



Wanting to be ‘with woman’, not with machine: Midwives’ experiences of caring for women being continuously monitored in labour

Deborah Fox ^{*}, Rebecca Coddington, Vanessa Scarf

Centre for Midwifery, Child and Family Health, University of Technology Sydney, Australia

ARTICLE INFO

Keywords:

Midwifery care
Intrapartum fetal monitoring
Mobility in labour
Bodily autonomy
Woman centred care
Health technology

ABSTRACT

Problem: Some continuous electronic fetal monitoring (CEFM) devices restrict women’s bodily autonomy by limiting their mobility in labour and birth.

Background: Little is known about how midwives perceive the impact of CEFM technologies on their practice.

Aim: This paper explores the way different fetal monitoring technologies influence the work of midwives.

Methods: Wireless and beltless ‘non-invasive fetal electrocardiogram’ (NIFECG) was trialled on 110 labouring women in an Australian maternity hospital. A focus group pertaining to midwives’ experiences of using CTG was conducted prior to the trial. After the trial, midwives were asked about their experiences of using NIFECG. All data were analysed using thematic analysis.

Findings: Midwives felt that wired CTG creates barriers to physiological processes. Whilst wireless CTG enables greater freedom of movement for women, it requires constant ‘fiddling’ from midwives, drawing their attention away from the woman. Midwives felt the NIFECG better enabled them to be ‘with woman’.

Discussion: Midwives play a pivotal role in mediating the influence of CEFM on women’s experiences in labour. Exploring the way in which different forms of CEFM impact on midwives’ practice may assist us to better understand how to prioritise the woman in order to facilitate safe and satisfying birth experiences.

Conclusion: The presence of CEFM technology in the birth space impacts midwives’ ways of working and their capacity to be woman-centred. Current CTG technology may impede midwives’ capacity to be ‘with woman’. Compared to the CTG, the NIFECG has the potential to enable midwives to provide more woman-centred care for those experiencing complex pregnancies.

Statement of significance

Problem or issue

Different forms of fetal monitoring create barriers and/or facilitators to midwives being able to practise woman-centred care and optimise physiological processes in labour.

What is already known

Monitoring fetal well-being in labour is important. The use of continuous monitoring via CTG since 1968 remains contentious. Better solutions are therefore needed. Non-invasive fetal ECG is a beltless, wireless device that is a promising alternative. Enabling women to have freedom of movement and positioning in labour results in greater sense of choice and control, shorter labours, reduced need for epidural anaesthesia and fewer caesarean sections. At present, approximately half of the women being continuously monitored in the United Kingdom, Australia and New Zealand do not have access to technologies that enable freedom of movement.

What this paper adds

This paper seeks to draw attention not to the efficacy of fetal monitoring devices, but to the way they influence midwives’ practice. It draws upon the discipline of philosophy of technology to demonstrate the need for midwives to mediate their interactions with technology so as to prioritise a woman-centred approach in intrapartum care.

^{*} Corresponding author at: University of Technology Sydney, PO Box 123, Broadway, NSW 2007, Australia.

E-mail address: Deborah.Fox@uts.edu.au (D. Fox).

1. Introduction

The role of the midwife is to work in partnership with the woman and her family to provide safe, woman-centred care. This care should include both the promotion of normal birth and preventative measures to ensure the safety of mother and baby and the detection of complications [1]. Woman-centred care is a concept originating in the 1960s and 1970s second wave of feminism. The concept describes midwifery care that prioritises the needs of each individual woman, maximises continuity of carer, promotes choice and control for every woman in childbearing and ‘addresses [her] social, emotional, physical, psychological, spiritual and cultural needs and expectations’ [2, p.12].

For women with healthy pregnancies at term, intermittent auscultation is universally recognised as the evidence-based method of monitoring fetal wellbeing in labour [3]. For women identified as having a complex pregnancy or being at high risk of complications in labour, continuous electronic fetal heart rate monitoring (CEFM) is recommended by numerous local and international guidelines [4,5,37]. Clinical guidelines recommending CEFM persist despite a lack of evidence for the ability of CTG to improve maternal and neonatal outcomes [6,7]. Women with complex pregnancies are often monitored in labour via a cardiotocograph (CTG), commonly referred to as CTG monitoring. Anecdotally, it is known that women rarely decline CEFM when it is offered as they trust the recommendation of health care professionals. Furthermore, women are often monitored continuously without obstetric indication.

Based on indications for continuous fetal heart rate monitoring in Australian national guidelines [5] it is estimated that CEFM affects more than half of the 300,000 women giving birth each year [36]. Conventional forms of CTG monitoring require the labouring woman to wear two tight elastic belts around her abdomen and, in many cases, leaves her tethered to a machine by wiring. The application of this technology can restrict the woman’s mobility during labour and may limit her choice of position whilst giving birth. Wireless CTG technology that better enables mobility in labour has been available since 2003, however, evidence demonstrates that uptake in many settings in Australia is not widespread [8].

A survey of Australian and New Zealand maternity units conducted by Fox et al. [8] found that wireless or beltless monitoring was available in 88% of public maternity units ($n = 105$) and 82% of private hospital maternity units ($n = 23$). However, of the 128 facilities that stated they had wireless or beltless CTG monitors, most facilities reported having only a few machines available [8]. Forty-three percent ($n = 54$) of survey participants stated that while wireless or beltless monitoring was available at their facility, it was used on less than half of the women who required continuous fetal monitoring [8]. It was unclear why access to wireless CTG was restricted for some women who were having continuous monitoring. It may be that these women were using an epidural, however we advocate for the use of wireless CTG for all women, including those with an epidural because of the increased comfort and convenience it offers. In some settings, such as the one in which we conducted this trial, wireless CTG is available in every room and is the routine method of monitoring. However, the findings from Fox et al. [8] demonstrate that a large proportion of Australian and New Zealand women continue to be offered only the more restrictive, wired CTG technology.

Similarly, Watson et al. [9] conducted a survey in the United Kingdom demonstrating that whilst 62% of responding hospitals possessed at least one machine capable of wireless monitoring, only 18% have more than three [9]. This indicates that the majority of women being continuously monitored are still receiving wired technology and that there is a low rate of availability of wireless technology. Despite a significant body of evidence demonstrating the benefits of mobility in labour, including a greater sense of choice and control, shorter length of labour, reduced need for epidural anaesthesia and lower likelihood of

caesarean section [10,11], women are continuing to experience fetal monitoring practices that restrict their bodily autonomy. This needs addressing urgently, as bodily autonomy is recognised as a universal human right [12].

A new form of wireless and beltless monitoring technology known as ‘non-invasive fetal ECG’ (NIFECEG) has been developed, utilising fetal and maternal electrocardiography (ECG) and uterine electromyography. The safety and reliability of the device has been established in a range of international settings [13–22] and in 2018, it was registered by the Therapeutic Goods Administration (TGA) for clinical use in Australia. Although the NIFECEG uses different technology to measure fetal and maternal heart rates and uterine activity than conventional CTG monitoring, it is compatible with existing CTG machinery and infrastructure installed in the majority of Australian hospitals. However, to date, little is known about the impact of this innovation on midwives’ work and women’s birth experiences.

To investigate this, we conducted interviews and focus groups with midwives before and after a period of trialling the NIFECEG device in an Australian tertiary maternity care facility. This paper reports on the qualitative findings of the study pertaining to midwives’ experiences of using the NIFECEG (‘Philips Avalon Beltless Fetal Monitoring Solution’), when compared with experiences of using wired and wireless CTG (‘Philips Avalon CL’) to continuously monitor the fetal heart rate in labour. The feasibility of implementing NIFECEG in clinical practice in the Australian context will be addressed elsewhere and a subsequent paper will describe women’s views and experiences.

2. Methods

2.1. Setting

The single site clinical feasibility study took place between January and July 2020 in the New South Wales Health South Eastern Sydney Local Health District at the Royal Hospital for Women in Sydney, Australia. This is a public teaching hospital facility which provides maternity, neonatal, gynaecology and oncology services. The Royal Hospital for Women has more than 4200 births per year, receives referrals for neonatal specialty care from throughout the state of New South Wales (NSW) in Australia and is part of a network which caters for the highest level of acuity.

Women were eligible to participate in the study trialling NIFECEG if they were equal to or greater than 36 weeks gestation, with a singleton pregnancy, planning to give birth vaginally and with obstetric indications, as per NSW Health protocol (2018), for continuous intrapartum fetal monitoring.

Midwives who cared for women participating in the clinical component of the study were invited to take part in pre and/or post-intervention interviews or focus groups. The inclusion criteria for midwives’ participation in the pre-intervention focus group was that they were an employee of the Royal Hospital for Women and had provided direct clinical care to labouring women in the birth unit. The criteria for midwives’ participation during and post-intervention interviews and focus group was involvement in the direct clinical care of at least one labouring woman trialling the NIFECEG device during labour.

2.2. Design

A qualitative descriptive approach [23] was used to explore the views and experiences of midwives who provided clinical care to women being continuously monitored during labour.

2.2.1. Reflexivity

The researchers are all midwives who have experience with using CEFM in the clinical environment. This was recognised as a potential source of bias; therefore, ongoing reflexive conversations were undertaken throughout the course of the research to ensure the researchers

were not influencing data or findings. None of the participants were known to the researchers prior to the study, therefore participants were free to express views on CEFM that may have been disparate to that of the researchers conducting data collection.

2.2.2. Data collection

Focus Group 1 with midwives was held in January 2020, prior to the introduction of the trial intervention with the NIFECG device. Interviews and Focus Group 2 with midwives were held in July 2020 at the conclusion of the trial period for the device. A topic guide was used by the focus group facilitator (RC) to keep the conversation on track with open-ended questions such as; ‘Tell me about your experiences of caring for women being continuously monitored in labour’ and ‘Tell me about your experience of using the new NIFECG device’. Audio-recording of the interviews and focus groups were later transcribed and de-identified.

2.2.3. Data analysis

Data were analysed according to the thematic analysis approach devised by Braun and Clarke [24]. Qualitative data analysis software NVivo 12 [25] was used to conduct coding and thematic development during analysis. One member of the research team (RC) led the qualitative data collection and analysis. She and the Chief Investigator (DF) coded the data independently and met to discuss and reach consensus at each stage of the analysis process. RC and DF also led the process of seeking and reaching whole team consensus for final theme development.

2.2.4. Ethics

Ethical clearance was sought via the Research Ethics and Governance Information System (REGIS) and was granted by the South Eastern Sydney LHD HREC on 8/5/2019. Site specific approval was also granted from the Royal Hospital for Women (reference number 2019/STE00589) and ratified by the University of Technology Sydney ethics committee (approval no. ETH19-3744). Anonymity of participants was ensured by the assignment of code numbers.

3. Findings

These findings are based on thematic analysis of data arising from focus groups and/or interviews with 22 midwives. The first focus group was conducted in late January 2020 before the commencement of the trial of the NIFECG at the study site. As such, it refers to midwives’ experiences of using the existing CTG technology available in the labour ward environment, i.e. both wired and wireless CTG. Nine midwives participated in this focus group that lasted 40 min.

A second focus group with midwives was conducted in July 2020 at the study site following completion of the clinical trial of the NIFECG device. This focus group explored midwives’ experiences of caring for women who were using the NIFECG to monitor the fetal heart rate. Nine midwives participated in a focus group that lasted 45 min. All midwives who participated in the first focus group had the experience of using CTG and if they used the NIFECG they were also eligible to participate in the second focus group or an interview. A small number participated in both the first focus group and the second focus group and/or an interview. Semi-structured interviews were conducted with four further midwives. Data from all focus groups and interviews were analysed together and are presented here with quotes to illustrate each theme.

The following themes emerged from the data: *It becomes all about the machine*, *Supporting women’s bodily autonomy*, and *Being ‘with woman’, not with machine*.

3.1. It becomes all about the machine

Some midwives noticed that when caring for women who were being continuously monitored during labour, the focus of the room shifted from the woman to the machine ‘*It becomes all about the machine*’

(Midwife 6, Focus Group 1). This shift in focus was observed in both women and their partners, as well as care providers:

People come in and talk to the machine. They talk to the woman but they’re looking at the machine, which is really, really sad to see (Midwife 5, Focus Group 1).

The CTG machine dominates every birth room. It is the thing that people focus on... they talk to the machine. Husbands, partners watch it (Midwife 8, Focus Group 1).

Many midwives felt the presence of the CTG monitor in the birth room was an unhelpful distraction for women in labour:

I’ve had women that want to face the machine so that they can see it and hear it (Midwife 2, Focus Group 1).

This diverted the woman’s focus away from ‘doing the work’ of labour. The audible fetal heart sounds dominated the room, constantly drawing attention to the machine and to its interpretation of the state of the fetus:

They can hear it even if they don’t understand [the fetal heart rate trace] by actually looking at it, the sound is on (Midwife 1, Focus Group 1).

I think there’s a bit of fear... They know if the heart rate’s dropping. They definitely know that (Midwife 5, Focus Group 1).

They noticed that women started relying on the numbers displayed on the CTG monitor rather than the physical sensations they were experiencing to determine whether they were having a contraction, as one midwife described:

[The woman is saying] the green number went up to 40, I must be having a contraction (Midwife 8, Focus Group 1).

Some midwives felt the shift in focus towards the machine diverted their attention away from providing woman-centred care. Furthermore, they observed that when the woman’s focus was on the machine, it appeared to externalise her experience of her labour.

3.2. Supporting women’s bodily autonomy

All midwives expressed a commitment to supporting women’s bodily autonomy in labour and had concerns about how various continuous monitoring devices impacted on this. They took a pragmatic stance that, at least for the foreseeable future, continuous fetal monitoring was a part of their practice when caring for women with complexities and risk factors. Midwives realised that this technology was necessary for some women and accepted that it was here to stay:

[CTG] will never go away. It’s not like, yes, it is annoying, but it’s never, it’s not going to go away. It’s never going to get [to the point] that they’ll turn around and say, “Oh yeah we’ll just do intermittent [auscultation]” (Midwife 6, Focus Group 1).

Wired CTG technology was thought to significantly restrict women’s freedom of movement during labour and make the obstetric bed the primary focus of the room. This tended to result in women labouring on the bed rather than remaining active in labour:

It’s very restrictive for women’s positioning in labour and their ability to move around (Midwife 6, Focus Group 1).

It also makes the bed the focus when they’re on wires. Whereas if you’ve got them on telemetry [wireless CTG], they’ve got the ability to get up and use a ball or you know, go into the bathroom, maybe use water therapy (Midwife 1, Focus Group 1).

Some women who were using wired CTG described to midwives that they felt ‘strapped to the bed’:

I think there's also a bit of stigma attached with being sort of strapped to the bed. I get a lot of women who are like "Oh, I couldn't think of anything worse than being strapped down to the bed." (Midwife 2, Focus Group 1).

Many midwives also observed that wired CTG resulted in a loss of autonomy for women as they had to ask for permission and needed assistance to detach from the machine in order to go to the toilet:

[With wired CTG] they ask you if it's okay if they go to the toilet... [Wireless CTG] gives the woman the opportunity to get up. Just knowing they can go to the toilet makes a big difference (Midwife 4, Focus Group 1).

The majority of participating midwives reported that they always choose wireless over wired CTG if it is available. Midwives preferred wireless CTG (also known as telemetry) over wired for a number of reasons. These included greater freedom of movement for the woman, a greater sense of autonomy and a perceived impact on women's mental and emotional state:

I think [a lack of wires] makes them feel differently (Midwife 3, Focus Group 1).

Whilst the wireless CTG was preferable to wired CTG in terms of the woman's ability to remain mobile, it also had drawbacks including loss of contact when the woman is mobilising:

So, the wireless is good in a way, but the battery runs out, sometimes the connection is not very good. It's also when the women move, the belts aren't attached properly. It flops over, you don't have a good connection (Midwife 3, Focus Group 1).

Midwives often felt that being continuously monitored via the CTG sometimes caused women to change their behaviour, including self-imposed restrictions on mobility and positioning in order to maintain a good fetal heart rate trace on the baby:

Well, some women feel that they can't move. They get focused on their leads and they're kind of like, "Alright, if I move then I'm going to have to hold them so I might as well just stay here 'cause I can see my baby is monitoring well" (Midwife 6, Focus Group 1).

This was a point of tension for midwives who wanted to support women's right to move freely in labour, because they had to balance this with the responsibility of obtaining an accurate record of fetal wellbeing.

In contrast, all participating midwives felt that the beltless NIFECG device had a considerably positive impact on women's mobility and comfort in labour:

...They can do things like go to the toilet and we're not standing there itching for them to come out so that we can start fiddling around with [the CTG]. So, I think that's much nicer for them (Midwife 11, Focus Group 2).

Despite the need for some troubleshooting of this new technology, the NIFECG was favoured by midwives over all other available monitoring devices when the trace was continuing reliably. The NIFECG was thought to be most comfortable for women due to the lack of belts and the lightweight nature of the device:

When it works, it works really well and I love it (Midwife 13, Focus Group 2).

The woman not having a strap, that tight strap, most women hate it. It's uncomfortable and so that's a big benefit [of the beltless device] (Midwife 10, Focus Group 2).

Midwives were keen to minimise the impact of the fetal monitoring device on women and on the care they were providing.

3.3. Being 'with woman', not with machine

All participating midwives were frustrated by the need to constantly 'fiddle' with CTG transducers in order to maintain good contact with the fetal heart rate. Inevitably this 'fiddling' resulted in disturbing the labouring woman and most were concerned that this interrupted the woman's focus in labour:

[I'm] interrupting her focus, interrupting her flow, interrupting her endorphins that are happening... It's interrupting her labour if not stopping labour. And certain people end up apologising to you. [Women say] "I'm so sorry"... You know, you shouldn't be apologising to me because I can't pick up your baby's [heart rate] properly. I'm apologising to you because I'm poking and prodding you (Midwife 5, Focus Group 1).

Loss of contact with the fetal heart rate was an ongoing issue that caused anxiety for all midwives. When the CTG transducer lost contact with the fetal heart rate, midwives spent considerable time repositioning it, only to find that when the woman changed position there would be loss of contact again:

I think I'm worrying more about maintaining that contact than actually being able to, you probably don't encourage that woman to do all these positions because you're afraid you're going to lose contact. She has to do various things with her body [to maintain contact with the fetal heart]. I'd have to say you feel like you're limiting her (Midwife 6, Focus Group 1)

Constant loss of contact and the need to reposition the CTG transducer was a disincentive for women to move in labour. At times this meant that midwives either did not encourage women to remain active or they asked them to sit on the bed to ensure the fetal heart was being recorded.

One of the benefits some midwives reported when trialling the NIFECG device was that it allowed them to be more available and present with the woman, rather than focused on the fetal monitoring technology. Unlike conventional CTG transducers, once applied to the abdomen the NIFECG required no further adjustments when the woman or fetus moved. This meant that the midwife could focus on other aspects of the woman's care:

If you can get it [NIFECG] working, it just frees up the rest of your time ... you spend so much time readjusting the CTG all the time (Midwife 12, Focus Group 2).

Midwives enjoyed how the NIFECG device freed them up to provide care that was more woman-centred:

I feel like you can just kind of be there with them and talk them through what they're doing. Or just being there and being present instead of constantly worrying about where the fetal heart is instead of focusing on how they're labouring and talking them through, you know what I mean? Like you're constantly touching them [with the CTG] if they're bent over you've got to be putting pressure there. I think that they enjoy [the NIFECG] a lot more (Midwife 13, Focus Group 2).

When using the NIFECG, most midwives felt that it positively impacted their workload and reduced stress, primarily related to the constant need to readjust CTG monitoring. Several midwives also commented on the advantages of NIFECG for women requesting an epidural, as it enabled fetal monitoring to continue whilst the woman was crouching forward for epidural insertion:

There's a new directive here that you're meant to listen to the baby through [the insertion of] an epidural... It's too difficult to do [with CTG]... [With the NIFECG] there's no straps and you don't have to stand holding it and trying to get it to work. It [NIFECG] takes that

stress away, I found. I thought it was great with the epidural (Midwife 11, Focus Group 2).

As the NIFECG device is beltless, it allows midwives to adhere to the policy of continuously monitoring the fetal heart whilst supporting the needs of both the woman and the anaesthetist during the epidural insertion.

4. Discussion

Women's experiences of giving birth have changed dramatically over the past century. Although in most high-income countries it is now the cultural norm to give birth in hospital, surrounded by technology, historically this has not always been the case. Up until the mid-1930s the majority of women gave birth at home, attended by a midwife and several family or community members [26,27]. Whilst the move from home to hospital has been painted as a progression towards safer birth, evidence suggests that intervention rates in hospitals are rising without substantive improvements in health outcomes for women and babies [28–30]. We recognise that the use of continuous electronic fetal monitoring technologies is contentious. While acknowledging the disparate views on whether these technologies improve outcomes for women and babies [6,7], this paper seeks to draw attention not to the efficacy of different devices but to the way they influence midwives' practice.

As evident in our findings, when women are being continuously monitored, it can become '*All about the machine*'. Depending on the midwife's interaction with the technology, continuous monitoring during labour can shift the focus in the birth room. Midwives may allow CEFM technologies to reshape their field of awareness in the birth room, from the woman to the machine. In the same way that binoculars transform our ability to see things at a distance, whilst simultaneously relinquishing our attention to those in close proximity [31], fetal monitoring has the capacity to attract attention at the expense of the midwife's attunement to the woman.

We argue that midwives have a responsibility to mediate the influence of such technology upon their practice and the woman's birth experience. For example, when fetal heart sounds are audible and the display of the fetal heart rate is visible on the CEFM monitor, these become the primary focus of the room, drawing attention away from the woman onto the machine. In this instance, care providers tend to interact with the CEFM as if it is the focus of their care. However, midwives do have the capacity to ensure that the aural and visual displays are not prominent in the birth space.

In the broader healthcare context, Montague et al. [32] assert that a patient's trust in medical technology is influenced by the behaviour of the healthcare providers who use the technology. In the maternity care setting, the way a midwife interacts with technology in the birth space sends a powerful message to the woman. By identifying the influence of technology on a woman's childbearing experience, midwives may become more cognisant of how to mediate the needs of the woman and the application of technology.

'Watchful attendance' has been proposed [33] as a concept to describe 'a combination of continuous support, clinical assessment, and responsiveness' (p.2) provided by midwives to women in labour. This concept encompasses the attunement of a midwife to the woman's clinical, emotional, psychosocial, cultural and spiritual needs, along with their capacity to 'be with' woman rather than simply 'doing things' to her [33, p.1]. Our study shows that midwives are committed to providing woman-centred care and have a desire to be 'with woman', not with machine. However, the need to constantly fiddle with and adjust fetal monitoring devices detracts from this. New CEFM solutions such as the NIFECG that reduce the need for continuous readjustment by the midwife, release the midwife from focusing on the machine and may allow her to provide more 'watchful attendance'. Further research will explore the impact of CEFM on midwives' ability to provide 'watchful

attendance' when caring for women with complex pregnancies who are being continuously monitored and on women's experiences of CEFM.

Fundamental to the concept of healthcare ethics are the principles of autonomy, beneficence, non-maleficence and justice [34]. When applied to fetal monitoring, it is evident that there is an imperative to de-implement routinely used wired fetal monitoring technologies that significantly restrict women's movement and positioning in labour and birth. The maternity care system has a duty to facilitate bodily *autonomy* and choice and control for women in childbirth, simultaneously addressing the principle of *beneficence* by providing more positive childbirth experiences for women. *Non-maleficence* relates to the Hippocratic oath to 'do no harm'. Given the evidence for freedom of movement in childbirth as a strategy to optimise physiological processes in labour [10], it is difficult to justify the harm caused to women by the restriction of movement that is imposed upon them by wired CEFM. Our view is aligned with the recently published argument by Rydahl et al. [35] that rising interventions in maternity care need to be re-evaluated from the perspective of 'do no harm'. A range of technologies that monitor the fetus without tethering women to machines is available, including intermittent monitoring for healthy women at term with a Pinard stethoscope or handheld doppler, and CEFM for women with complex pregnancies or risk factors using wireless CTG or NIFECG. It is known from aforementioned data from the UK [9] and Australia and New Zealand [8] that further implementation and upscaling is required in order to meet the principle of justice. Currently, access for women to technologies that enable complete freedom of movement is inequitable, as approximately only half the women being continuously monitored in the UK, Australia and New Zealand are offered wireless and/or beltless technologies [8,9].

In our study, midwives acknowledged the responsibility they carried to apply, maintain and interpret the data pertaining to fetal wellbeing that is ascertained via CEFM. The requirement for them to manage the technology in this way impacted their practice and capacity to be 'with woman'. They were cognisant of the disruption to the woman's hormonal and physiological processes when they were needing to constantly attend to the technology and resented the distraction from providing woman-centred care.

5. Strengths and limitations

This study was limited in that it only incorporated participants from one study site. It is likely the midwives employed at this site are heavily influenced by the workplace culture and philosophy of care prevalent within that particular hospital which may influence their attitudes and experiences related to CEFM. A strength is that participants included midwives with a vast range of experience, from new graduate midwives to those with 30 or more years of midwifery experience. Additionally, participants worked in a range of models of care including core midwives from delivery suite (fragmented model of care) and midwifery group practice (continuity of care).

6. Conclusion

CEFM is recommended in local protocols for more than half of the 300,000 women in Australia giving birth each year [4,5,36]. As a result of women feeling strapped to the bed, midwives noted that they experienced reduced freedom of movement and restricted capacity to utilise birth equipment that is designed to support active labour. This leaves many midwives feeling conflicted about their role in supporting women to achieve a physiological birth, whilst carrying the responsibility of ensuring an accurate trace was recorded. Ultimately, all the midwives who participated in our study felt the restrictive nature of wired CTG made it an undesirable option for monitoring the fetal heart rate.

The presence of technology in the birthing space impacts on midwives' ways of working and their capacity to be woman-centred. Most found that CTG technology currently used distracts from their capacity

to be ‘with woman’ during labour, primarily due to the need to constantly re-position transducers when the woman or fetus changes position. Compared to the CTG, the NIFECG has the potential to enable midwives to provide more woman-centred care for those experiencing complex pregnancies. Further research is needed to understand women’s experiences of fetal monitoring technology and to evaluate the impact of NIFECG on clinical outcomes for women with complex pregnancies.

The ongoing challenge faced by midwives is the need to mediate the human-technology relationship when caring for women with complex pregnancies. As midwives, we have the capacity to choose how we practice and how we navigate our interactions with technology. It is evident that we can mediate the impacts on women by prioritising the woman’s needs over that of the technology. It is our intent that by critiquing the routinely accepted use of technology in childbirth we may better understand how to prioritise the woman and her innate physiological processes in order to facilitate safe and satisfying birth experiences.

Ethical statement

Ethical clearance was sought via the Research Ethics and Governance Information System (REGIS) and was granted on 8/5/2019. Site specific approval was also granted from NSW Health South Eastern Sydney Local Health District (approval no, 2019/ETH00630) and ratified by the University of Technology Sydney ethics committee (approval no, ETH19-3744).

Australian New Zealand Clinical Trials Registry number: ACTRN12619000293167p.

Author contributions

Deborah Fox: Conceptualization, Funding acquisition, Project administration, Methodology, Investigation, Data curation, Writing - original draft, Writing - review & editing.

Rebecca Coddington: Investigation, Data curation, Formal analysis, Writing - original draft, Writing - review & editing.

Vanessa Scarf: Investigation, Writing - review & editing.

Funding acknowledgement

This investigator-led project was sponsored by the University of Technology Sydney and industry funded by Philips Healthcare, Germany. UTS and the research team led the design and conduct of the project at all times and were not coerced by funders in any analysis or reporting of findings.

Conflict of interest

The Chief Investigator, Dr Deborah Fox, has received honoraria from Philips Healthcare for presenting lectures and workshops to midwives and obstetricians, in a consultant capacity, about mobility in labour. Neither Dr Fox, nor any other research team members have any financial interest in the NIFECG product, or in Philips Healthcare or any of its subsidiaries.

Contributors

We would like to acknowledge Associate Professor Andrew Bisits and Ms Anne Lainchbury from the Royal Hospital for Women, Sydney for their significant contributions to the implementation of this research project. We would also like to thank all the midwives who generously gave their time by participating.

References

- [1] International Confederation of Midwives (ICM), ICM International Definition of the Midwife, 2017. https://www.internationalmidwives.org/assets/files/definitions-files/2018/06/eng-definition_of_the_midwife-2017.pdf.
- [2] N. Leap, Woman-centred or women-centred care: does it matter? *Br. J. Midwifery* 17 (1) (2009) 12–16, <https://doi.org/10.12968/bjom.2009.17.1.37646>.
- [3] R.M. Maude, J.P. Skinner, M.J. Foureur, Putting intelligent structured intermittent auscultation (ISIA) into practice, *Women Birth* 29 (3) (2016) 285–292, <https://doi.org/10.1016/j.wombi.2015.12.001>.
- [4] NSW Clinical Excellence Commission, NSW Health, Fetal Heart Rate Monitoring Guideline GL2018.025, 2018. <https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2018.025.pdf>.
- [5] Royal Australian and New Zealand College of Obstetricians and Gynaecologists, (RANZCOG), Intrapartum Fetal Surveillance Clinical Guideline, fourth ed., 2019. <https://ranzocog.edu.au/news/intrapartum-fetal-surveillance-clinical-guideline>.
- [6] B.H. Al Wattar, E. Honess, S. Bunnewell, N.J. Welton, S. Quenby, K.S. Khan, J. Zamora, S. Thangaratnam, Effectiveness of intrapartum fetal surveillance to improve maternal and neonatal outcomes: a systematic review and network meta-analysis, *Can. Med. Assoc. J.* 193 (14) (2021) E468–E477, <https://doi.org/10.1503/cmaj.202538>.
- [7] K.A. Small, M. Sidebotham, J. Fenwick, J. Gamble, Intrapartum cardiotocograph monitoring and perinatal outcomes for women at risk: literature review, *Women Birth* 33 (5) (2020) 411–418.
- [8] D. Fox, R. Maude, R. Coddington, R. Woodworth, V. Scarf, K. Watson, M. Foureur, 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, *Midwifery* 93 (2021), <https://doi.org/10.1016/j.midw.2020.102887>, 102887–102887.
- [9] K. Watson, T.A. Mills, D.T. Lavender, The use of telemetry in labour: results of a national online survey of UK maternity units, *Br. J. Midwifery* 26 (1) (2018) 14–19, <https://doi.org/10.12968/bjom.2018.26.1.14>.
- [10] A. Lawrence, L. Lewis, G. Hofmeyr, C. Styles, Maternal positions and mobility during first stage labour, *Cochrane Database Syst. Rev.* (10) (2013), CD003934, <https://doi.org/10.1002/14651858.CD003934.pub4>.
- [11] H. Priddis, H. Dahlen, V. Schmied, What are the facilitators, inhibitors, and implications of birth positioning? A review of the literature, *Women Birth* 25 (3) (2012) 100–106.
- [12] UNFPA, My Body is My Own: Claiming the Right to Autonomy and Self-determination. What is Bodily Autonomy?, 2021. https://www.unfpa.org/sites/de fault/files/pub-pdf/SoWP2021_Report_-_EN_web.3.21.0.pdf.
- [13] W.R. Cohen, S. Ommami, S. Hassan, F.G. Mirza, M. Solomon, B.R. Schiffrin, J. M. Himsworth, B.R. Hayes-Gill, Accuracy and reliability of fetal heart rate monitoring using maternal abdominal surface electrodes, *Obstet. Anesth. Dig.* 34 (1) (2014) 34–35, <https://doi.org/10.1097/01.aoa.0000443377.31186.44>.
- [14] T.Y. Euliano, S. Darmanjian, M.T. Nguyen, J.D. Busowski, N. Euliano, A.R. Gregg, Monitoring fetal heart rate during labor: a comparison of three methods, *J. Pregnancy* 2017 (2017) 5, <https://doi.org/10.1155/2017/8529816>, 8529816.
- [15] G. Haran, M. Elbaz, M.D. Fejgin, T. Biron-Shental, A comparison of surface acquired uterine electromyography and intrauterine pressure catheter to assess uterine activity, *Am. J. Obstet. Gynecol.* 206 (5) (2012) 449, <https://doi.org/10.1016/j.ajog.2012.03.019>.
- [16] B. Hayes-Gill, S. Hassan, F.G. Mirza, S. Ommami, J. Himsworth, M. Solomon, R. Brown, B.S. Schiffrin, W.R. Cohen, Accuracy and reliability of uterine contraction identification using abdominal surface electrodes, *Clin. Med. Insights: Womens Health* 5 (2012), <https://doi.org/10.4137/CMWH.S10444>, CMWH.S10444.
- [17] B.C. Jacod, E.M. Graatsma, E. Van Hagen, G.H.A. Visser, A validation of electrohysterography for uterine activity monitoring during labour, *J. Matern. Neonatal Med.* 23 (1) (2010) 17–22, <https://doi.org/10.3109/14767050903156668>.
- [18] J. Reinhard, B. Hayes-Gill, S. Schiermeier, W. Hatzmann, E. Herrmann, T. Heinrich, F. Louwen, Intrapartum signal quality with external fetal heart rate monitoring: a two way trial of external Doppler CTG ultrasound and the abdominal fetal electrocardiogram, *Arch. Gynecol. Obstet.* 286 (5) (2012) 1103–1107, <https://doi.org/10.1007/s00404-012-2413-4>.
- [19] J. Reinhard, B.R. Hayes-Gill, S. Schiermeier, H. Hatzmann, T.M. Heinrich, F. Louwen, Intrapartum heart rate ambiguity: a comparison of cardiotocogram and abdominal fetal electrocardiogram with maternal electrocardiogram, *Gynecol. Obstet. Invest.* 75 (2) (2013) 101–108, <https://doi.org/10.1159/000345059>.
- [20] T. Stampalija, M. Signoroli, C. Mastroianni, E. Rosti, V. Signorelli, D. Casati, E. M. Ferrazzi, Fetal and maternal heart rate confusion during intrapartum monitoring: comparison of trans-abdominal fetal electrocardiogram and Doppler telemetry, *J. Matern. Neonatal Med.* 25 (8) (2012) 1517–1520, <https://doi.org/10.3109/14767058.2011.636090>.
- [21] M.W.C. Vlemminx, K.M.J. Thijssen, G.I. Bajilekov, et al., Electrohysterography for uterine monitoring during term labour compared to external tocodynamometry and intra-uterine pressure catheter, *Eur. J. Obstet. Gynecol. Reprod. Biol.* 215 (2017) 197–205, <https://doi.org/10.1016/j.ejogrb.2017.05.027>.
- [22] M.W.C. Vlemminx, C. Rabotti, M.B. Van Der Hout-Van Der Jagt, S.G. Oei, Clinical use of Electrohysterography during term labor: a systematic review on diagnostic value, advantages, and limitations, *Obstet. Gynecol. Surv.* 12 (5) (2018) 303–324.
- [23] M. Sandelowski, Focus on research methods-whatever happened to qualitative description? *Res. Nurs. Health* 23 (4) (2000) 334–340.
- [24] V. Braun, V. Clarke, Using thematic analysis in psychology, *Qual. Res. Psychol.* 3 (2) (2006) 77–101, <https://doi.org/10.1191/1478088706qp0630a>.

- [25] QSR International, NVivo Qualitative Data Analysis Software Version 12, QSR International Pty Ltd., 2020.
- [26] K. Fahy, An Australian history of the subordination of midwifery, *Women Birth* 20 (1) (2007) 25–29.
- [27] S. Hunt, A. Symonds, *The Social Meaning of Midwifery*, MacMillan Press, 1995.
- [28] K. Coxon, J. Sandall, N.J. Fulop, To what extent are women free to choose where to give birth? How discourses of risk, blame and responsibility influence birth place decisions, *Health Risk Soc.* 16 (1) (2014) 51–67.
- [29] S. Miller, E. Abalos, M. Chamillard, A. Ciapponi, D. Colaci, D. Comande, V. Diaz, S. Gellar, C. Hanson, A. Langer, V. Manuelli, K. Millar, I. Morhason-Bello, C. Pileggi Castro, V. Nogueira Pileggi, N. Robinson, M. Skaer, J. Paulo Souza, J.P. Vogel, F. Althabe, Beyond too little, too late and too much, too soon: a pathway towards evidence-based, respectful maternity care worldwide, *Lancet* 388 (10056) (2016) 2176–2192.
- [30] World Health Organization, WHO Statement on Caesarean Section Rates (No. WHO/RHR/15.02), World Health Organization, 2015.
- [31] R.J. Rosenberger, P. Verbeek, *Postphenomenological Investigations: Essays on Human-technology Relations*, Lexington Books, 2015.
- [32] E. Montague, W. Winchester, B. Kleiner, Trust in medical technology by patients and health care providers in obstetric work systems, *Behav. Inf. Technol.* 29 (2010) 541–554, <https://doi.org/10.1080/01449291003752914>.
- [33] A. de Jonge, H. Dahlen, S. Downe, 'Watchful attendance' during labour and birth, *Sex. Reprod. Healthc.* 28 (2021), 100617, <https://doi.org/10.1016/j.srhc.2021.100617>.
- [34] T.L. Beauchamp, J.F. Childress, *Principles of Biomedical Ethics*, Oxford University Press, 1979.
- [35] E. Rydahl, M. Juhl, E. Declercq, R.D. Maimburg, Disruption of physiological labour — a population register-based study among nulliparous women at term, *Sex. Reprod. Healthc.* 27 (2021), <https://doi.org/10.1016/j.srhc.2020.100571>, 100571–100571.
- [36] Australian Institute of Health and Welfare (AIHW), Australia's Mothers and Babies 2018: in Brief. Perinatal Statistics Series no. 36. Cat. No. PER 108, AIHW, Canberra, 2020.
- [37] D. Ayres-de-Campos, C.Y. Spong, E. Chandrachan, FIGO Intrapartum Fetal Monitoring Expert Consensus Panel, FIGO consensus guidelines on intrapartum fetal monitoring: cardiotocography, *Int. J. Gynecol. Obstet.* 131 (1) (2015) 13–24.