Temperature measurement of babies born in the pre-hospital setting: analysis of ambulance service data and qualitative interviews with paramedics

Laura Goodwin[1*], Sarah Voss[1], Graham McClelland[2,3], Emily Beach[1], Adam Bedson[4], Sarah Black[4], Toity Deave[1], Nick Miller[1], Hazel Taylor[5], Jonathan Benger[1].

[1] School of Health and Social Wellbeing, University of the West of England, Glenside Campus (1H14), Blackberry Hill, Bristol, BS16 1DD, England

[2] North East Ambulance Service NHS Foundation Trust, Goldcrest Way, Newcastle upon Tyne, NE15 8NY, England

[3]Stroke Research Group, Population and Health Sciences Institute, Henry Wellcome Building, Newcastle University, NE1 7RU, England

[4] South Western Ambulance Service NHS Foundation Trust, Eagle Way, Exeter, EX2 7HY, England

[5] Research Design Service – South West, University Hospitals Bristol and Weston NHS Foundation Trust, Upper Maudlin Street, Bristol, BS2 8AE, England

*corresponding author

Address: School of Health and Social Wellbeing, Room 1H14, Glenside Campus Bristol, BS16 1DD

Email address: laura.goodwin@uwe.ac.uk, Twitter: @laurakgoodwin

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ABSTRACT

Background: Birth before arrival at hospital (BBA) is associated with unfavourable perinatal outcomes and increased mortality. An important risk factor for mortality following BBA is hypothermia, and emergency medical services (EMS) providers are well-placed to provide warming strategies. However, research from the UK suggests that EMS providers (paramedics) do not routinely record neonatal temperature following BBA. This study aimed to determine the proportion of cases in which neonatal temperature is documented by paramedics attending BBAs in the South West of England and to explore the barriers to temperature measurement by paramedics.

Methods: A two-phase multimethod study. Phase one involved an analysis of anonymised data from electronic patient care records between 1st February 2017 and 31st January 2020 in a single UK ambulance service, to determine: 1) the frequency of BBAs attended; 2) the percentage of these births where a neonatal temperature was recorded, and what proportion of these were hypothermic. Phase two involved interviews with 20 operational paramedics from the same ambulance service, to explore their experiences of, and barriers and facilitators to, neonatal temperature measurement and management following BBA.

Results: There were 1582 'normal deliveries' attended by paramedics within the date range. Neonatal temperatures were recorded in 43/1582 (2.7%) instances, of which 72% were below 36.5°C. Data from interviews suggested several barriers and potential facilitators to paramedic measurement of neonatal temperature. Barriers included unavailable or unsuitable equipment, prioritisation of other care activities, lack of exposure to births, and uncertainty regarding responsibilities and roles. Possible facilitators included better equipment, physical prompts, and training and awareness-raising around the importance of temperature measurement.

Conclusions: This study demonstrates a lack of neonatal temperature measurement by paramedics in the South West following BBA, and highlights barriers and facilitators that could serve as a basis for developing an intervention to improve neonatal temperature measurement.

KEY MESSAGES

Section 1: What is already known on this subject
• There is limited evidence to suggest that EMS providers (paramedics) record the temperature of newborns in around 10% of pre-hospital births. • The barriers to temperature measurement by paramedics are unknown.
Section 2: What this study adds
• In the qualitative element of this study, paramedics in a single ambulance service in England reported that barriers to newborn temperature measurement included unavailable or unsuitable equipment, prioritisation of other care activities, lack of exposure to births, and uncertainty regarding responsibilities and roles. • Potential facilitators include more suitable equipment, physical prompts, and training and awareness-raising.

BACKGROUND

Around 0.5% of all UK births are unplanned out of hospital births, or 'Births Before Arrival' at hospital (BBA)[1]. These often occur without the attendance of a qualified midwife or obstetrician. Paramedics are frequently called to such births, arriving shortly before or after delivery. It is estimated that 3,700 BBAs are attended by the UK ambulance service each year.[2]

BBA is associated with unfavourable perinatal outcomes and increased perinatal mortality.[3] One of the most significant risk factors for neonatal mortality and morbidity for these babies is hypothermia,[4-6] and it is the only modifiable predictive factor for perinatal outcomes in the pre-hospital setting.[6] Hypothermia in newborns is

defined as an axillary temperature <36.5°C.[7] Evidence suggests a direct relationship between hypothermia and neonatal mortality, especially for premature (<37 weeks) or low birth weight (<2500g) infants; in low birth weight infants, mortality increases by 28% per 1°C decrease in admission temperature below 36.5°C.[7]

Newborns lose body heat quickly, especially pre-hospital, where environmental temperature is difficult to control. For every minute that a newborn is exposed, their temperature can drop by 0.1°C - 0.3°C.[8] In the UK, paramedics are the clinicians best placed to improve temperature management for BBA newborns; for example by providing hats, encouraging skin-to-skin contact with the mother, increasing the ambient temperature and/or conveying newborns to hospital when required.[9] The risk of neonatal hypothermia following BBA is recognised by the Joint Royal Colleges Ambulance Liaison Committee (JRCALC) guidance on 'Care of the newborn', which states that temperature assessment should be one of the 'initial clinical assessments' following BBA.[10] Despite this guidance, there is evidence that paramedics do not routinely record neonatal temperature following BBA.[11] In a prior study from a single ambulance service in England conducted between 2017-2018, the temperature of the newborn was recorded in 10% of paramedic-attended births and 72% of these were below 36.5°C;[11] the lower limit recommended by the World Health Organization.[12] A similar study in Australia found that 2% of babies whose births were supported by paramedics had temperature measurements recorded, and that all were hypothermic (< 36.2°C).[13]

Given these data, it is important to determine whether similar rates of temperature measurement exist in other jurisdictions, and if so why paramedics do not routinely record neonatal temperature following BBA.

The aims of this study were (1) to determine how often BBAs occurred in South Western Ambulance Service NHS Foundation Trust (SWASFT), the proportion of neonatal temperature measurements recorded, and the prevalence of hypothermia; (2) to explore SWASFT paramedics' experiences of attending BBAs, including barriers and facilitators to neonatal temperature measurement.

METHODS

Two-phase multimethod study involving the SWASFT ambulance service in the South West of England. Anonymised data were extracted from electronic patient care records (ePCRs) to explore: 1) how often SWASFT paramedics attend BBAs; 2) the percentage of BBAs where newborn temperature measurements were recorded, and what proportion of these were hypothermic (phase one). Semi-structured telephone interviews were conducted with 20 operational paramedics from SWASFT to explore paramedics' experiences of BBA, including the barriers and facilitators to neonatal temperature measurement and management (phase two). Exploratory research is a methodological approach that investigates research questions that have not been studied in depth previously, [15] and we used this exploratory qualitative approach to investigate, explain and describe complex processes and behaviours within the context in which they occur.

Setting

SWASFT is a large ambulance service covering an area of 10,000 square miles. The Trust serves a total population of over 5.5 million and employs over 4,000 clinical and operational staff[14] including 2,263 qualified paramedics in permanent positions.

At the time of data collection for this research (January 2021) there were no additional SWASFT guidelines on 'care of the newborn', and JRCALC guidance[10] was followed. This guidance states that when both paramedics and a midwife are present, it is the midwife's responsibility to manage the labour and birth, and ambulance clinicians should work under their direction.[10] The midwife can either discharge the paramedics and arrange for ongoing community midwifery care, or arrange for the ambulance service to convey mother and baby to the most appropriate facility.[10]

Phase one: Analysis of anonymised data extracted from electronic patient care records

Design

All ePCRs from a three-year period between 1st February 2017 and 31st January 2020 were searched by the Clinical Information and Records team at SWASFT for a diagnosis code of 'Normal Delivery Before Ambulance

Arrival', 'Normal Delivery in Ambulance', or 'Normal Delivery in Public Place'. Multiple births (i.e. twins) are not included in the 'normal delivery' category, and records were excluded if they referred to a birth in hospital, a miscarriage, stillbirth, or birth of a very preterm infant (<24 weeks gestation).

Anonymised data regarding the birth and demographics of the mother were extracted from the ePCRs by SWASFT and passed to the lead author for analysis. This included: incident number; relevant timings (time of birth, time at hospital, time placenta delivered, time of observations); age of mother; gestation; parity of mother (number of previous births); clinical observations of the baby (temperature, heart rate, respiratory rate, APGAR); anonymised free-text. Data were exported to Microsoft Excel and descriptive statistics were used to summarise the data; percentages for binary or categorical variables and either means and standard deviations for continuous variables, or in cases where the distribution was very skewed (as with parity) the median and range.

Phase two: Interviews with paramedics

Participant recruitment

A purposive sampling technique was adopted to ensure rich information about the topic.[16] Participants were eligible to take part if they were working operationally for SWASFT as a paramedic registered with the Health and Care Professions Council, were aged 18 years or over, and had experience of attending a BBA. Because BBA is relatively rare, paramedics with less than one year's experience were excluded.

The study was promoted in the weekly SWASFT news bulletin and social media channels. Eligible participants were invited to contact the lead author to take part. Potential participants received a study information sheet, privacy notice and consent form via email. Verbal confirmation of consent was audio-recorded at the start of the telephone interview. A £10 gift voucher was offered to each participant to acknowledge their contribution.

Design

A topic guide was drafted by the research team, based on findings from phase one of the study, and was reviewed and refined by the Patient and Public Involvement (PPI) contributors (described below). Questions

explored participants' experiences of attending BBA, with a specific focus on temperature measurement and management. Telephone interviews were conducted by an experienced qualitative researcher (LG) at a time convenient to the participant and audio-recorded.

Data analysis

Audio files from interviews were transcribed verbatim and anonymised. A well-established iterative process for thematic analysis was used to analyse each data source[17], with the support of NVivo software. The lead author read the transcripts several times and then coded selections of text to represent instances of a concept. The same author reviewed codes in terms of their relationship to other codes and combined these to create more developed themes. From this analysis, distinctions could be made between the different levels of themes. Two members of the study team (SV and TD) checked 20% of the transcripts for alignment with the themes identified by the lead author and presented in this paper. Data extracts were also shared with members of the PPI group to discuss interpretation of the data and to confirm the identified themes.

Patient and public involvement

PPI contributors, recruited via social media, included four women who had experience of giving birth in the pre-hospital setting, with paramedics in attendance. The lead researcher was in regular consultation with the group who advised on the research questions, structure and content of the interviews, data analysis, and dissemination strategy.

RESULTS

Phase one: Analysis of ePCRs

There were 1670 records identified with a diagnosis code of 'normal delivery' between 1st February 2017 and 31st January 2020. After excluding 88 cases (61 duplicate, 1 stillbirth, 1 <24 weeks and 25 not childbirth), 1582 individual childbirth cases ('normal deliveries') were included for analysis (Table 1).

Characteristics of women and their babies

The mother's age and parity were available in 1516 (96%) and 567 (36%) cases, respectively, and gestation data in 1263 (80%) cases. A summary of characteristics is provided in Table 1.

Neonatal temperature measurement

Forty-three (2.7%) of the 1582 cases of BBA had a neonatal temperature measurement recorded (Table 1). The mean initial temperature was 35.7°C, and the majority were below 36.5°C. The majority of temperature measurements were recorded on a separate neonatal ePCR, and the remainder were recorded in the free-text section of the maternal record. Where a separate neonatal record was created for the baby (86/1582; 5%) an initial temperature was recorded in 32.5% (n=28/86).

Table 1: Quantitative findings on neonatal temperature measurement

Characteristics of the eligible 1582 Women		
Age (n=1516)	Mean (SD)	30 (5.5)
Parity (n = 567)	Median (Range)	1 (0, 12)
Gestation in weeks (n =1263)	Mean (SD)	39 (1.9)
Neonatal Recorded Temperature Data		**Number (%)**
Temperature(s) recorded		43 (2.7%)
Hypothermia recorded (n=43)		31 (72%)
Location of recorded temperature(s) (n=43)	Maternal record	15 (35%) (0.9% of total)
	Neonatal record	28 (65%) (1.8% of total)
Number of individual temperatures recorded per case (n=43)	One	30 (70%)
	Two	7 (16%)
	Three	5 (12%)
	Four	1 (2%)
	Decreased	2 (15%)
	Stayed the same	2 (15%)

Number of cases with 2 or more temperatures (n=13) where temperature	Increased	9 (69%)
Initial Temperature (n = 43)	Mean (SD) (Range)	35.7 (0.9) (33.3-37.3)
	≥36.5°C	12 (28%)
	35.5°C-36.4°C	17 (40%)
	34.5°C-35.4°C	10 (23%)
	33.5°C-34.4°C	3 (7%)
	<33.5°C	1 (2%)

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165 **Phase two: Interviews with paramedics**

166 Participant characteristics

167 Twenty operational paramedics were interviewed during January 2021 (Table 2). The final sample size was

168 reached based on thematic saturation, as evidenced by consistency of themes across interviews.

169 Table 2: Participant characteristics

Characteristic	No. (%) of participants
Gender	
Female	10 (50)
Male	10 (50)
Approximate experience as paramedic (years	
1-5	6 (30)
6-10	6 (30)
11-15	6 (30)
16+	2 (10)
Paramedic training route (HEI = Higher Education Institution; IHCD = Institute of Health and Care Development)	
HEI	12 (60)
IHCD	8 (40)

Findings were organised into three overarching themes: (1) Experiences of conducting neonatal temperature measurement/management; (2) Barriers to neonatal temperature measurement; (3) Potential facilitators to neonatal temperature measurement. Quotes are used to illustrate key findings, where 'P' refers to participant number.

(1) Experiences of conducting neonatal temperature measurement/management

All participants emphasised the importance of drying and warming the baby as soon as it was born and of maintaining normothermia. Warming strategies were described, including the use of hats, skin-to-skin, warming the room and ambulance and warm towels. When asked about their experiences of conducting neonatal temperature measurement following BBA, the majority of participants reported that this was not part of their routine care.

> 'I don't think I've ever seen anybody else do it…and I've certainly not done it myself.' (P012)

All paramedics stated that if a temperature was measured then it would be recorded, however most were unaware that temperature measurement was part of the JRCALC guidance on care of the newborn.

During these discussions, several participants questioned their own reasons for not measuring neonatal temperature.

> 'It's a basic observation on any adult patient we go to… so why shouldn't the same be for a new-born baby?' (P017)

For those who reported previously measuring neonatal temperature following BBA, there was variation in where this information was recorded. Paramedics described two possible recording options: in the free-text box on the mother's patient care record, or in a separate neonatal record created for the baby (which includes a specific box for temperature). Some participants reported hesitancy in creating a neonatal record unless the baby needed an intervention like resuscitation, due to the baby not yet having a name or NHS number.

(2) Barriers to neonatal temperature measurement

Equipment

Paramedics stated that the main barrier to neonatal temperature measurement was a lack of reliable equipment. Participants said that the tympanic thermometers used for adult patients were unsuitable for infants under three months old, but that the digital axillary thermometers for neonatal temperature assessment were used infrequently and often missing or without battery power. Some participants questioned the accuracy of readings given by the equipment and stated that it could be difficult to get the probe into the correct place for long enough to obtain a reading. Others expressed concerns that completing observations could increase the risk of neonates becoming cold.

> 'The more we kind of like poke around and do observations and assessment, the more we're kind of like unwrapping them, and getting them potentially more cold.' (P005)

Another equipment barrier was the way the ePCR is designed. The lack of a specific box for neonatal temperature on the maternal record meant that paramedics did not view it as an important observation to complete and record.

> 'If there was a box to fill in for doing [a temperature] then…you'd get people doing them all the time.' (P019)

Prioritisation of other care activities

Paramedics noted that sometimes one paramedic crew would attend two patients (mother and baby). This meant that there could be a variety of different medical complications arising during or following the birth (e.g. postpartum haemorrhage), and that the mother would take priority.

> 'We don't really treat the baby as patient, you deliver it from the mum and then the mum's the patient, and the baby's a little bit of a bystander.' (P004)

The lack of priority given to temperature measurement also seemed to relate to paramedics' confusion regarding the care pathway for cold babies. Most participants were unsure on the lower limit for neonatal

normothermia and only one had ever conveyed a baby for concerns regarding neonatal temperature. Some felt that measuring temperature would not change the care they gave.

> 'I suppose maybe in their head they're thinking well if, if I'm doing everything I can to keep them as warm as I can what difference does it make what the temperature is because I can't do any more.' (P008)

Lack of exposure to births

The phrase 'jack of all trades' was used frequently during interviews, to describe participants' feelings regarding their confidence and experience of pre-hospital birth.

> 'The difficulty with being a paramedic and working for the ambulance service is that…most people, myself included, don't attend births very often.' (P006)

Participants reported their own lack of exposure to birth and suggested that this, coupled with multiple changes in practice relating to pre-hospital maternity care over recent years, could make it difficult to remember all of the different observations needed. Participants also reported a disconnect between their mandatory training in obstetrics and the realities of a BBA, which made it challenging to apply their training to the pre-hospital environment. While obstetrics training was provided in a delivery suite, paramedics stated that much of what they were taught did not easily transfer to the pre-hospital setting where factors such as lighting, space, equipment, clinical support and climate control were significantly different.

> 'We did a week in a maternity unit, but they were all quite what I'd call normal births and any births that weren't progressing normally were sent to the doctor led unit, so they kind of disappeared out of our view, and they have a whole lot more kit there than we'd have.' (P016)

While some participants had attended further obstetric training funded by SWASFT (specifically the pre-hospital practical obstetric multi-professional training (PROMPT)[18] course), they expressed concerns that there may be low uptake by paramedics as it was voluntary and undertaken in their own time.

Participants stated that lack of exposure to births impacted their confidence in handling newborns and attempting to take an accurate temperature measurement was seen as daunting by many.

Uncertainty regarding responsibilities and roles

Paramedics reported that if a baby looked well (i.e., good colour and tone) then they would not carry out any further observations. Some felt that temperature measurement was part of the midwife's care and so would leave this observation to be completed when a midwife arrived or when they conveyed the baby to hospital. However, participants suggested that midwives were often not in attendance when they arrived on scene, and many reported that they were often the person responsible for requesting midwifery presence; sometimes after the baby was born.

> 'The main problem I had was midwives wouldn't come across the [county] border. So, I spent – it probably took me about five phone calls to get…somebody out…it was quite stressful. And I did end up losing my temper and saying 'I don't care who comes, but somebody needs to come'.' (P003)

(3) Potential facilitators to neonatal temperature measurement

Equipment

Suitable thermometers were seen as one of the main potential facilitators to neonatal temperature measurement. Participants felt that there was a need for a thermometer which was designed more specifically for pre-hospital births, for example, with an increased battery life, increased speed of measurement and something that could be used without having to unwrap the baby.

> 'It needs to be something that is relatively cheap so that it can be definitely with each ambulance resource and relatively simple and robust, so you're not necessarily relying on having to have batteries changed every three months… something either single use or relatively simple that can be provided in the maternity packs rather than kept with other ambulance diagnostic equipment which is more likely to go walking.' (P011)

Further suggestions for changes to equipment included adding a box in the maternal ePCR to record neonatal temperature, or moving all of the neonatal observations to the separate neonatal record, with the understanding that creating this record would be part of routine care for all BBAs.

Prompts

Participants proposed the use of prompts or alerts to remind paramedics to perform and record neonatal temperatures and act on a low reading. Proposed prompts included the addition of alerts to the ePCR, and physical BBA 'checklists', 'flowcharts', or labels which could include the lower recommended limit for normothermia.

> 'Maybe having like a check sheet in the maternity pack. So, they often have the newborn resus guidelines or something in there, but maybe, I don't know, even as much as a brightly coloured tag attached to the temp probe saying 'take baby's temperature, don't forget.' (P016)

Awareness and training

Awareness-raising was seen as another potential facilitator to neonatal temperature measurement following BBA. Participants noted that this could be achieved through the introduction of a short mandatory e-learning session for all paramedics, extra training (for example simulation training with midwives), the addition of pre-hospital PROMPT to the mandatory training, or by completing a Trust audit of temperature measurements.

> 'An online training module could be developed for staff… to reiterate the taking of normal observations and the significance of those for a newborn baby.' (P006)

DISCUSSION

In the quantitative part of this multi-method study we found that, over a three-year period, neonatal temperatures were recorded in only 2.7% of paramedic-attended BBA and that 72% of these temperatures were below the recommended 36.5°C limit. This reflects research from both the North East of England[11] and other countries,[13] which reported similarly low rates of neonatal temperature measurement by emergency medical services (EMS) providers following BBA. This is concerning, as rates of neonatal hypothermia following

BBA have been shown to range from 30 to 100%, resulting in increased Neonatal Intensive Care Unit (NICU) admission rates and higher mortality for these newborns.[9]

Regular temperature measurement by paramedics is important to monitor the effects of any warming strategies and escalate care if temperatures do not increase. Neonatal warming is not always effective in the pre-hospital setting[19] and so timely conveyance to hospital may be necessary for some newborns to avoid prolonged or increasing hypothermia. In a prospective case series of consecutive out-of-hospital deliveries in the USA, neonatal hypothermia was recorded for 60% of paramedic-attended BBAs on arrival at hospital, despite paramedics warming 92% of these neonates.[19] There are also legal implications of documenting this type of assessment in patient care records. In a descriptive review of litigation claims against the UK London Ambulance Service, obstetric cases were found to make up a quarter of the high-value claims, despite representing a small proportion of the overall caseload.[20]

Unavailable and/or unsuitable equipment was a main theme in the qualitative element of this study and reflects the experiences of other EMS providers attending out of hospital birth. For example, an interview study with specialist ambulance nurses in Sweden identified concern over a lack of equipment for assessing newborns.[21] In an Australian study, all ambulance vehicles in Queensland carried only tympanic thermometers, which are not recommended for newborns.[22] In the UK, the National Institute for Health and Care Excellence (NICE) recommends that in infants under the age of 4 weeks, body temperature is measured with an electronic thermometer in the axilla.[23] There is no standardised thermometer for measuring neonatal temperature in pre-hospital care and some ambulance services do not currently stock digital axilla thermometers, relying, instead, on tympanic or chemical dot thermometers (McAdam H, personal communication, 2021). Even when axilla thermometers are stocked, issues remain in terms of battery life and usability. There is a clear need for reliable, standardised equipment that is suitable and available to all paramedics to accurately measure and record neonatal temperature.

Maintenance of neonatal normothermia was seen as a priority by paramedics, temperature measurement was not; the majority of participants were unaware of the lower limit for neonatal temperature. Participants suggested that if the baby appeared well, they rarely performed any further observations and switched their attention to the mother. This reflects previous research with EMS providers, where assessment and/or treatment was seen to vary depending on what individual practitioners determine to be the priority.[24] Concerns over prioritising care between mother and baby have also been noted in a study of specialist nurses' experiences of BBA, where the presence of two patients gave rise to feelings of concern and insufficiency.[21] Participants in the current research felt that the lack of a specific field to document neonatal temperature on the maternal care record might confirm paramedics' assumptions that temperature measurement was not a priority. This was supported by the quantitative findings, which showed much higher rates of recording for temperature measurements when a separate neonatal record (with a specific field to document temperature) was created.

The low priority given to temperature measurement by paramedics may also be partially explained by the lack of clear guidance on temperature assessment in the national JRCALC guidance.[10] For example, this guidance does not state a timeframe for temperature measurement, frequency of observations or what equipment should be used. Although clearer guidance is given for cases needing newborn life support (i.e. 'after birth a temperature must be recorded as soon as practicable and repeated during conveyance'[10]), this does not apply to the majority of BBA cases that paramedics attend. Lack of clear guidance was noted as a barrier to temperature measurement by paramedics in our study, who felt there was often nothing further they could do to warm the baby. Recent changes have been implemented in SWASFT that address some of these issues. Warming mattresses were introduced on all frontline vehicles in February 2021, alongside clinical guidance regarding the measurement of newborn temperature (i.e., to obtain and document an axillary temperature using a digital thermometer as part of base line observations, once transferred into the vehicle, regularly on route to hospital and prior to unloading). This approach could be applied more widely to clarify the role of paramedics in measuring and managing newborn temperature following BBA.

Based on the number of paramedics employed by the Trust,[14] we estimate that around 14% of SWASFT paramedics will see a BBA each year. It is therefore unsurprising that paramedics' lack of exposure to births was also perceived to be a barrier to neonatal temperature measurement. This is supported by previous pre-hospital research[19,25] and concerns have been raised around the maintenance of skills and competency in other situations to which paramedics are infrequently exposed, for example cardiac arrest.[26]

Participants proposed potential facilitators to paramedic measurement of newborn temperature, including additional training on care of the newborn. This reflects previous research, where EMS providers have expressed a wish for further education on childbirth[21] and authors suggest that essential care such as neonatal warming should be reinforced frequently.[19,21] In the hospital setting, further education has contributed to lower rates of hypothermia.[27]

Other possible facilitators put forward by participants included the addition of a BBA checklist to the maternity bags carried by paramedics. Checklists and flowcharts have proved successful in quality improvement initiatives to reduce hypothermia in hospital deliveries,[28,29] and an international review of unplanned out of hospital births suggested that protocols, developed in collaboration with maternity services, may provide further support for paramedics when managing BBA.[30]

Study limitations, strengths and future directions

Data from this study were analysed by a single researcher but anonymised data were shared with members of the research team and PPI group to check agreement on themes, statistical analyses and interpretation. While data from patient care records were screened thoroughly for eligibility, we acknowledge that data input and coding errors may have occurred. All interview participants were from a single ambulance Trust in the UK, which may have different cultures and practices compared to other EMS providers in the UK and internationally. However, the low rate of temperature recording found in this research reflects data from other areas of the UK and abroad. While the high rates of hypothermia found in this study are also found in previous research, it should be noted that newborns with a temperature recorded may not be representative of all BBA

babies. Paramedics may be more likely to measure and record temperature when a baby is premature or unwell, therefore the rate of pre-hospital hypothermia reported in this study may be an overestimate.

We were unable to determine the proportion of cases where a midwife was in attendance following BBA. It is therefore possible that for some cases with a midwife in attendance, midwives measured and recorded temperature in lieu of paramedics. However, standard practice in SWASFT dictates that paramedics should record any observations made by other attending clinicians and as a result these temperatures should still have been captured in ePCRs. During attempts to determine length of time between time of birth and first recorded temperature, we were unable to determine consistently whether babies were born before or after paramedic arrival on scene. Although the timing of paramedic arrival may impact on temperature measurement and management, there is evidence to suggest that the frequency of hypothermia is similar between neonates delivered before and after paramedic arrival.[19]

CONCLUSIONS

Neonatal temperature is not recorded routinely by UK paramedics following BBA. Our findings suggest that paramedics in the South West of England feel they would benefit from a number of changes to practice to facilitate the measurement and recording of neonatal temperature following BBA. The development of an evidence-based intervention that prompts paramedics to measure newborn temperatures and provides a clear pathway for cold babies could improve the measurement, recording and management of temperature.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All participants gave informed written consent. Ethical approval for this study was obtained from the Health Research Authority (IRAS ID: 291125) as well as the University of the West of England (UWE Bristol) Faculty of Health and Applied Sciences Research Ethics Committee (HAS.20.11.038).

CONSENT FOR PUBLICATION

Not applicable

DATA AVAILABILITY STATEMENT

The datasets generated and analysed during this study are not publicly available due to participant confidentiality but are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS CONTRIBUTIONS

LG was the Chief Investigator with overall responsibility for the study, and participated in study conception, design and coordination, performed and coded the interviews, analysed the data, and drafted the manuscript. SV and TD participated in study conception, design and interpretation of the results, and supported qualitative data analysis. HT participated in study conception, design and interpretation of the results, and supported quantitative data analysis. GM, EB, AB, SB, NM, and JB participated in study conception, design and interpretation of the results. All authors were responsible for the critical revision of the manuscript for publication and approved the final version to be published.

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