to assess labour progress, a skill fundamental to midwifery practice. This was supported by research conducted with midwives examining decision making during birth in the Netherlands (Weltens et al., 2019).

Midwives spend much time repositioning a wired CTG, especially if a woman wishes to remain mobile throughout her labour (Fox et al., 2021). According to Uusiku et al. (2022) midwives spend up to two hours a shift adjusting the CTG to ensure auscultation of the fetal heart. A recent comparison of wired CTG with a new wireless device found that midwives preferred the new technology as it reduced time interacting with the device, increasing time with women (Fox et al., 2022). Unfortunately, this technology is not widely implemented. The use of technology detracting from time spent directly in the care of women was identified as a reason Norwegian midwives preferred the use of a Pinards Stethoscope over CTG, as the pinards helped midwives remain attuned to the woman and facilitated a sense of calm while assessing the fetal heart (Engelhart et al., 2022). Central monitoring did not improve time spent with women, in fact, according to Brown et al. (2016), the use of central monitoring decreased midwives time in direct midwifery practice.

When discussing how the use of technology in their work impacted their time, the participants identified interacting with the computerised medical record as an area of concern. The midwives reported that whilst they accepted the technology was recently implemented and hoped that as they became more familiar with it use would become more intuitive, currently the computer was a major focus, reducing time spent with women. This is supported by research on the acceptance of electronic medical records by nurses and midwives in Australia (Wynter et al., 2021) and in the United States (Wisner et al., 2021). The computer being in the birthing room was seen as a distraction and inappropriate to the environment trying to being created.

5.4 Summary

This chapter has provided discussion that both the enablers and barriers to the acceptance of technology by midwives in maternity care identified by the study participants are supported by the literature. The next chapter is the conclusion, where the strengths and limitations of the study are presented and future direction for research discussed.

Chapter 6 - Conclusion

6.1 Strengths and Limitations

A commonly cited limitation of phenomenological studies is the small sample size (Charlick et.al., 2016), a limitation of this study. The age of the participants (mean 50.8 years) is a limitation of the study as there were few young midwives represented which may impact how they feel about the use of technology. However, this is representative of the average age of midwives in Australia (Department of Health and Aged Care, 2019). Selection bias is a further limitation, as the participants were purposively selected based on what the author believed would benefit the study. The small research team (the author and supervisors) may increase bias into the analysis of the data, another potential limitation of this study, however, the research team does contribute to investigator triangulation, where more than one researcher contributes to coding and analysis of data (Daniel, 2018; Korstjens & Moser, 2017), a potential strength. A further strength of the study is the inclusion of more than one site, increasing access to a range of participants, enabling data triangulation which enhances credibility (Korstjens & Moser, 2017).

6.2 Future Directions

Research targeting newly graduated and younger midwives, as well as midwives practicing in different settings, for example, home birth, would provide a deeper understanding of the views a less homogonous group. Examining the expectations of younger practitioners, who are more accustomed to technological involvement in their lives, on the use of technology for maternity care would provide insight into future directions of emerging practitioners. Of note, none of the participants made any protest about the fact that midwives are not routinely consulted about technological advancements or their implementation into practice. The assumption is that midwives will follow instructions without consultation or discussion.

Research into the acquiescence by midwives to the technocratic model, and what drives, this would be recommended as an extension to the existing body of work.

6.3 Conclusion

In order to delve into the factors that facilitate or impede the acceptance of new technology among midwives, this study employed a phenomenological approach. The researcher conducted semi-structured interviews with a sample of 11 midwives, spread out over a six-week period. Through a meticulous process of thematic analysis, the study identified three key themes that served as barriers to acceptance, as well as four themes that acted as enablers.

The findings of the study shed light on the complex dynamics at play when it comes to midwives' views on technology in their field. While the midwives recognized the inherent value of technology in enhancing maternity care, they held an ardent hope that the development of new technologies would not overshadow the importance of maintaining clinical skills, both in midwifery and medicine. They emphasized the need for a balanced approach that integrates technological advancements without compromising the fundamental principles of physiological birth and the vital role of skilled healthcare providers.

One noteworthy aspect that emerged from the interviews was the influence of the risk discourse prevailing in our society. The participants expressed how the societal emphasis on certainty and minimizing risk has led to a heightened demand for technologies that promise to enhance safety and provide reassurance. Technology, in this context, was seen as a tool capable of augmenting certainty in the realm of maternity care.

However, the midwives also voiced concerns about the introduction of emerging technologies without sufficient evidence of their accuracy and efficacy. They emphasized the importance of ensuring that any new technology seamlessly complements their existing clinical skills and ultimately benefits women and their babies. Striking a delicate balance between

technological advancements and the preservation of traditional, evidence-based practices remained a primary concern for the midwives.

In conclusion, this study highlights the nuanced perspectives of midwives regarding the acceptance of new technology in their field. While acknowledging the value of technological advancements, midwives advocate for a cautious approach that prioritizes the maintenance of clinical skills and the protection of the physiological birth process. Their hopes lie in integrating technology in a manner that aligns with established best practices, avoids compromising the human element of care, and guarantees optimal outcomes for mothers and their newborns.

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APPENDIX A

Summary Table – Qualitative Studies

Author(s) surnames and year/country **Title**	**Study aims/purpose**	**Study design/methodology**	**Setting and sample**	**Main findings**	**Strengths and limitations**	**Relevance to research**
1. Aune, Hoston, Kolshus, and Larson, (2017) Norway. Nature works best when allowed to run its course. The experience of midwives promoting normal births in a home birth setting. Norway	To examine how midwives, promote normal birth.	Qualitative. Phenomenological. In depth interviews.	Nine Midwives Home settings in Norway	The midwives had a strong belief in birth as a natural process and believed that patience, viewing the home as a safe environment, developing a trusting relationship with the women in their care, and the promotion of normal birth to the	LIMITATIONS: Small sample size and home birth setting meant it may not be transferable to the Australian context. As all participants were homebirth midwives promoting normal birth, reduces generalisability to clinical practice.	The midwives all had a strong faith in birth as a normal process, which they were able to transfer to the women in their care. Women with a strong belief in their ability to birth are less accepting of birth

				women were the keys to normal birth.		technology, thus making it a potential **barrier** to the acceptance of a new technology for uses in a maternity setting, for both women and midwives.
2. Carolan-Olah, Kruger &Garvey-Graham, (2015) Australia. Midwives' experience of the factors that facilitate normal birth among low risk women at a public hospital in Australia	The objective of the study was to explore the factors that midwives view as barriers or facilitators to normal birth.	Qualitative. Phenomenological, in-depth, semi-structured interviews.	22 midwives with an average of five- years of clinical experience, and a two-year history of working in one Melbourne maternity setting.	The study identified factors as barriers or enablers to normal birth. Barriers included; a risk adverse culture that lead to increased surveillance, and an increase in women being categorised as high risk leading to an expectation of	LIMITATIONS: The findings are restricted to one particular hospital and may not be transferable to another setting. The sample of participants consisted mainly of midwives who were supportive of normal birth and may not be representative of	The study highlights that midwives who work in obstetric led maternity settings face many barriers to the facilitation of normal birth. Reasons for this include the categorisation of more

				increased use of technology.	midwives working in other models of care. STRENGTHS: The aim of the study was achieved. The interpretive phenomenological approach allowed for a deep understanding of the research question. The researchers were also experienced midwives and qualitative researchers, reducing the likely hood that their own views would impact negatively on data collection.	women as high risk, leading them to experience and to expect the use of more medical intervention in pregnancy and labour. An increase in labour and pregnancy being regarded as risky, as opposed to a normal physiological event, is an enabler to the acceptance of technology for use in a maternity setting.

3. Healy, Humphries and Kennedy. (2017) Ireland. A qualitative exploration of risk affects care practices for low-risk women and normal birth.	To understand the perception of risk in low intervention women and what effect this has on the decision making of midwives and obstetricians.	Qualitative. Incorporated a pluralist approach that considered different methodologies. Data was collected using semi-structured interviews and analysed thematically with Yin's five step process for analysis. Recruitment and Interviewing occurred until data saturation was achieved.	25 participants, including midwives and obstetricians currently working in a birthing environment in Ireland.	The authors found that birth is viewed through a lens of risk, by both consumers and professionals. The medicalisation of childbirth has led to the routine use of technology, and sometimes unnecessary interventions. Midwifery practice is dominated by the medical model, often resulting in acceptance rather than resistance by midwives.	LIMITATIONS: Irish maternity care models are similar to that provided in Australia, however, the experiences of the Irish professionals may not be transferrable to the Australian context. STRENGTHS: Participants were recruited from multiple models of care and maternity settings, as well as varying professional grades.	Results from this study suggest that birth is increasingly influenced by an obstetric model. Both midwives and obstetricians felt that there was a degree of unnecessary intervention and agreed that consumers of maternity care were also increasingly viewing pregnancy and birth as medical conditions needing to be managed. These findings

						are enablers to the acceptance of an innovative technology in the maternity setting.
4. Kapaya, Dimelow & Anumba. (2018). UK. Women's experience of wearing a portable fetal-electrocardiogram device to monitor small-for-gestational age foetus in their home environment	To determine maternal acceptability of fECG monitoring in the home where the foetus is small for gestational age.	Qualitative. Flexible data collection questionnaire and focus groups. Content analysis used for focus groups.	Pregnant women (24-40 weeks GA) with a foetus identified as SGA. 35 women in total. Jessop Wing Hospital, Sheffield, UK.	The acceptance rate for wearing the device for long term home monitoring (average time 10hrs) was high, with two thirds of women consenting to wear it on two occasions. Some women reported discomfort to the skin. All women felt that the discomfort was outweighed by a perceived benefit to the baby.	STRENGTHS: Only study to conduct in-depth questioning (focus groups) of women's acceptability of a technological innovation. Good external validity LIMITATIONS: A quantitative study with a validated questionnaire would better assess maternal anxiety.	Maternal acceptance of wearing the device was high, even in the presence of skin irritation, as mothers felt the wellbeing of their baby was a priority. This is identified as an enabler of the acceptance of an innovative technology in a maternity setting.

5. Kornelsen (2005). Canada. Essences and imperatives: An investigation to technology in childbirth.	To investigate the attitudes of both home and hospital birthing women towards technology in childbirth, as well as the consequences of these attitudes in relationship to the actual birth.	Qualitative. Exploratory semi-structured interviews. Interviews occurred between 6 weeks and 18 months post-partum. Questions were based on themes from the literature on the theory of technology.	25 women who had a home birth (recruited from four midwifery practices) and 25 hospital birthing women in a large urban centre in Canada	Home birthing women were identified as actively resisting technology, however, they agreed that technology had a place in making birth safe. Hospital birthing women were more likely to have interventions during labour but both groups felt they had some control in the use of technology during their birth.	STRENGTHS: In-depth interviews conducted with rigor. LIMITATIONS: Assessing satisfaction with childbirth experience is difficult as a negative experience can be mitigated by a good outcome	Women in both groups expressed an attitude that technology was important for childbirth, if needed. Although actively avoiding technology was important to homebirth women, they appreciated that technology had a place. This indicates an enabler to the acceptance of a new technology in a maternity setting.

6. Lafontan, Sundby, Ersdal, Abeid, Kidanto & Mbekenga. (2018). Tanzania and Norway. "I was Relieved to Know That My Baby Was Safe": Women's Attitudes and Perceptions on Using a New Electronic Fetal Heart Rate Monitor during Labour in Tanzania.	To explore the attitudes and perceptions of women who had worn the Moyo device for their most recent birth, as well as their perceptions of how it affected their care.	Qualitative. Semi-structured interviews with open ended questions.	20 mothers who were monitored continuously during their most recent birth. Interviews occurred in a hospital in Tanzania before discharge.	The women were overwhelmingly accepting of the technology. They identified feeling that their care was better, their baby is safer and that they were reassured by the device. Some women incorrectly attributed pain relief properties, or an ability to speed the labour, to the device. This highlighted the importance of women understanding the devices functionality, as many women did not understand the device at all.	LIMITATIONS: Many of the women didn't understand the devices capabilities, which questions the validity of their responses as no real explanation of the device to women was identified. Only women with positive fetal outcomes were included. Some women may not have answered truthfully for fear of repercussion as they were still patients. There is poor external validity as the results cannot easily be	Although the findings overall may not be generalizable, the study highlights that the perception that a device might make birth safer for their babies, and might provide reassurance, can be applied to many women, as earlier research has identified. These factors act as enhancers to technology in maternity care.

					transferred to the general Australian population. STRENGTHS: Efforts to increase the validity of the study included: a wide variety of socio-demographic backgrounds in participants and a multidisciplinary and experienced research team.	

7. O'Brien, Rauf, Alfirevic & Lavender. (2013). UK. Women's experiences of outpatient induction of labour with remote continuous monitoring.	To assess the experience, and preference, of women undergoing induction of labour in the home while being continuously monitored remotely	Qualitative. Semi-structured interviews. Thematic analysis was used to identify dominant themes in the interviews.	Maternity hospital in the north of England. 70 women were monitored for 24 hours	Results indicated that women preferred outpatient induction in the home setting as it provided them with a sense of freedom, comfort, control and overall maternal satisfaction. Further, it was found that women's ability to labour from home resulted in increased emotional support, decreased familial stress and allowed for distraction from labour pain. Moreover, continuous monitoring from the home	LIMITATIONS: The study was limited by its participant selection according to geographical location, resulting in possible socio-economic bias towards preference for remote monitoring and limits its external validity/ generalisability. Further, potential participant cognitive bias towards the device is another limiting factor, resulting from interviewing women during the postnatal period	The study identifies maternal acceptability of a remote monitoring device, an enabler to the acceptance of an innovative technology in maternity. Not only was did the device provide maternal reassurance and allow them to begin labour at home, it enabled professionals to continue foetal surveillance during the process.

				environment allowed women to feel as if they experienced the "normality of birth" despite not labouring spontaneously. It was found that an essential factor contributing to maternal positivity was real-time, remote monitoring at the hospital, despite some women still depending on effective communication from hospital staff.	with their "healthy babies", producing a halo effect. STRENGTHS: Rich data was able to be generated from the studies design, facilitating a deeper knowledge of the important issues within the lived experience of the women.	
8. Prosen & Krajnc. (2019) Slovenia. Perspectives and experiences of healthcare professionals	To explore the experience and perceptions of the medicalisation of childbirth in Slovenia of both	Qualitative. Phenomenological. In-depth, semi-structured interviews.	16 midwives and 4 Obstetricians recruited from four different maternity	Both the obstetricians and midwives felt that the increased use of technology and resulting level of	LIMITATIONS: The qualitative nature of this research is subjective and	Increased risk perception is again identified by health professionals, as is the

regarding the medicalisation of pregnancy and childbirth.	midwives and obstetricians.		clinics in Slovenia.	intervention, could attributed to the increased perception of risk in childbirth. As such, some interventions were driven by women themselves, especially those with high levels of childbirth fear.	may not be transferable. STRENGHTS: Purposive sampling used to gain a better understanding of the phenomenon. Data analysis process was done with rigor to increase credibility.	increasing level of medicalisation in the birth space. Increased interventions, including the use of technology are driven by this perception, often increasing consumer (maternal) demand for such use of technology. Increased perception of risk is identified as an enabler to the acceptance of technology in birth.

9. Rattay, Flowers, Miles and Clarke. (2011). Australia Foetal monitoring: A woman-centred decision-making pathway.	To examine the practice of midwives using continuous electronic foetal monitoring on low risk labouring woman, contrary to the guidelines.	Qualitative. Grounded Theory study. Semi-structured interviews.	Purposefully recruited midwives (n=5) from two reginal QLD hospitals	The clinical guidelines on CEFM are not always followed. Reasons identified: Business of staff, woman's level of perceived risk, fear of litigation. The decisions may have a significant impact on the woman's labour, including predisposition to unnecessary intervention.	LIMITATIONS: The study took place in reginal hospitals, this may affect transferability to urban centres but other studies suggest the findings are generalizable. STRENGTHS: Theoretical sampling during selection of participants ensured a broad range of experience and education, regular discussions with midwives and research supervisors during the inquiry	Fear of litigation, increased perception of risk and busy workplaces are identified as potential enablers of the acceptance of an innovative technology in maternity.

					process, assisted with validity.	
10. Edvardsson, Mogren, Lalos, Persson & Small (2015). Australia A tool with far-reaching influence: Australian midwives' views on the use of ultrasound during pregnancy.	To explore the experiences and views of Australian midwives on the role of obstetric ultrasound on clinical management of complicated pregnancy	Qualitative. FGD's	37 midwives drawn from two large tertiary hospitals in Victoria, Australia.	The acceptance of ultrasound, by both consumers and clinicians, as a routine part of pregnancy care, belies the significant influence it has on maternity care provision. Highlighted were the ethical and professional considerations for midwives regarding notions of informed decision making for women and the preservation of autonomy in pregnancy and childbirth in an	STRENGTHS: FGD's generate rich discussion drawing on the views and experiences of participants which were varied by age, experience and setting. The researchers' diverse backgrounds and extensive research experience contribute to trustworthiness. Set in Australia with Australian participants, this study has good generalisability.	This study identifies the impact that this technology has on the clinical and ethical elements of midwives' practice, the consideration of which is central to this research.

				increasingly medicalised model of care.	LIMITATIONS: FGD's may potentiate conformity of views. Variation in group size may have affected discussion. Study was designed to focus on complicated pregnancy, however the participants raised other aspects of ultrasound of their own initiative.	
ABBREVIATION KEY: **fECG** foetal ECG, **SGA** small for gestational age, **CEFM**, continuous electronic foetal monitoring, **QLD**, Queensland, **FGD,** focus group discussion						

APPENDIX B

Summary Table – Quantitative Articles

Author(s) surnames and year/country **Title**	**Study aims/purpose**	**Study design/methodology**	**Setting and sample**	**Main findings**	**Strengths and limitations**	**Relevance to research**
1. Arya, Rathinaswamy, Krishnan, Duplessis & Donofrio. (2015) USA. Feasibility of Non-invasive Foetal Electrocardiographic Monitoring in a Clinical Setting	To determine the feasibility of a non-invasive foetal heart rate device, the Monica AN24, for the acquisition of foetal electrocardiographic (fECG) data in a foetal cardiology clinic	Quantitative. Prospective, observational study.	50 women with foetus' between an estimated gestational age of 16 and 42 weeks, who were referred for foetal echocardiogram in America.	Although tracings were sometimes difficult to obtain, due to technical issues, the use of the AN24 was feasible in a clinical setting with foetus' between 19 and 42 weeks.	LIMITATIONS: Small sample size and small number of adequate signal-averaged waveforms for evaluation of the device, meaning that no significant comparisons could be made in measures such as gestational age (GA) and foetal	This study proves the feasibility of a non-invasive foetal monitor that uses electrocardiograph (ECG) waveforms in a clinical setting. The proof of such feasibility is an enabler to the acceptance on a similar, but improved and innovative technology in a maternity setting.

					heart rate (FHR).	
2. Benyamini, Molcho, Gozlanand Preis. (2017) Israel. Women's attitudes towards the medicalization of childbirth and their associations with planned and actual modes of birth.	To assess the attitudes of pregnant women towards the medicalisation of birth, their fear of birth and their associations with the background of the women (parity, socioeconomic status), and whether these attitudes have any effect on their planed and actual modes of birth.	Quantitative. Longitudinal Observational study. Prospective as participants completed surveys before 28 weeks and again at around 34 weeks of pregnancy. They then participated in a phone interview at 6 weeks postpartum to determine actual mode of birth	836 pregnant women recruited from Women's Health Centres in Israel, where they were receiving antenatal care.	Attitudes to medicalisation of childbirth were more likely to be positive in less educated, younger women or those with a poor obstetric history. Positive attitudes were also associated with high levels of childbirth fear. Women who willingly accepted the medical model ante-natally were more likely to receive medical intervention in	LIMITATIONS: The participants were not representative of the ethnically diverse women in Israel. There was no quantitative assessment of the diversity among the participants. STRENGTHS: A large sample size with good retention of participants. The study was able to meet the aim	A woman's socio-economic and obstetric background and fear of childbirth impact their attitude to, and acceptance of medicalisation of birth. This attitude has an effect on their planned and actual modes of birth. Maternal acceptance of medicalisation in childbirth is an enabler to the introduction of a technological innovation in a maternity setting.

				their actual birth		
3. Brown, Johnstone & Heazell. (2016) UK. Professional's views of foetal-monitoring support the development of devices to provide objective longer-term assessment of foetal wellbeing.	Aim was to assess professional views of current foetal monitoring techniques as well as their opinions of the potential for technologies to provide continuous objective FHR monitoring. Beliefs about potential effects from such technological development were also explored.	Quantitative. Questionnaire developed and validated by 10 validators and was distributed online via links published by professional associations.	Midwives (28%) and Obstetricians (72%) in the United Kingdom. Total respondents = 125.	Most respondents expressed some dissatisfaction with current foetal surveillance methods (for varying reasons) and agreed with the need for improved and objective methods, especially for use in high risk women. Only 4 participants had had any experience with a device designed for CFM. Concerns	LIMITATIONS: Small sample size, participants may not be representative of the population as survey was advertised online. STRENGTH: Survey design showed excellent internal consistency (Cronbach's alpha = 0.95)	Professional's beliefs that current foetal monitoring techniques are limited and an openness to new technologies are both enablers of the acceptance of new and innovative technologies in obstetrics.

				expressed included; risk of increased maternal anxiety, potential effects on maternity care, financial implications, technical issues with device and uncertainty of data analysis, and appropriateness of use in various populations.		
4. Graatsma, Jacod, Egmond, Mulder	The aim of the study was to assess the feasibility of continuous FHR	Quantitative FHR using a device that measures fECG for periods of 15 hours.	150 pregnant women with gestations of 20-40 weeks. Women experienced	Recordings in both groups were found to be of sufficient quality. Women did not	STRENGTHS: A good sample size with both antenatal and intrapartum women.	The proven feasibility of fECG is an enabler to the acceptance of an innovative

and Visser. (2008) The Netherlands. Foetal electrocardiography: feasibility of long-term foetal heart rate recordings.	monitoring using fECG.	SPSS was used for statistical analysis.	either home monitoring (n=110) or on admission in labour (n=40) in the Netherlands.	report experiencing any discomfort wearing the device and were open to being monitored again when asked. The study determined that the recordings were optimal when monitoring occurred at night and that continuous fECG monitoring is feasible and would be of benefit to women with high risk pregnancies.	LIMITATIONS: Although the authors report that the women did not suffer any adverse effects, their experiences of being monitored were not explored.	technology in a maternity setting.

5. Hauck, Stoll, Hall and Downie. (2016). Australia. Association between childbirth attitudes and fear on birth preferences of a future generation of Australian parents.	The examination of the attitudes towards childbirth, including factors that contribute to fear and birth preferences, as well as reasons for the preferences, in young adults.	Quantitative. A cross sectional study using an online survey. Survey consisted of informed response options with acceptable reliability (Cronbach alpha =0.86)	654 participants who were childless with an intention to have children in the future, of both sexes, less than 40 years old and attending a university in Western Australia.	Attitudes to childbirth were shaped by the experiences of friends and family members, exposure to media and their confidence in the birth process. Elevated scores of fear of childbirth more than doubled their odds of wanting CS in the absence of medical necessity. Birth technology was seen by 55.2% of respondents as making birth easier and	LIMITATIONS: The survey response rate was only 13.1%. The respondents, may not be reflective of the general Australian population and the results are reflective of a certain period in tine, that may alter in an ever-evolving social context. STRENGTHS: Good validity of the survey instrument.	More than half of the participants placed value on birth technology, and students who expressed a preference for CS were more likely to feel that obstetric interventions were acceptable and desirable. Fear of childbirth was likely to influence a preference for technological interventions. The above are all potential enablers to the acceptance of technology in prospective parents.

				10.7% felt technology was necessary to deliver a baby.		
6. Kamala, Ersdal, Dalen, Abeid, Ngarina, Perlman & Kidanto (2018) Norway/Tanzania. Implementation of a novel continuous foetal Doppler (Moyo) improves quality of intrapartum foetal heart rate monitoring in a resource-limited tertiary hospital in Tanzania: An observational study	To compare continuous FHR monitoring in labour using the Moyo device with intermittent FHR assessment using a Pinnard stethoscope for the detection of FHR abnormalities.	Quantitative. Pre- and Post-observational study.	TA referral hospital in Tanzania. Low risk women in labour. Pre-implementation sample participants = 1640. Post-implementation = 2442	In the detection of abnormal FHR, the Moyo device was superior to a Pinnards stethoscope. The CS rate increased, as did the use of instrumental delivery. The requirement for neonatal resuscitation was decreased, however, admission to the neonatal unit were higher after 24 hours in the post	LIMITATIONS: No randomisation as was pre/post implementation. Only low risk pregnancies were involved so fewer adverse outcomes than might be expected. Results are not transferrable to the Australian context as we have CTG. STRENGTH: large sample size.	The introduction of the Moyo device was strongly associated with an increase in medical interventions and improvements in neonatal outcomes. These outcomes serve as enablers to the acceptance of an improved innovative technology, especially for use in resources limited countries.

				implementation group.		
7. Klein, Kaczorowski, Hearps, Tomkinson, Baradaran, Hall, McNiven, Brant, Grant, Dore, Brasset-Latulippe &Fraser (2011) Canada. Birth Technology and Maternal Roles in Birth: Knowledge and Attitudes of Canadian Women Approaching Childbirth for the First Time.	To describe the attitude of Canadian women, who were having their first child, to birth technology and the role it plays in childbirth	Quantitative. A web based survey.	1315 women expecting 1st babies and utilising the care of either a midwife (28.1%), a family doctor (29.3%) or an obstetrician (42.6%). Settings were across rural and urban centres in Canada.	Women under care of OB more likely to view technology favourably, GP care more likely to be open-minded, MW care were less open to technology use.	LIMITATIONS: Women were mostly middle class and well educated – not representative of a diverse group. STRENGTHS: Large sample size. Women recruited via a pathology service which reduced recruitment bias.	Women engaging in a medical model of maternity care are more likely to be accepting of medical technology. Other models of care are not barriers, however, care by an obstetrician is an enabler to the acceptance of technology.
8. Schramm, Lapert, Nees, Lempersz, Oei, Haun,	To determine the acceptability of a non-invasive device measuring fECG.	Quantitative. Questionnaire-based.	University Hospital Heidelburg. 106 pregnant women. Two	The device was highly acceptable to all subjects in group A.	STRENGTHS: Large sample size, good external validity (diverse	Exposure to the technology may have an enabling effect on the acceptance of the

Maatouk, Bruckner, Sohn and Schott. (2018) Germany. Acceptance of a new non-invasive foetal monitoring system and attitude for telemedicine approaches in obstetrics: a case-control study.			groups, A & B. Group A – CTG and fECG simultaneously then completed a questionnaire. Group B questionnaire only.	Group B (no exposure to device) were sceptical of the technology. Exposure to the device significantly impacted acceptance by women.	population, reduced selection bias) LIMITATIONS: A qualitative approach would have given more insight to the views of the women.	technology. The women noted that the safety of the device, and subsequent protection from risk they believed it offered, were important – more evidence of enablers to acceptance of an obstetric technology.
9. Stampalija, Signaroldi, Mastroianni, Rosti, Signorelli, Casati & Ferrazzi. (2012) Italy. Foetal and maternal heart rate confusion during intra-partum monitoring: comparison of trans-	To compare the performance of fECG with Doppler telemetry.	Quantitative. Prospective longitudinal study.	39 women in labour at a maternity ward in Italy.	Transabdominal fECG was associated with less maternal heart rate confusion during second stage labour when compared to Doppler telemetry (via CTG), and fECG. It was	LIMITATIONS: Small sample size, exclusion of women with increased BMI (fECG may have technical difficulties in high BMI women)	fECG is a feasible replacement of CTG with equal and sometimes better results. It is less restrictive of maternal movement. These factors are both enablers to the acceptance of the

abdominal foetal electrocardiogram and Doppler telemetry.				determined by the authors to be a safe alternative to CTG as it does not reduce maternal mobility and requires less staff resources.	STRENGTHS: Good external validity overall.	proposed technology.
10. Stoll, Edmonds, Sadler, Thompson, McAra-Couper, Swift, Malott, Streffing, Gross and Downe. (2018). Canada, UK, USA, Chile, NZ and Australia. A cross-country survey of attitudes towards childbirth technologies and	To examine the attitudes held by future maternity care users on childbirth technology and interventions, and whether factors that influence these attitudes are affected by sociodemographic factors.	Quantitative. On line survey.	4569 students both male and female (79.3%) from 8 countries. All childless but with an intention to have children in the future.	A high proportion of the respondents believed that technology improves birth and birth outcomes. Positive views on technology were linked to childbirth fear. The attitudes of the students appeared to be dominated by cultural norms	LIMITATION: convenience sampling, relatively low response rate, affect external validity. STRENGTHS: Shows insight into how future parents from a range of cultural settings are influenced regarding childbirth.	The belief that technology improves outcomes, makes birth easier and is essential for the delivery of a child are all enablers to the acceptance of an innovative technology in maternity.

interventions among university students.				rather than education.		
11. Stoll, Edmonds & Hall (2015). Canada. Fear of Childbirth and Preference for Caesarean Delivery Among Young American Women Before Childbirth: A Survey Study	To assess the proportion of young American women with elevated levels of childbirth fear and preference for CS, and to identify potential variables to explain their preferences.	Quantitative. Cross sectional web based study.	Female students enrolled at a private university in Northeastern United States. n=752	Elevated fear of birth and risk perception, and a family history of CS had a significant impact on birth preferences in this group. Women who reported the media and school sex education sessions influenced their attitudes were more likely to experience childbirth fear. Confidence in knowledge about birth was	LIMITATIONS: Limited generalizability, potential self - selection bias. Cross sectional design represents a specific time and place, reducing generalisability. STRENGTHS: Large sample size, results are supported by other studies.	The results of this study are supported by previous studies. Fear of childbirth and societal norms predispose women to acceptance of the medical model, making them enablers of technology in childbirth.

				associated with reduced fear.		
12. Fox, Maude, Coddington, Woodworth, Scarf, Watson & Foureur (2021). Australia The use of continuous foetal monitoring technologies that enable mobility in labour for women with complex pregnancies: A survey of Australian and New Zealand Hospitals.	To determine the use of wireless and beltless technologies for foetal monitoring in Australian and New Zealand hospitals, identifying both the frequency of use and most likely recipients as well as enablers and barriers to their application.	Use of a validated survey adapted for the Australian and New Zealand context. The survey was distributed online.	Public and private hospitals in Australia (n=187) and New Zealand (n=21), who had over 1000 births per year and provided CFM during labour.	Of the participants surveyed, the majority had access to the technology to some degree, those who did not planned to purchase in the future. There was a high level of acceptability of the technology and belief that universal use would increase comfort, autonomy and freedom of movement during labour and birth.	LIMITATIONS: The nature of the survey did not allow for in-depth exploration of the barriers and facilitators of the technology. STRENGTHS: Findings are generalisable and provide good data on factors that facilitate the adoption of technology by midwives while identifying barriers to its adoption.	The results of this study are significant as they identify that lack of availability is a barrier to the use of the technology.

ABBREVIATION KEY:

fECG: Foetal Electrocardiograph, **ECG** Electrocardiograph, **GA** gestational age, **FHR** foetal heart rate, **CFM** continuous foetal monitoring, **CS** caesarean section, **OB** obstetrician, **MW** midwife, **CTG** cardiotoccograph

APPENDIX C – Social Media Advertisement

Flinders UNIVERSITY

MIDWIVES & TECHNOLOGY

Recent innovative advances have seen an increase in the development of technology for use in maternity care. Rarely is the midwives experience considered before it is implemented into practice.

We would like to talk with you about how you feel about technology use in maternity care.

For more information about participating in an interview via Zoom video link, please contact

Karin Birkner, Masters of Midwifery student on *birk0029@flinders.edu.au*

Flinders University Human Research Ethics Committee | Approval no: HEL1926-3