



Experiences and outcomes on the use of telemetry to monitor the fetal heart during labour: findings from a mixed methods study

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ABSTRACT

Background: Wireless continuous electronic fetal monitoring (CEFM) using telemetry offers potential for increased mobility during labour. United Kingdom national recommendations are that telemetry should be offered to all women having CEFM during labour. There is limited contemporary evidence on experiences of telemetry use or impacts it may have.

Aim: To gather in-depth knowledge about the experiences of women and midwives using telemetry, and to assess any impact that its use may have on clinical outcomes, mobility in labour, control or satisfaction.

Methods: A convergent parallel mixed-methods study was employed. Grounded theory was adopted for interviews and analysis of 13 midwives, 10 women and 2 partners. Satisfaction, positions during labour and clinical outcome data was analysed from a cohort comparing telemetry (n = 64) with wired CEFM (n = 64). Qualitative and quantitative data were synthesised to give deeper understanding.

Findings: Women using telemetry were more mobile and adopted more upright positions during labour. The core category *A Sense of Normality* encompassed themes of 'Being Free, Being in Control', 'Enabling and Facilitating' and 'Maternity Unit Culture'. Greater mobility resulted in increased feelings of internal and external control and increased perceptions of autonomy, normality and dignity. There was no difference in control or satisfaction between cohort groups.

Conclusions: When CEFM is used during labour, telemetry provides an opportunity to improve experience and support physiological capability. The use of telemetry during labour contributes to humanising birth for women who have CEFM and its use places them at the centre and in control of their birth experience. Crown Copyright © 2021 Published by Elsevier Ltd on behalf of Australian College of Midwives. All rights reserved.

Problem or issue

Continuous electronic fetal monitoring with wires decreases mobility and limits positions for labour.

What is already known

Wireless monitoring during labour (telemetry) may increase mobility and lead to less requirements for epidural analgesia. Telemetry is available in over 60% of maternity units in the United Kingdom but experiences of midwives and women who use it have not been explored in depth.

What this paper adds

Telemetry facilitates increased mobility in labour and upright positions for birth which leads to women experiencing a greater sense of control, dignity and normality. The use of telemetry during labour offers a contribution to humanising care in labour.

1. Introduction

Continuous electronic fetal monitoring (CEFM) is recommended for women who enter labour with an underlying condition increasing the risk of hypoxia, or if complications develop during labour [1]. It is estimated that approximately 60% of all women in labour in the United Kingdom (UK) each year will have CEFM. Disadvantages of CEFM are that mobility may be reduced (due to the presence of wires), and discomfort increased [2–5]. Decreased

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mobility may lead to limits in positions for labour and birth [6], increased requirements for pain relief, and increased interventions, including caesarean section [7]. Women are also unable to use a birthing pool with wired CEFM. Despite the lack of high quality evidence for the benefits of CEFM in reducing adverse outcomes [8,9], it continues to be used widely in modern maternity care, and is set to increase with higher levels of maternal complexity and intervention.

Wireless CEFM, or telemetry, has advanced in its technology and capability so that modern machines can be purchased as an adjunct to existing cardiotocograph (CTG) facilities, are waterproof, have a longer range and result in better recording of the fetal heart than older models. Current UK intrapartum guidelines recommend that all women having CEFM in labour should be offered telemetry [1] and a survey of all maternity units in the UK showed that 63% had at least one telemetry machine [10]. One of the widely believed advantages of telemetry is that women may be more mobile during labour without the constraints of wires, however there is no research evidence on which to base this. Greater freedom to ambulate has been shown to contribute to a woman's feelings of control and satisfaction with birth [14,20] and the use of telemetry may therefore contribute to these important measures. The existing evidence base for telemetry, including that used to develop NICE recommendations, is of variable quality and limited relevance to current midwifery practice. The majority of literature is over 25 years old, older telemetry models required women to carry a battery pack with them and to have routine artificial rupture of membranes to monitor the fetus with a fetal scalp electrode [11–17]. The aim of this mixed methods study was to gain a greater understanding of the use of telemetry within contemporary midwifery practice, to support implementation of current recommendations. In-depth views and experiences of women and midwives using telemetry were explored. The study also reports on impacts telemetry use may have on mobility, potential effects on control and satisfaction, and clinical outcomes. This paper contributes significantly to the lack of recent evidence on experiences of fetal monitoring, with a focus on telemetry, in labour.

2. Participants, ethics and methods

2.1. Design

A convergent parallel mixed methods design, informed overall by pragmatism [18], was chosen. A pragmatic approach ensured that the potential differing worldviews of both phases of the study (positivist and constructivist) could both be considered and utilised. Qualitative and quantitative data were synthesised to bring greater insight into the use of telemetry to monitor the fetal heart in labour. The cohort study included; assessment of perceived control and satisfaction using a validated instrument developed by Stevens et al. [20], positions in labour, and clinical outcomes from a group of women using telemetry compared to a group of women using CEFM. Constructivist grounded theory [19] was employed for the whole qualitative phase of the study, given that very little was known about the experiences of telemetry. In-depth interviews were undertaken with women, partners, and midwives (including 1 student midwife). Synthesis of both sets of data was employed to give an overall broad, deep and contextual understanding of telemetry use.

2.2. Study setting and sample

Participants were recruited from two consultant-led maternity units in two tertiary NHS Trusts in North West England. Both units had telemetry monitoring available for women to use during

labour but had different brands of equipment. Based on mean scores for both the Perceived Control in Childbirth Scale (PCCh) and Satisfaction with Childbirth (SWCh) scale reported by Stevens et al. [20] the sample size needed for the cohort study was calculated to be 64 women in each group (comprising of those who had telemetry monitoring for at least 90 min of their labour and those who had conventional wired monitoring), giving a sufficient sample to estimate 95% confidence intervals. The sample size calculation was based on detecting differences between the groups for the control and satisfaction scores and not on clinical outcomes or positions in labour data. During analysis it became evident that some women in the telemetry group were converted to wired monitoring and spending a variable proportion of their labour using telemetry. Data were not collected on the reasons why telemetry monitoring was converted to wired monitoring. Discussion within the research team concluded that a pragmatic approach would be to investigate a cut-off of women in the telemetry group spending more, or less, than 50% of their labour using telemetry. Not every woman recruited returned a questionnaire and recruitment ceased at 161 women, once the required number of questionnaires were returned ($n = 128$). Clinical outcome data was available for all 161 women. For the interviews, an initial purposive sample of 2 women and 2 midwives was followed by theoretical sampling until data saturation (total sample 10 women, 2 partners, 12 midwives and 1 student midwife).

2.3. Recruitment and inclusion/exclusion criteria

Inclusion criteria for the cohort study were English-speaking women, 18 years of age or older, had given birth to a baby 37 weeks gestation or more and had continuous monitoring of the fetal heart during labour (with the telemetry group having telemetry for at least ninety minutes). Women were excluded from the study if they had a multiple pregnancy, breech presentation, or a complicated pregnancy (such as pre-eclampsia), as monitoring the fetal heart in these situations can be more challenging. Women having intermittent auscultation of the fetal heart were not included in the study as the study was designed to investigate the experiences and outcomes of women having CEFM during labour on obstetric-led maternity units. In the UK, intermittent auscultation is recommended for women who have fetuses at low risk of fetal hypoxia during labour and these women will be mostly cared for in midwifery-led settings. Women having a fetus with a known anomaly or planned admission to the neonatal unit were also excluded. Inclusion criteria for the partner being interviewed was being present during labour for 90 min or more and to be English-speaking. Inclusion and exclusion criteria for the interviews of women were as for the cohort study. Midwives and student midwives were required to have provided care for women in labour using telemetry and to be employed at one of the two sites.

Due to timings of recruitment, women were only recruited into either the interviews or the cohort study, not both. A flyer with details of the study was placed in relevant areas on both maternity units, the study was discussed with eligible women and an information sheet given. For women taking part in the cohort, consent was taken prior to labour and the questionnaire given to them in a sealed envelope to complete in the postnatal period. The majority of women who consented to the study were undergoing induction of labour. This was due to time being available during admission for women to read information about the study and give consent. Once women who had consented to the study were on the labour ward standard care was given, including whether they were offered telemetry by the midwife caring for them, or women asked for it themselves. Offering telemetry to *all* women having CEFM was not standard practice in either setting. For the interviews a

'consent to contact' form was used, and the primary author contacted women following birth to enquire whether telemetry had been used and if they would consent to be interviewed.

2.4. Ethical considerations

Ethical approval was obtained from the Northwest Haydock Research Ethics Committee (17-NW-0699). Written informed consent was obtained from all participants, who were informed that participation was voluntary, and they could withdraw at any time. Confidentiality and anonymity were maintained with anonymised data and the use of pseudonyms.

2.5. Data collection

Data collection was in three parts for the quantitative phase. Women were asked to complete a validated questionnaire [20] with 19 Likert questions, ranging from strongly agree (score = 6) to strongly disagree (score = 1), about perceived control of the childbirth environment (12 questions) and satisfaction with the childbirth experience (7 questions). Questionnaires were posted back to the research team or collected from the postnatal ward. A data collection form outlining 16 possible different positions women may adopt in labour was developed from clinical experience and agreement between the authors. Data were collected from the electronic record, where position was documented at least half-hourly. Not all women in the study had their position in labour documented in the electronic record at least half hourly and therefore some details on this were unavailable. Demographic details, clinical maternal and neonatal outcomes were collected from the maternal notes and electronic records.

Data collection for the qualitative phase used one-to-one in-depth interviews, digitally recorded and transcribed verbatim. Interviews were conducted by the primary author either at the women's home or, for midwives, in the hospital setting. Interviews lasted between 21 and 64 min. An initial topic guide was developed for the purposive interviews, using previous literature and personal experience, which was then amended for the theoretical sample to ask more focused and specific questions in response to concurrent analysis.

2.6. Rigour/reflexivity

Lincoln and Guba's [21] 'trustworthiness' framework (credibility, transferability, dependability, confirmability) was used as criteria to guide rigour for the qualitative phase. The primary author is an experienced clinical midwife who has cared for women in different birth settings and with varying levels of complexity. This ensured theoretical sensitivity with emergent data and for the researcher to be receptive to all viewpoints and perspectives. The other two authors are academic midwives who shared similar backgrounds, knowledge and experience.

2.7. Data analysis

Data from the quantitative phase were analysed using the SPSS software package. A ten percent random sample of entries was compared against the original data to check for quality. Descriptive statistics were employed for the demographic, clinical outcome and position in labour data. Aggregate and mean scores for control and satisfaction scales were calculated and difference between the groups calculated using independent samples t-test, using $p < 0.05$ as the significance level. Position in labour data comprising 17 different positions were collapsed into 4 main positions for analysis and difference in percentages of time spent in each position as a proportion of time in labour was calculated between groups.

Data for qualitative analysis included all transcribed interviews, and memos. Sampling and analysis followed key grounded theory principles aimed at theory generation [19] including; creating analytical codes and categories from the data itself; advancing theoretical development throughout; making systematic comparisons; and theoretical density [19,22–24]. Coding followed the process described by Charmaz [19] and involved initial, focused and theoretical coding. Data collection and analysis were performed simultaneously, moving from one to the other to allow categories to emerge and analysis to move to a more theoretical and conceptual level [22,25].

All transcriptions were uploaded and managed with the use of NVivo 12 software. Initial analysis was conducted by the primary author and several transcripts were read by the research team followed by discussion of emerging codes and agreement.

Table 1
Baseline characteristics of women.

	Overall	Telemetry	Wired
Participants N (%)	161 (100.0)	74 (46.0)	87 (54.0)
Age, years, mean (SD)	31. (5.5)	31.7 (5.3)	30.5 (5.6)
BMI, kg/m ² , mean (SD)	26.8 (5.52)	25.7 (4.53)	27.6 (6.14)
Parity, N (%)			
• 0	76 (47.2)	38 (51.4)	38 (43.7)
• 1–4	78 (48.4)	32 (43.2)	46 (52.9)
• 5–10	7 (4.3)	4 (5.4)	3 (3.4)
Ethnicity, N (%)			
• White British, other white background	126 (78.3)	60 (81.1)	66 (75.9)
• Non-white background	35 (21.7)	14 (18.9)	21 (24.1)
Mean gestation, weeks (SD)	39.6 (1.47)	39.7 (1.46)	39.5 (1.47)
Pre-existing medical condition, N (%)	31 (19.5)	8 (11.1)	23 (26.4)
Induction of labour, N (%)	149 (92.5)	63 (85.1)	86 (98.9)
Fetal indication for induction	140 (94.0)	59 (92.2)	81 (95.3)
Maternal indication for induction	6 (4.0)	3 (4.7)	3 (3.5)
Other indication for induction	3 (2.0)	2 (3.1)	1 (1.2)

Table 2
Aggregate scores for PCCh and SWCh questions.

	Telemetry n = 64	Wired n = 64	p
Mean aggregate score for PCCh (SD)	5.2 (0.8)	4.9 (0.9)	0.138
Median	5.4	5.1	
Range	2.7–6.0	2.5–6.1	
95% CI for mean	5.0–5.3	4.7–5.2	
Mean aggregate score for SWCh (SD)	4.4 (1.5)	4.7 (1.7)	0.256
Median	4.2	4.9	
Range	1.6–7.0	1.0–7.0	
95% CI for mean	4.0–4.8	4.3–5.2	

Following analysis of the results of both phases of the study the findings were considered in relation to each other and areas of convergence explored.

3. Findings

3.1. Quantitative phase

3.1.1. Demographics

Overall, 161 women consented to the quantitative phase. Baseline characteristics for women using telemetry (n = 74) and wired monitoring (n = 87) were broadly similar and presented in Table 1.

3.1.2. Perceived Control in Childbirth (PCCh) and Satisfaction with Childbirth (SWCh) questionnaire

Aggregate score data for both control and satisfaction are presented in Table 2. There was no difference between women having any telemetry in labour compared to wired monitoring for either aggregate score. Aggregate score analysis for the subgroups of women having telemetry for more than 50% of their labour, less than 50% of their labour, and wired monitoring is presented in Table 3. Women using telemetry for over 50% of their time in

Table 3
Sub-group analysis of aggregate scores for PCCh and SWCh.

	Telemetry >50% of CEFM n = 48	Wired n = 64	p	Telemetry <50% of CEFM n = 16	Wired n = 64	p	Telemetry >50% of CEFM n = 48	Telemetry <50% of CEFM n = 16	p
Mean aggregate score for PCCh (SD)	5.3 (0.8)	4.9 (0.9)	0.047	4.8 (0.7)	4.9 (0.9)	0.719	5.3 (0.8)	4.8 (0.7)	0.062
Median	5.5	5.1		5.0	5.1		5.5	5.0	
Range	2.7–6.0	2.5–6.1		3.08–5.58	2.5–6.1		2.7–6.0	3.08–5.58	
95% CI for mean	5.0–5.5	4.7–5.2		4.5–5.2	4.7–5.2		5.0–5.5	4.5–5.2	
Mean aggregate score for SWCh (SD)	4.5 (1.5)	4.7 (1.7)	0.539	4.0 (1.2)	4.7 (1.7)	0.122	4.5 (1.5)	4.0 (1.2)	0.227
Median	4.6	4.9		3.8	4.9		4.6	3.8	
Range	1.6–7.0	1.0–7.0		2.3–6.9	1.0–7.0		1.6–7.0	2.3–6.9	
95% CI for mean	4.1–5.0	4.3–5.2		3.4–4.7	4.3–5.2		4.1–5.0	3.4–4.7	

Table 4
Positions in labour.

	Wired N = 17	Telemetry N = 41	Probability, p
Off the bed (or on knees using the back of the bed for support), mean % (SD)	22 (34.0)	59 (24.6)	<0.005
Semi-recumbent or lateral in the bed, mean % (SD)	61 (27.5)	28 (18.7)	<0.005
Sitting upright in bed, mean % (SD)	15 (15.0)	11 (15.5)	0.421
Lithotomy, mean % (SD)	2 (2.7)	2 (3.7)	0.468

labour had significantly higher scores for PCCh questions than women having wired monitoring (5.3 versus 4.9, p = 0.047).

3.1.3. Positions in labour and clinical outcome data

Positions in labour data were available for 58 women in the study, the majority of this for women using telemetry (n = 41) and is presented in Table 4. Women in the telemetry group spent a greater proportion of their time in labour off the bed (or on her knees using the back of the bed for support; 59%) compared to women in the wired group (22%). Women in the telemetry group spent less time in labour semi-reclined or lateral in the bed (28% versus 61% wired group). Women in both groups spent a similar amount of time in labour upright in the bed ('chair' position) and in lithotomy.

Clinical outcome data is presented in Table 5. Within the telemetry group women spent a mean time using telemetry of 6.3 h (range 1.5–17.3 h). The study was not powered to detect differences in clinical outcomes, however there were some notable (albeit non-statistically significant) differences observed. More women using telemetry had an emergency caesarean section compared to women having wired monitoring (21.6% telemetry vs 13.8% wired group). The epidural rate was lower for women having telemetry than women having wired CEFM (39.2% telemetry vs 46.0% wired) and fetal blood sampling was lower for women having telemetry than women with wired CEFM (9.5% telemetry vs 19.5% wired). Women having telemetry had higher rates of giving birth in an upright position than those having wired CEFM (29.7% telemetry vs 12% wired) and women having wired CEFM had more intact perineums (26%) than women with telemetry (16.2%).

3.2. Qualitative interviews

3.2.1. Participants

Interviews were conducted with 13 midwives (including 1 student), 10 women and 2 partners. Participant characteristics are presented in Table 6 and Fig. 1. Six of the twelve qualified midwives had previous employment at other NHS Trusts where telemetry

Table 5
Clinical outcome data.

	Telemetry n = 74	Wired n = 87
Length of 1st stage of labour, hours (SD)	n = 63 5.0 (3.7)	n = 75 4.4 (3.3)
Mean time 2nd stage of labour, hours (SD)	n = 61 1.4 (1.4)	n = 75 0.9 (1.0)
Artificial rupture of membranes, N (%)	60 (81.1)	69 (79.3)
Oxytocin used in labour, N (%)	56 (77.8)	67 (77.0)
Mean Time spent on any CEFM, hours (SD)	10.0 (5.2)	8.5 (5.6)
Range	1.5–23.9	1.5–23.0
Mean time spent on telemetry, hours (SD)	6.3 (4.0)	
Range	1.5–17.3	
Mode of birth, N (%)		
• Spontaneous vaginal	37 (50.0)	50 (57.5)
• Ventouse	9 (12.2)	7 (8.0)
• Forceps	12 (16.2)	18 (20.7)
• Emergency Caesarean section	16 (21.6)	12 (13.8)
Pain relief, N (%)		
• Water/pool	5 (6.8)	0 (0.0)
• Entonox	65 (87.8)	68 (78.2)
• Pethidine	9 (12.2)	8 (9.2)
• Diamorphine	11 (12.6)	7 (9.5)
• Remifentanyl	15 (20.3)	18 (20.7)
• Epidural	29 (39.2)	40 (46.0)
• Spinal anaesthetic	9 (12.2)	4 (4.6)
• General anaesthetic	1 (1.4)	0 (0.0)
Fetal scalp electrode use, N (%)	19 (25.7)	26 (31.0)
Fetal blood sampling, N (%)	7 (9.5)	17 (19.5)
Birth position (normal birth only), N (%)		
• Semi-reclined/side	21 (56.8)	31 (62.0)
• Lithotomy	5 (13.5)	13 (26.0)
• All fours/upright/standing/pool	11 (29.7)	6 (12.0)
Perineum (normal birth only), N (%)		
• Intact	6 (16.2)	13 (26.0)
• 1st degree tear	18 (48.6)	16 (32.0)
• 2nd degree tear	10 (27.0)	15 (30.0)
• 3rd degree tear	0	0
• 4th degree tear	0	0
• Episiotomy	3(8.1)	6 (12.0)
Estimated blood loss, mls, mean (SD)	509 (401.6)	550 (426.3)
Breastfeeding within first hour (for those intending to breastfeed), N (%)	53 (82.8)	47 (71.2)
Delayed cord clamping, N (%)	52 (71.2)	55 (64.7)

Table 6
Participant characteristics – midwives.

Grade of midwife	Number
Student midwife	1
Band 5 (newly qualified)	2
Band 6 (>2 yrs since qualified)	5
Band 7 birthing unit co-ordinator (senior midwife)	3
Band 7 ward manager (senior midwife)	2
Total	13

was also used. All interviews with women took place within the first eight weeks of giving birth.

3.2.2. Core category: a sense of normality

The use of telemetry for CEFM during labour led directly to women experiencing a 'sense of normality'. This manifested in increased mobility during labour and women perceiving labour as more 'physiological' with less intervention. Midwives also perceived that telemetry contributed to this sense of normality both in how the woman's labour progressed and, and how the

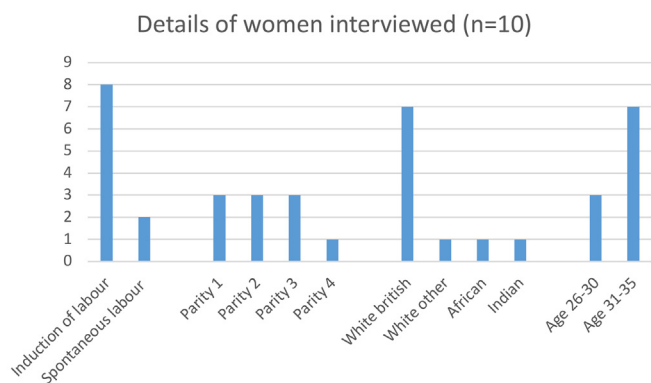


Fig. 1. Details of interviews with women.

woman moved and behaved in the room. The grounded theory of the impacts of telemetry on labour and birth is represented diagrammatically in Fig. 2. The core category, ‘A Sense of Normality’ spans across three main categories: ‘Being Free, Being in Control’, ‘Enabling and Facilitating’ and ‘Maternity Unit Culture’. All the categories included both women’s and midwives’ experiences and narrative segments present widely shared ideas from the interviews.

• *Being Free, Being in Control*

Most of the women interviewed mentioned previous experiences of wired CEFM, either in a previous labour or during the current induction of labour process. Many of these experiences were negative and women spoke of being ‘tied’ and ‘strapped’ to the bed, and ‘attached’ or ‘hooked up’ to a machine. This led to feelings of lack of control, restriction, illness, vulnerability and disembodiment, as articulated by Anna:

‘I think when I was hooked up to these machines, I heard all this noise around me, I couldn’t move, I felt very done to, and I felt less in control of my labour, I felt I was very much part of a medical model. I kind of felt like, just do as you’re told, just stay on the bed, don’t move, be a good patient’ (2nd baby).

Previous experiences impacted on the preferences and expectations of fetal monitoring for the current birth. Women actively discussed fetal monitoring options with midwives in the antenatal

period, some reported discussions about telemetry. However, others only became aware of telemetry after admission to the labour ward and a midwife suggested it.

All the women interviewed expressed that telemetry enabled them to be much more mobile than wired CEFM and were able to move freely around the labour room. They were able to get off the birthing bed, using birthing balls, beanbags, and the bed for support, and adopt different and desired positions during labour. Women described moving during labour as physically rewarding along with giving them increased ownership and control of the birth space and environment:

“I felt like I owned the room, I owned the space . . . I felt like I was at home giving birth. And that was a very different experience to my previous child when all the lights were turned on, I was very much in a hospital giving birth. Whereas this time around I felt that because I could get up and use the beanbag or go and use the toilet and get a glass of water, sit with my partner, I felt like this space is mine and I think that made me feel at ease in the labour.” (Amanda, 2nd baby)

For most women, the ability to be off the bed, with greater autonomy over their actions led to feeling greater control of what was happening during labour. Perceived control led to a sense of empowerment, a belief in their innate ability to birth and for some, a healing of past negative experiences. Women expressed that being more mobile, upright and in control directly impacted on pain relief requirements and medical intervention.

“I think if I hadn’t had the telemetry and I had gone on [wired] continuous monitoring straight away I think we’d have ended up in theatre a lot earlier. Because I think if I’d been lay on the bed I don’t think things would have progressed as quickly as they did I think it was the staying active and staying on the ball as much as I could and not lying down for as long as I could that helped with all that definitely. And it just, I think it made me realise that I was a lot more in control and that my body could do it, rather than just being right, you’re lying down, . . . I think there would have been a lot more intervention, definitely.” (Miranda 4th baby).

One of the most important aspects for all women using telemetry was the ability to go to the bathroom independently, resulting in increased feelings of dignity during labour. Many women spoke of previous experiences of walking to the bathroom with wires dangling around their necks or being asked to use a bedpan. Having a private space, being able to shut the bathroom

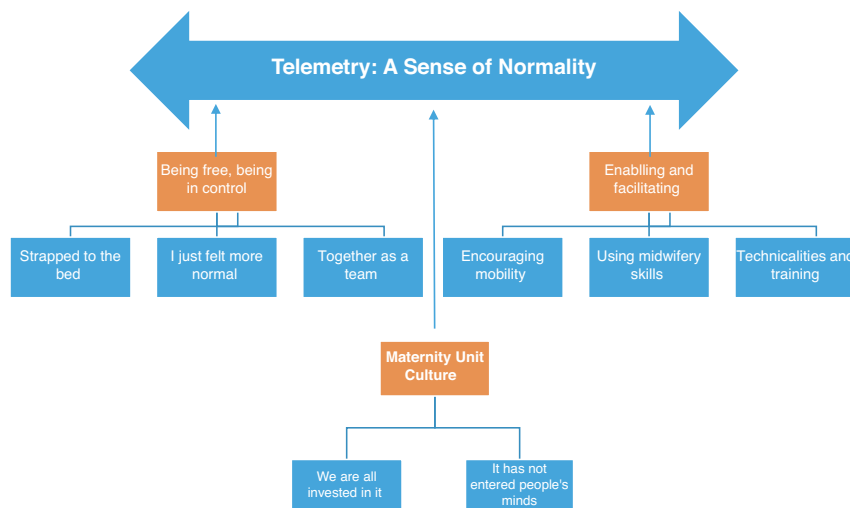


Fig. 2. Grounded theory: a sense of normality.

door and be reassured the baby was still being monitored was hugely important for the women. Anna described her experience:

“I could shut the door, have privacy, even at parts of the labour where there was a lot of blood and all of that, the fact that I could get up and move and they could change the sheets, it just felt so much more respectful and so much more dignified than the first time around” (2nd baby)

Using the bathroom independently was also viewed as doing something ‘normal’, something that is done every day and not treated as different when in labour. Women felt more themselves and part of a natural labour process that was able to progress and have less intervention. None of the women mentioned a ‘normal birth’, as would be defined in a midwifery sense; for them it was doing normal physical actions in labour that were important:

“Being up and walking about, I felt like a normal person, although I was having a baby I felt like a normal person rather than being ill on a bed, so it was nice, I enjoyed it” (Claire, 1st baby).

Lack of the physical presence of wires and more freedom when off the bed promoted closer physical contact between some women and their birth partners. This was also observed by the midwives. Partners were able to suggest different positions to women in labour and be more involved than sitting beside the bed, being a passive observer. Women spoke of a positive feedback loop where their reduced anxiety in labour was seen by their partners who in turn felt less anxious:

“I think he was a lot less stressed because he could see that I was able to be on my feet. So, he kind of knew that, oh, she must be okay because she’s moving about, and it was probably more normal for him. So, I think he was calmer. And I think with that we probably did get a sense of normality, that this is us together as a team, giving birth to our baby and feeling quite okay with that” (Nina, 2nd baby).

“But when she was just on the bed, you know, most of that was just me sat there, a few conversations with midwives. At least when it came to the fact that she could move around, I could go and get the ball for her . . . so although it’s just simple things . . . they just made me as the partner feel a lot more included and more useful to the whole thing. So that was a big positive . . . because when you’re just sat there, you know, your partner’s in discomfort or pain, you just feel helpless (Mark, Amanda’s partner).

Some women also expressed that being mobile had an impact on how decisions were made around the labour and birth and that standing and being upright placed them on a more ‘even-footing’ with staff. For these women, when they felt more in control of their labour they felt more in control of decisions and more empowered to speak up.

“I think even if they [the medical staff] had of spoke to me about a C-section, I think because of the experience of being in control, being able to move, being able to have a choice of what I can do, I would have felt more in control of my decisions. So I would have felt if you were talking to me about a C-section, because I felt in control this whole time I would have felt more empowered to make the right decision” (Anna, 2nd baby).

• *Enabling and Facilitating*

This category was predominantly centred on the midwives’ experiences of telemetry and their fundamental role in facilitating its use. The interviews with women corroborated what the midwives reported, and this helped to saturate the category. All the midwives interviewed recognised the benefits of mobility

during labour and reported trying to encourage mobility with wired CEFM but that sometimes this was more problematic. Midwives described in detail how telemetry facilitated more options for women including being able to use a birthing pool, birthing balls and other equipment, and enabled autonomy and ownership over the space. Midwives acknowledged, however, that not all women wished to be mobile, particularly if they had a protracted induction of labour process and were overly tired.

Many of the midwives reported that the use of telemetry led to a labour that felt more ‘low-risk’, more ‘normal’. Midwives viewed telemetry as enabling choice around monitoring options and mobility:

“So, I think it moves away from the medicalised birth, doesn’t it, in terms of women, the medicalised picture of a lady in labour is being attached to a monitor, being attached to a drip on the bed. And whilst we look after a lot of ladies on here that are being induced, that are perhaps going down a bit more of a medical path telemetry gives women a bit more of a choice. It allows them to be more mobile. And perhaps maybe normalises more complex women.” (Sarah, senior midwife).

Some midwives also described increased satisfaction when looking after women who were mobile using telemetry. All the births were in obstetric-led settings and midwives found fulfilment in drawing on all of their midwifery skills, which incorporated supporting birth in water and positions other than semi-reclined on the bed:

“And I felt like I fulfilled her birth plan by her being able to do that [be mobile]. And it was really satisfying to see it, because it just worked so brilliantly. And you get job satisfaction then, because you think, oh, you know, I’ve been able to help facilitate a normal birth, make what could have been a high-risk situation low risk. It was just lovely” (Harriet, midwife).

Both maternity units had birthing pools that could be used with the telemetry, however none of the women interviewed had used a pool during labour. Guidelines for who was able to use a pool often meant that women were unable to use them (for example if requiring oxytocin stimulation during labour).

Midwives from one of the maternity units described their more updated telemetry as giving an excellent recording and no difference in quality than wired monitoring. Some midwives at this maternity unit would go to actively find a telemetry machine if not present in the labour room. The other maternity unit, who had older models and a different brand of machine, had more issues with getting a good quality recording of the fetal heart and ‘loss of contact’ could be an issue. This sometimes resulted in a change to wired CEFM. Midwives described ways of managing ‘loss of contact’ such as documenting on the paper recording when there was loss of contact related to the woman’s movement rather than real concern with the fetal heart.

• *Maternity Unit Culture*

It was apparent that use of telemetry in the two maternity units differed. Many staff at one of the units viewed the use of telemetry as part of a package of care offered to women with more complex pregnancies. This approach was centred on prioritising a more equitable experience between women who were able to labour and birth in a midwifery-led setting (often with birthing pools, enhanced lighting, and ‘home-like’ furnishings) and those on an obstetric-led setting. Purchase of more telemetry monitoring was part of midwifery-led leadership work improving the obstetric-led labour room environment.

“Quite often the women that come from the birth centre, say an intrapartum transfer, they come from this spa like environment

and you know we're doing our very best but it is a medical environment despite everything that we are doing so you feel if you can offer them telemetry it's like you're not shattering their birth experience, they're still getting the monitoring that they require but they know you are respecting their wishes and you're supporting them to be mobile and to have what they want whilst addressing the need for the transfer" (Lucy, senior midwife).

Use of telemetry appeared less 'embedded' in the other unit. Some of this was due to poor experiences with the technology and poor quality recordings, training issues and availability of the machines. However, midwives from this unit also expressed that providing labour care that facilitated mobility and supported physiological birth was challenging in a very busy, large unit that was caring for women with often highly complex pregnancies. For many midwives, the use of telemetry was not something that they thought about offering to women.

"I think fundamentally it is a highly medicalised unit. I think it's quite hard to change that. We have four high dependency rooms. We have a critical care nurse on every shift. We're looking after women with very complex medical histories. Our ward rounds are massive in terms of obstetric input, in terms of anaesthetic input. And midwives can sometimes be a bit of a lone voice in terms of championing normal birth. So it can be quite challenging. And sometimes I think the culture is just to, kind of, get on with the medicalised side of it." (Sarah, senior midwife).

The different cultures of the maternity units impacted on the priority given to women having access to telemetry. When good quality telemetry was combined with an environment that incorporated elements of low risk midwifery care and encouraged calm, quiet labour spaces and promotion of physiological labour and birth, then telemetry was used enthusiastically for women whose fetuses were monitored continuously in labour.

4. Discussion

This is the first recent exploratory study of telemetry use in UK settings. The findings are novel and provide a broad understanding of its use in the context of contemporary midwifery care provision in two maternity units in the UK. The findings will support midwives in recommending the use of telemetry for women who are having CEFM during labour. The main themes resulting from synthesis of both phases of the study are: the impact of telemetry on mobility during labour; the influence of telemetry on normality and control during labour; and telemetry and its contribution to upholding dignity and human rights in labour.

4.1. The impact of telemetry on mobility during labour

Within both parts of the study, women adopted different positions for labour, were mobile and upright when using telemetry for CEFM and more so than when using wired CEFM. The position in labour data demonstrated that women who used any amount of telemetry during labour spent more time off the bed, or on their knees using the back of the bed for support, and less time in a semi-recumbent or lateral position on the bed. This data was collected from the labour and birth notes documented by staff and it was notable that the position of the women during labour was documented more frequently for women having telemetry than those having wired CEFM (who may be more likely to remain on the bed). There was some evidence from the observational clinical outcome data that women using telemetry gave birth in more upright positions than those having wired CEFM (29.7% vs 12%) which correlates with the interview findings that

women adopted many different positions for labour and birth when using telemetry. The qualitative data from both the women and the midwives confirmed that women were indeed more mobile, rather than merely adopting one other position in labour that was not semi-recumbent. Women spoke of walking, moving, swaying, and changing position many times. Midwives also reported that telemetry enabled them to encourage women to be more mobile and to use a birthing pool when appropriate. Being mobile and consequently upright has distinct advantages in the first stage of labour such as decreasing the length of labour, the risk of caesarean section and the request for epidural anaesthesia [7,26]. Clinical outcome data showed some evidence that the epidural rate was lower for women in the telemetry group compared to the CEFM group (39% vs 46%) and a larger study powered to detect this difference is worth exploring.

4.2. The influence of telemetry on perceptions of normality and control during labour

Women in this study who used telemetry were more mobile and this mobility led to increased feelings of control over their environment, control over what was happening in labour and perceived control over pain relief and levels of intervention, leading to increased perception of normality. All of the women interviewed had used telemetry for the whole of their labour which aligns with the sub-group analysis findings for women who used telemetry for over 50% of their labour scoring higher on the aggregate PCCh score.

Previous work has found perceptions of increased control in labour to be an important factor in contributing to a woman's overall positive birth experience [27–30], and freedom to ambulate a major variable contributing to a conceptual model of control [31]. Control is a complex term and may involve various concepts and phenomena that contribute to its definition. The findings reporting in this study resonate with much of the literature and language on control and satisfaction, particularly the concepts of 'internal' (control over body and behaviour) and 'external' (control over what is done to you) control [27,32]. Control was described and defined in different ways during the interviews. Women expressed that telemetry influenced external control, in that they felt more involved with decision-making and procedures. Women felt less like a 'patient' when mobilising with telemetry, more an active participant in labour, and less that things were being 'done to' them. The women's ability to access equipment within the birthing environment and increased physical and emotional support from partners that telemetry conferred, also influenced external control. Internal control was influenced in a positive way by telemetry. Women were able to adopt different positions during labour, they were freer, and for some women this led to a perceived ability to cope with pain and avoid unnecessary interventions. The ability to perform basic bodily functions independently also affected the control that women felt during labour and women reported increased feelings of autonomy, self-determination and agency when using telemetry in labour. Women also expressed that they felt more involved in decision-making. This resonates with Downe [33] who found that most women wish to birth 'normally' but that 'even when intervention is needed or wanted, women usually wish to retain a sense of personal achievement and control by being involved in decision-making'.

Women and midwives in this study used the term 'normal' and 'normalise' frequently even though they were providing or receiving care in obstetric-led 'high-risk' settings. Midwives felt that telemetry could contribute to 'normalising' a woman's labour, and rather than a woman lying on a bed in a patient role she could move around much like a woman in 'normal' labour would do. The focus on technology was minimised when women were using

telemetry and women felt more like themselves. Women spoke of being able to do 'normal' things like get personal items from bags and use the bathroom without assistance or supervision and this engendered a sense of de-medicalisation despite labours that had been induced or were being augmented.

4.3. Telemetry and its contribution to upholding dignity and human rights in labour

Bodily autonomy was a crucial element reported during the interviews with both women and midwives, and telemetry was seen to facilitate this, particularly around control over private space and use of the bathroom. In a Dignity in Childbirth Survey [34] women who were labelled 'high risk' were perceived to be less likely to receive care that upheld their dignity. The impact that telemetry has on dignity, agency, autonomy and control links intrinsically with the subject of human rights in childbirth. Human rights 'protect dignity and promote equality' and are protected by the Universal Declaration of Human Rights [35]. Many health care practitioners and midwives may view the protection of human rights during childbirth as something more aligned with care in low and middle-income settings. Hill [36] states however, 'the notion that the violation of women's rights in childbirth is something that happens 'elsewhere' and not in the privileged 'developed' world, is all too prevalent' (p 286). When considering accounts of women (from both the literature and from interviews for this study) who have experienced wired CEFM, then terms used such as 'mechanical monster', 'restriction' and the ubiquitous 'being strapped or tied to the bed' very much bring the protection of human rights to the forefront of discussion. Central also to human rights is the issue of consent. Increasing intervention and medicalisation of childbirth has resulted in some care that women receive very much routinised within protocols and done without consent. The use of conventional wired CEFM is one such routine with women nearly always cared for on a bed without this being posed as a choice; the birth environment is very much a 'surveillance room' as opposed to a 'sanctum' [37]. Findings from this study show that the use of telemetry during labour can contribute vastly to upholding many of the underlying premises of human rights; namely dignity, respect and autonomy and align with the concepts of humanising birth and respectful care. When viewing care in labour and birth through a human rights lens then the benefits of telemetry for women having CEFM during labour become hugely powerful.

4.4. Limitations of the study

The overall sample did not include women who did not speak or understand English and within the interviews all but two women were White British, educated to a professional level and over 25. The sample represents an inherent problem within healthcare research within the UK and strategies to specifically look at involvement of BAME and more vulnerable groups in health research is needed [38]. The cohort data was complicated by the fact that a number of women within the telemetry arm did not use telemetry for the entirety of the labour and this may have contributed to the lack of difference in any of the clinical outcomes between the groups. Thus, the post-hoc sub-group analysis conducted requires further research to validate. Reasons for the discontinuation of telemetry could have been explored and increased depth of the findings. The majority of women within the cohort were having induction of labour which may impact on the generalisability of the findings for women in spontaneous labour. However, induction of labour rates are rising in the UK and are currently around thirty three percent [39], so

the findings are relevant for a considerable group. Despite national recommendations of offering telemetry to all women who require CEFM in labour, this was done variably at both units in the study. Women using telemetry in both parts of the study may have been women who were more interested in this type of monitoring when it was discussed with them during the consent process and then asked for it on the labour ward. These women may have been more motivated to be mobile in labour and achieve physiological normal births which may have influenced some of the findings. Similarly, midwives who offered the use of telemetry to women may have been more likely to support mobility and different positions in labour and have an approach to labour that was more supportive of encouraging normal physiology. These limitations may be mediated by further research where women are allocated to a specific type of monitoring.

4.5. Implications for future research

Further research in this area is warranted given the novel findings reported. Consideration should be given to a large multi-centred randomised controlled trial, including health economic evaluation, of CEFM versus telemetry. In some places, CEFM is used universally for all women irrespective of fetal hypoxia risk and therefore consideration could also be given to including an intermittent auscultation arm for women at low risk of intrapartum fetal hypoxia. This study should be powered to determine if different types of fetal monitoring have any impact on clinical outcomes such as use of epidural, length of stages of labour and mode of birth and include qualitative aspects. Such a study may be more difficult to undertake solely within the UK as more maternity units purchase and utilise telemetry. Future research is also needed on the impact of the birth environment for women having CEFM and consideration of telemetry as a part of a 'package of care' that includes a more home-like environment for women who are giving birth in consultant-led maternity units.

5. Conclusion

This study is the first contemporary examination of the use of telemetry during labour and presents novel and interesting findings. When women use telemetry they adopt different positions in labour and are more mobile; this in turn leads to an increased sense of control, dignity and normality and supports the recommendation that all women who are having CEFM in labour should be offered telemetry. When the fetal heart is continuously monitored during labour, access to telemetry provides an opportunity to improve women's experience and physiological capability. The use of telemetry during labour also contributes to humanising birth [40] for women who have CEFM and its use places them at the centre and in control of their birth experience.

Conflict of interest

None declared.

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Author contributions

Kylie Watson: conceptualisation, methodology, formal analysis, investigation, writing - original draft, writing - review and editing, funding acquisition. Tracey Mills: conceptualisation, methodology, formal analysis, writing - review and editing, supervision. Tina Lavender: conceptualisation, methodology, formal analysis, writing - review and editing, supervision.

Conflict of interest

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