



Health Services Safety
Investigations Body

Investigation report

Investigation report: Management of preterm labour and birth of twins

Date Published:

25/08/2022

Theme:

Maternity

This PDF was downloaded from the Health Services Safety Investigations Body (HSSIB) website. To make sure you are reading the latest version, and for accessible reports, please visit <https://www.hssib.org.uk>

Contents

[Show subheadings](#)

[A note of acknowledgement](#)

[About this report](#)

[Executive Summary](#)

[1 Background and context](#)

[2 The reference event](#)

[3 Involvement of the Healthcare Safety Investigation Branch](#)

[4 Analysis and findings – the reference event](#)

[5 Analysis and findings – the wider investigation](#)

[6 Summary of findings, safety observations and safety action](#)

[7 References](#)

[Providing feedback and comment on reports](#)

A note of acknowledgement

We would like to thank Sarah whose experience is documented in this report, and her family. We would also like to thank the healthcare staff and stakeholders who engaged with the investigation for their openness and willingness to support improvements in this area of care.

About this report

This report is intended for healthcare organisations, policymakers and the public to help improve patient safety in relation to the management of preterm labour and birth in a twin pregnancy. For readers less familiar with this area of healthcare, medical terms are explained in **section 1**. Stakeholders familiar with HSIB's maternity programme will see differences in the style of this national investigation report, further information on the difference between the maternity and national programmes can be found at www.hsib.org.uk. This national investigation does not highlight any individual's or single organisation's approach to care but explores system-wide issues relating to a lack of scientific knowledge in the field of preterm labour and birth of twins. The early findings from this investigation indicated that a considerable level of attention was currently being directed towards research and national initiatives relating to preterm labour and birth. **Section 5** describes this work and outlines how it intends to address the questions raised by the investigation's findings

Executive Summary

Background

This investigation considers the management and care of preterm labour and birth of twins. Preterm is defined as babies born alive before 37 weeks of pregnancy. As an example, which is referred to as 'the reference event', the investigation reviewed the care of Sarah who was admitted to hospital at just over 26 weeks of pregnancy with signs that indicated a risk of preterm labour. The investigation considers Sarah's care and the evidence relating to the management of preterm labour of a twin pregnancy and a later diagnosis of brain injury.

The investigation identified several findings to explain Sarah's experience, including the lack of scientific evidence or specific guidelines and the uncertainty associated with the clinical decision making relevant to preterm labour and birth of twins. This highlights the need for further research into preterm labour as a recognised risk factor for twin pregnancies.

The reference event

Sarah was pregnant with twins. During her pregnancy her care was overseen by an obstetrician - a doctor who specialises in care for women/pregnant people during pregnancy, labour and birth. She was assessed as having a higher-risk pregnancy. This was because it was a twin pregnancy and because she had had a previous medical intervention on her cervix which had implications for the pregnancy.

When she was 26 weeks and 4 days pregnant (26+4 weeks), Sarah visited her local maternity unit with abdominal tightening, which can indicate the start of labour. She was transferred to and treated at a hospital with additional neonatal facilities that could support the babies if they were born at this time. At 29 weeks pregnant she was discharged home under the care of her local maternity unit. Sarah then went to her local maternity unit at 29+2 weeks with further episodes of abdominal tightening. Her labour did not progress as expected. A caesarean section was required to deliver the babies at 29+6 weeks. The twin girls were born well; however, 23 days after their birth a scan revealed brain injury in both babies.

The national investigation

HSIB was notified of a patient safety concern relating to preterm labour in the context of a twin pregnancy. The notification was made by Sarah who was concerned about the care she had received during the delivery of her babies.

The investigation used a range of methods to gather information, for example, interviews, observation of the maternity unit and reviews of guidelines and organisational documents. The evidence was analysed to understand the system-wide factors that contributed to Sarah's experience and the decisions made by staff.

The evidence suggested that the process of decision making in the context of Sarah's care was relevant to this investigation. Therefore, the investigation has summarised the key factors that appear to have influenced the decision making associated with her care and the delivery of her babies.

Findings

- There are currently no proven treatments available to reduce the risk of preterm labour for twin pregnancies.

- There are gaps in scientific knowledge and challenges to completing research in the field of preterm labour and birth. This creates a challenge for the development of detailed guidelines to support clinical decision making.
- Guidelines and equipment recommended for managing and monitoring singleton (one baby) and full-term pregnancies are used to assist with clinical decision making about preterm twin pregnancies; some interventions within the guidelines are unproven for use in preterm twin pregnancies.
- Research and national improvement initiatives, such as the British Association of Perinatal Medicine perinatal optimisation care pathway and NHS England and NHS Improvement 'Saving babies' lives care bundle version two' and the Maternity and Neonatal Safety Improvement Programme are improving the standardisation and implementation of evidence-based interventions.
- Intelligence from national data gathered by maternity units can support the learning on preterm labour and birth in twin pregnancies.

1 Background and context

1.1 Twin pregnancies

1.1.1 In 2018, The Office for National Statistics reported a total of 9,873 twin pregnancies, approximately 1.5% of all pregnancies (Office for National Statistics, n.d.).

1.1.2 Twins may share the same placenta (and blood supply) and amniotic sac (monochorionic) or have a separate placenta and amniotic sac (dichorionic).

1.1.3 Twins have an increased chance of being born early (preterm), needing to be cared for on the neonatal unit (a facility specialising in the care of newborn babies) (National Institute for Health and Care Excellence, 2019a; 2019b).

1.2 Preterm labour and birth

1.2.1 Babies born alive before 37 weeks of a pregnancy are defined as preterm. There are sub-categories of preterm birth, based on gestational age (length of pregnancy) (World Health Organization, 2018):

- extremely preterm (less than 28 weeks)
- very preterm (28 to 32 weeks)
- moderate to late preterm (32 to 37 weeks).

1.2.2 Preterm labour is when labour starts before 37 completed weeks of a pregnancy. Approximately 8 out of 100 babies will be born preterm.

1.2.3 Preterm birth is associated with high levels of morbidity (illness), mortality (death) and long-term disability (Royal College of Paediatrics and Child Health, 2019). A preterm birth increases the risk of a number of conditions including intraventricular hemorrhage (bleeding in the brain), periventricular leukomalacia (PVL) and cerebral palsy.

1.2.4 PVL is the softening of the white brain tissue (white matter) near the ventricles (cavities within the brain) which occurs because the brain tissue has been injured or died due to a lack of blood flow or inflammation within the brain. The evidence for the cause of PVL is still uncertain. Existing scientific findings suggest a link between inflammatory events, infection and reduced blood flow to the brain, thought to occur between 23 and 32 weeks of pregnancy (Ahya and Suryawanshi, 2018; Rennie and Robertson, 2012; Deng and Pleasure, 2008).

1.2.5 Intrauterine infection (an infection of the membranes that surround the baby in the womb, also known as chorioamnionitis) is common and linked to preterm labour. The clinical signs and symptoms of infection in pregnancy cannot always be identified and therefore may go untreated. Where signs of infection are evident, for example a high temperature or abdominal pain, antibiotics would be provided and a plan made for delivery. In the event of a preterm labour a baby may be cared for within a neonatal unit. There are different types of neonatal units within hospitals which are named depending on the complexity of care they provide:

- A special care unit (SCU) provides special care for babies born at or above 32 weeks who require a short time of higher levels of care.
- A local neonatal unit (LNU) is for babies born at 27 weeks or more gestation or for multiple pregnancies at greater than 28 weeks.
- A neonatal intensive care unit (NICU) cares for babies with the highest support needs which will include babies born at less than 27 weeks or multiple pregnancies born at less than 28 weeks.

1.2.6 If preterm labour (when the woman's/pregnant person's cervix has started to open and they are having contractions) is considered imminent medication may be required. Two key medications used at this stage include steroids and magnesium sulphate.

1.2.7 Steroids can help the baby's lungs to mature. The current national recommendation is for steroids to be delivered no longer than 7 days and ideally between 24 and 48 hours prior to birth (British Association of Perinatal Medicine, 2021).

1.2.8 Magnesium sulphate is given to protect the baby's brain development and prevent conditions associated with preterm brain injury. Magnesium sulphate is given to the woman/pregnant person as an initial dose (bolus) and then by an intravenous infusion (delivered via a 'drip' into the vein) for at least 4 hours before the birth and within 24 hours of the birth (British Association of Perinatal Medicine, 2021). Monitoring the woman/pregnant person closely is necessary when delivering magnesium sulphate. One of the side effects of magnesium sulphate is that it reduces the strength and frequency of uterine contractions because it has a relaxing effect on large muscle fibres (National Library of Medicine, 2021).

1.3 National guideline

There are three National Institute for Health and Care Excellence (NICE) guidelines which are relevant to the labour and birth of preterm twins. Two of these have been updated since the reference event described within this report. There is no national guideline on intrapartum care (care during labour) specific to preterm labour. National guidance and a small number of interventions are also available to support obstetricians (doctors who specialise in care during pregnancy, labour and birth) to manage and attempt to reduce the risks for preterm labour and births in some scenarios. There is no single guideline which details the management of preterm labour in the context of twin pregnancies.

1.3.1 The NICE guideline for preterm labour and birth was originally written in 2015 but updated in 2019 (National Institute for Health and Care Excellence, 2019a). During this investigation the guideline was further updated and shared for consultation in February 2022. The guideline is written in the context of a singleton (one baby) pregnancy. The guideline acknowledges the challenge and gaps in evidence on preterm labour and therefore the lack of a prescribed approach to the identification and management of suspected preterm labour.

1.3.2 This NICE guideline does consider how to manage relevant risks. The guideline indicates the significance of the measurement of the length of a woman's/pregnant person's cervix during pregnancy as an indicator of, or contributing to the risk of preterm birth.

1.3.3 A second NICE guideline refers to the management of twin and triplet pregnancy (National Institute for Health and Care Excellence, 2019b). This guideline suggests the measurement of the length of a woman's/pregnant person's cervix in twin pregnancies only as a 'moderate predictor' of preterm birth. This guideline does not recommend cervical length screening where there is an absence of effective interventions to offer women/pregnant people at higher risk of preterm birth.

1.3.4 The NICE guideline for intrapartum care states that cardiotocography (CTG – a technique used to monitor the baby's heartbeat and the uterine contractions) findings alone should not inform decisions about the care of a woman/pregnant person and their baby (National Institute

for Health and Care Excellence, 2017). The NICE guideline on twin and triplet pregnancy specifically highlights that recommendations on the use of CTG in multiple births are based on singleton pregnancies as there is a lack of evidence specific to twin or preterm babies. However, the guideline later suggests the use of CTG might be used to make decisions during labour beyond 26 weeks of pregnancy (National Institute for Health and Care Excellence, 2019b).

1.4 National initiatives

There are a number of national programmes of work and initiatives which have aimed to increase the evidence relating to and management of preterm labour and birth.

1.4.1 EPICure (University College London, n.d.) is a study that started in 1995 and continues to collect data on the management and outcome of preterm labour and births. This study continues to provide learning and evidence on the management and development of children following preterm birth.

1.4.2 MBRRACE-UK (2020) makes one recommendation from its perinatal mortality review which suggests that 'Particular emphasis should be placed on reducing rates of preterm birth'.

1.4.3 NHS England's 'Saving babies' lives care bundle version two' (NHS England and NHS Improvement, 2019a) identifies five elements of care recognised as best practice in minimising the risk associated with stillbirth or neonatal death. This includes the management of the risk of preterm birth. This element was added as an addition to the care bundle developed in response to the Department of Health's 'Safer maternity care' report (Department of Health, 2016).

1.4.4 NHS England and NHS Improvement runs a Maternity and Neonatal Safety Improvement Programme (MatNeoSIP), which aims to improve the national provision of maternity care (NHS England and NHS Improvement, n.d.). The activities within this programme focus on optimising the care pathways for perinatal care and the identification of deterioration within women/ pregnant people and babies.

1.4.5 The Maternity Transformation Programme has implemented the Neonatal Critical Care Review to monitor the appropriate place of birth for babies born at less than 27 weeks (NHS England, 2019).

1.4.6 The British Association of Perinatal Medicine is currently undertaking a number of projects to optimise the antenatal care of women at risk of preterm labour and to optimise the approach adopted by the teams that manage labour and birth of preterm babies (British Association of Perinatal Medicine, 2019).

1.4.7 The National Neonatal Audit Programme works on a range of programmes to improve child health including quality improvement and workforce studies, research in the UK and global child health programmes (National Neonatal Audit Programme, 2019).

2 The reference event

This investigation used Sarah's experience, referred to as 'the reference event', to examine the issue of the management of preterm labour and birth of twins.

The reference event considers the early support provided during Sarah's antenatal care, focusing on interactions intended to manage the risk of preterm birth. This section briefly summarises Sarah's care, describing the key interactions and decisions that are considered in this report.

The investigation engaged with Sarah and her family and two NHS trust maternity units that provided care during her pregnancy. The investigation recognises that this episode of care took place approximately 2.5 years ago, which is likely to have affected the recall of information.

2.1 At Sarah's first antenatal assessment it was identified that she was pregnant with dichorionic twins (**see 1.1.2**). A risk assessment identified she was at higher risk of a preterm labour. This was due to a number of factors: it was a multiple pregnancy, Sarah had previously had an LLETZ treatment (a large loop excision of the transformation zone, the most common treatment to remove abnormal cells from a woman's/pregnant person's cervix using a thin wire loop that is heated), and she had a complex vaginal tear from her previous full-term pregnancy. The decision was made for her maternity care to be overseen by an obstetrician.

2.2 When she was 16 weeks and 5 days pregnant (16+5 weeks) Sarah had signs of a urine infection and received antibiotics.

2.3 At 17+4 weeks Sarah attended a consultation to discuss the implications and risk factors of multiple births and preterm labour and birth.

2.4 At 22+2 weeks she received a cervical scan length (a scan to measure the length of the cervix) as part of the plan to manage the risk identified due to a twin pregnancy. The measurement was 22mm, which was outside the expected range. The Trust was in the process of running a trial of progesterone pessaries to reduce preterm labour for women with measurements below 25mm. The trial did not include twin pregnancies and so Sarah was not included.

2.5 At 22+2 weeks a consultant obstetrician discussed with Sarah the options for management of the reduction in her cervical length. These included no intervention, a progesterone pessary, or cervical cerclage (a single stitch placed around the cervix, used to prevent preterm labour). Sarah agreed to try the progesterone pessary.

2.6 At 26+4 weeks she reported 'on and off' abdominal tightening and a sensation of pressure. She was also found to have a green vaginal discharge. A physical examination using a speculum showed evidence of 'membranes [waters around the babies] bulging'. A scan showed the babies were in a cephalic (head down) position and Sarah's cervical length as 16mm. Sarah was started on steroid treatment (**see 1.2.7**) and the Trust arranged to transfer her by ambulance to the nearest neonatal intensive care unit (NICU).

2.7 At the Trust with the NICU, Sarah's cervical length was recorded as 12mm and her cervix was described as 'open'. Steroid treatment was continued. She had no pain or regular contractions that indicated labour and birth were imminent and she was admitted to a ward and reviewed the next day. Tests for infection were returned as negative and the babies' heart rates were both recorded as within expected range. A consultant neonatal clinician visited Sarah and her husband to provide information about preterm births. This conversation highlighted that the potential outcomes in the case of the delivery of preterm babies included severe disability, potential problems with the babies' respiratory and digestive systems, and the risk of bleeding within the babies' brains.

2.8 At 26+6 weeks Sarah reported a slight pink vaginal discharge. A scan of the babies was completed, and they were confirmed to be well. No cervical length measurement was completed.

2.9 At 27 weeks Sarah was advised to take bed rest. Further vaginal discharge was reported with no significant concern. The babies' heart rates were checked and assessed as being within the expected range.

2.10 At 27+1 weeks twice daily cardiotocography (CTG, equipment used to continuously monitor fetal heart rates) was started. A 'possible' deceleration (drop) in fetal heart rate was noted on commencing the CTG. An obstetrician was called to review the CTG and they documented that they had no clinical concern.

2.11 At 29 weeks pregnant the NICU Trust intended to discharge Sarah. A plan was made for her to remain at the NICU Trust over the weekend so she could receive a routine scan booked for 29+1 weeks. Sarah then returned home.

2.12 A consultant obstetrician at the local neonatal unit (LNU) assessed Sarah the following day in the day assessment unit and advised gentle levels of activity and to mobilise (move) around her home environment. Sarah was advised to contact the unit in the event of any changes in symptoms, including any bleeding or abdominal tightening.

2.13 That night, Sarah experienced episodes of abdominal tightening and was admitted to the LNU at the local Trust at 29+2 weeks. Magnesium sulphate (**see 1.2.8**) and steroids were administered and antibiotics were also provided because there was some evidence that she had a urine infection.

2.14 A CTG provided assurance that the babies' heart rates were within the expected range. As contractions were intermittent a plan was made to stop magnesium sulphate but that there should be a "low threshold" for delivery if there was any concern for Sarah or the babies.

2.15 At 29+4 weeks Sarah experienced contractions and difficulty in passing urine. A magnesium sulphate infusion was restarted, a urinary catheter passed (a tube to empty the bladder) and antibiotics prescribed. The infusion was later stopped due to the level of Sarah's contractions, with instructions to continue to monitor Sarah through blood and urine testing for signs of infection. Regular CTG monitoring occurred during the day and no signs of urine infection were identified.

2.16 At 20:35 hours Sarah complained of increasing pain and rectal pressure; the midwife recorded evidence of a bloodstained show (discharge containing mucus and blood from the cervix suggesting labour is imminent). Sarah's cervix was found to be fully dilated and her membranes were described as 'bulging'. A loading dose of magnesium sulphate was delivered, she was started on antibiotics, and her bed was changed to a delivery bed.

2.17 Between 22:25 hours and 05:30 hours the midwife's records show that Sarah was reviewed by the night-time obstetrician, that there was a reduction in the strength of contractions, regular CTG recordings within the expected range with some episodes of loss of recordings, and Sarah was sleeping.

2.18 At 29+5 weeks at 06:32 hours Sarah had an increased urge to push; a vaginal examination by the obstetrician identified that her membranes were bulging and the neonatal team was called. Between 06:40 hours and 06:47 hours the neonatal team arrived. An ultrasound scan was performed and the obstetrician completed an artificial rupture of membranes (the waters around the baby were broken). At 07:03 hours a vaginal examination noted '? [possible] brow attempted flexion unable', which refers to uncertainty about the head position of the baby lowest in Sarah's birth canal. At approximately 07:15 hours following a telephone conversation between the on-call consultant obstetrician and the night-time obstetrician an intravenous oxytocin infusion (a drug to stimulate contractions) was commenced

with a plan to increase the strength of the dose every 15 minutes. The medical records indicate the infusion was in place until 09:20 hours. Sarah signed a consent form for an examination under anaesthesia and caesarean section if 'not an easy delivery'.

2.19 At 09:08 hours, the daytime obstetrician took over Sarah's care. They completed a physical examination and transferred her to the operating theatre for a caesarean section at 09:20 hours. The first twin was born at 10:00 hours and the second twin at 10:01 hours.

2.20 The neonatal team were present at the birth of the babies and both babies were intubated (a tube was passed through each baby's mouth and into their windpipe to allow oxygen to be delivered directly to the lungs) and ventilated (when a breathing machine, called a ventilator, is used to move oxygen into and out of the lungs) to provide respiratory support.

2.21 Both babies had an Apgar score (observations that are made of a baby's heart rate, breathing, colour, muscle tone and response to stimulation to assess their condition at birth) of 10 (the highest score on the scale) within 10 minutes of birth and were described as in 'good condition'. Blood from the umbilical cord did not indicate the babies' oxygen supply had been compromised close to the time of delivery. The twins were subsequently transferred to the neonatal unit within the Trust.

2.22 While on the neonatal unit the babies were scanned weekly to assess their central nervous system (to monitor for any developmental issues within the brain). On the 23rd day, the final scan before discharge, the scan revealed changes within the brain of both twins and diagnosis was made in both twins of periventricular leukomalacia (**see 1.2.3 to 1.2.4**).

3 Involvement of the Healthcare Safety Investigation Branch

This section outlines how HSIB was alerted to the issue of preterm labour and birth involving twins. It also describes the criteria HSIB used to decide whether to go ahead with the investigation, and the methods and evidence used in the investigation process.

3.1 Notification of the reference event and decision to investigate

3.1.1 HSIB was notified of a patient safety concern relating to the care of a woman/pregnant person during labour and the birth of preterm babies. The notification was made by Sarah who was concerned about the care she had received during the delivery of her preterm twin girls.

3.2 Decision to conduct a national investigation

3.2.1 The HSIB maternity investigation team initially reviewed the referral, which did not meet its criteria for investigation. The referral was then considered for a national investigation. HSIB conducted an initial scoping investigation which determined that the patient safety concern met the criteria for investigation (see below). HSIB's Chief Investigator authorised a national investigation.

Outcome impact – what was, or is, the impact of the safety issue on people and services across the healthcare system?

Worldwide preterm birth is one of the main causes for under-five mortality and of neurodevelopmental impairment (Torchin and Ancel, 2016). In the UK, 75% of stillbirths and 71% of neonatal deaths are related to preterm births (MBRRACE-UK, 2020).

It is recognised that the UK has a greater number of preterm births compared to other European countries. The most recent report to review deaths associated with preterm birth suggests some improvements between 2015 and 2019 with improvements in the survival of preterm babies within the UK (Draper et al, 2021).

Systemic risk – how widespread and how common a safety issue is this across the healthcare system?

The NHS Digital data for England and Wales indicates that of the 29,400 births reported in June 2019 (the year of the reference event), 8% were preterm births, with 60% of twin pregnancies resulting in premature births (NHS Digital, n.d.).

There has been a reduction in stillbirths and neonatal deaths for twin pregnancies. However, despite this reduction the risk of death for a twin compared to a single pregnancy is nearly double for stillbirths and over three times as high in the case of neonatal deaths (MBRRACE-UK, 2021).

Learning potential – what is the potential for an HSIB investigation to lead to positive changes and improvements to patient safety across the healthcare system?

There are national guidelines and a small number of interventions available and used by obstetricians to manage the risks of preterm labour and birth in twins. However, the scientific evidence relied upon to inform the guidelines and management are predominantly based on singleton and full-term pregnancies.

HSIB has identified that since 2019 a large volume of national work and research, relevant to the field of preterm labour and birth, has been commenced. This investigation report sets out the work currently in progress and seeks to understand if it will address gaps in knowledge identified by the investigation.

3.3 Evidence gathering

3.3.1 Evidence was collected between September and October 2021.

3.3.2 A range of evidence was collected during visits with the family and the healthcare organisations where Sarah received care. This included:

- Sarah's medical records
- the babies' neonatal medical records
- observation of the clinical setting where Sarah's labour progressed
- interviews with Sarah and her family members
- interviews with clinical and safety governance staff
- a review of relevant local and national guidelines and policies
- consideration of current national initiatives and research into preterm labour and birth.

3.3.3 Sarah's medical records were reviewed by two HSIB subject matter advisors (SMAs) in obstetrics and neonatal care. The neonatal care SMA did not identify any findings of concern relating to the neonatal care provided.

3.4 Methods used to analyse the evidence

3.4.1 HSIB does not seek to apportion blame or liability in its investigations. It considers the healthcare system in its entirety to identify the factors that have contributed to the reference event. This was explained to staff and the family prior to collecting evidence.

3.4.2 A range of methods were used to collect and analyse evidence during the investigation. These were informed by a systems framework which has been developed to reflect healthcare systems, the Systems Engineering Initiative for Patient Safety (SEIPS) model. The evidence gathering process adopted an iterative approach so that as further information was received, additional sources of evidence were identified.

3.4.3 Interview questions were developed to reflect the job roles involved in Sarah's care. All interviews completed were recorded and subsequently thematically analysed using the SEIPS framework to identify key system factors contributing to either the decisions made, actions taken or Sarah's experience.

3.4.4 The evidence suggested that there was a need to further understand the context of the decision making that took place during Sarah's care pathway. A discrete set of interview questions was developed to explore decision making in relation to preterm labour and birth with staff and the family. These questions were based on recognised methods and concepts described within the decision-making literature (Hoffman et al, 1998; Klein et al, 1993; Rasmussen, 1985).

4 Analysis and findings – the reference event

Sarah had several contacts with the healthcare system during her pregnancy. This section describes the investigation's findings in relation to the interactions and the themes within the reference event, including attempting to understand decision making and information relied on during Sarah's care. The investigation considered all relevant guidelines, acknowledging that no single guideline covers the management of preterm birth in the context of twin pregnancies.

The findings are grouped according to the key themes arising from the analysis of the evidence:

- assessment, management and perception of risk of preterm labour
- decision making related to antenatal care in preterm labour
- decision making related to intrapartum care in preterm labour.

4.1 Assessment, management and perception of risk of preterm labour

Clinical implications of length and opening of the cervix

4.1.1 Sarah's history of receiving a large loop excision of the transformation zone (LETZZ) procedure was identified and recognised as a risk factor for preterm labour (National Institute for Health and Care Excellence, 2019a). The Trust's local guidance reflects the national guidelines and fortnightly cervical length scans were introduced to monitor this risk.

4.1.2 Once Sarah's cervix length reduced to below 25mm, this was recognised by the Trust as the point at which interventions may reduce the risk of a woman's/pregnant person's cervix opening and preterm labour. The interventions currently recommended to prevent or delay preterm labour include the use of a progesterone pessary or a cervical cerclage (stitch) and are based on guidance for singleton pregnancies (National Institute for Health and Care Excellence, 2019a). The use of a progesterone pessary is common in the UK and recommended for 'off label' use (a medicine recommended for use not within the medicine's marketing authorisation) by the National Institute for Health and Care Excellence (NICE) guidelines (National Institute for Health and Care Excellence, 2022; 2019a).

4.1.3 At the time of Sarah's pregnancy there was evidence to indicate progesterone pessaries were ineffective for twin pregnancies (Norman et al, 2009). NICE also recommended the need for further research on the use of progesterone pessaries in women/pregnant people with risk factors for preterm labour (National Institute for Health and Care Excellence, 2019a). The use of a cervical cerclage was not recommended for use in twin pregnancies and NICE recognised the lack of evidence in the use of this intervention.

4.1.4 Sarah had discussions with two consultant obstetricians about how appropriate the available interventions were in the context of a twin pregnancy. The uncertainty in the scientific evidence, reflected in the national guidelines, informed this discussion. However, the uncertainty around the evidence reduced Sarah's confidence in the information shared by the consultants and their management of the risk indicated by the reduction of the length in her cervix.

4.1.5 The investigation found that Sarah agreed to the intervention of a progesterone pessary following these discussions. The investigation heard that since 2020, the Trust now has a designated preterm pregnancy clinic which provides continuity in the approach to cervical length scanning and the management of the associated risks. This also reflects the national direction to optimise the care pathway for the management of preterm birth.

4.1.6 At 26 weeks and 4 days pregnant, (26+4 weeks) the identified dilation of Sarah's cervix could imply labour; however, clinicians told the investigation that predicting preterm labour was not easy: "... they are unpredictable ... some women have these silent labours they can suddenly feel pressure not a single contraction and a baby is sitting there." The consultant obstetrician decided to administer steroids to support the babies' development if labour did occur, and to transfer Sarah to the Trust with the neonatal intensive care unit (NICU). The transfer was described by consultant obstetricians at both Trusts as a precautionary action, informed by local and national guidance, which requires women suspected to be at risk of preterm labour to be transferred to a NICU if less than 28 weeks pregnant (National Institute for Health and Care Excellence, 2010).

4.1.7 Two consultant obstetricians, at the different Trusts, suggested the opening of Sarah's cervix may have been influenced by the previous LLETZ procedure and not a sign of imminent labour. The independent subject matter advisor (SMA) made the same point.

4.1.8 The clinicians acted on the change in Sarah's symptoms and transferred her to an appropriate clinical setting, where the appropriate level of neonatal care was available in the event of the twins being born before 28 weeks.

Risk and management of potential infection during pregnancy

4.1.9 At 26+4 weeks of pregnancy, obstetricians who reviewed Sarah were concerned about signs that suggested the potential for an infection. Sarah was also treated for a urine infection at 16+5 weeks and there were no other confirmed or treated infections during her pregnancy. The concern was due to the exposure of the membranes and an increased likelihood of infection, and potential risk for the neurological development of the babies (Weckman et al, 2019). The plan made by the consultant obstetrician acknowledged the need to monitor Sarah for further signs of infection and the steps taken were in line with NICE guidelines (National Institute for Health and Care Excellence, 2019a; 2019b).

4.1.10 When Sarah was admitted to hospital for suspected preterm labour at 29+2 weeks she was proactively given antibiotics. Antibiotics were also administered to Sarah during labour and the caesarean section. Immediately after the birth she received further antibiotics due to a suspicion that she may have a urine infection.

4.2 Decision making related to antenatal care

4.2.1 The risks associated with preterm labour were highlighted by obstetric and neonatal staff to Sarah and her family at the early stages of the pregnancy. A detailed explanation is recorded in Sarah's notes on her admission to the NICU at 26+4 weeks of pregnancy. The notes record that Sarah understood the information and expressed an intention to preserve the pregnancy for as long as possible to optimise the babies' wellbeing.

4.2.2 When Sarah was approximately 27 weeks pregnant the obstetric review on the ward resulted in a plan for bed rest and twice daily cardiotocograph (CTG) readings. A consultant obstetrician at the NICU reviewed the records as part of the investigation but could not suggest the reasoning behind the decision for bed rest. This approach does not reflect the NICE guidelines (National Institute for Health and Care Excellence, 2019b).

4.2.3 The commencement of twice daily CTG recordings showed a possible deceleration of the babies' heart rates. It appeared that staff found it difficult to obtain a good CTG trace. The investigation heard from midwives and obstetricians at both Trusts that the challenge of monitoring heart rates in a twin pregnancy is further complicated in the context of preterm babies. The SMA independently confirmed this insight.

4.2.4 Sarah's admission at 27 weeks of pregnancy and the advice to reduce mobility and close monitoring via twice daily CTG recordings suggested to Sarah there was a need for concern and caution. The decisions made and actions taken created a perception of risk and once reaching 28 weeks discussions of discharge concerned her. This was managed through discussions between the two consultant obstetricians at the different Trusts. The investigation heard that this additional communication was not the usual practice adopted but was at Sarah's request.

4.2.5 The two consultant obstetricians agreed that as the pregnancy was now beyond the 28-week limit specified in the guidance (National Institute for Health and Care Excellence, 2019a), the local neonatal unit (LNU) would be able to provide the level of neonatal care required and there were no concerns relating to either Sarah's or the babies' wellbeing at this time. The investigation heard from the consultant obstetrician at the NICU that if Sarah had lived closer to the Trust it is unlikely that she would have remained an inpatient for as long. The local geography and travel time from her home to the unit was the key factor that influenced the duration of her stay.

4.2.6 Sarah shared with staff her anxieties associated with the potential risk of a premature birth. She expressed a desire to transfer her care to the Trust with the NICU on two occasions during her inpatient stay. Obstetric staff described a desire to balance the clinical management and risk of preterm labour with a woman's/pregnant person's social situation. The consultant obstetrician at the NICU reflected there would have been an awareness that she had another child and lived at a distance from the unit, which would have made it difficult to see family. There was a mismatch between Sarah's wish to remain as an inpatient under the care of the NICU and the local pathway of transferring women/pregnant people back to an LNU. The transfer home was in the context that the clinicians had no immediate clinical concerns and that Sarah could be seen as a day patient and could attend quickly if labour started. The senior obstetrician at the NICU told the investigation

"... nothing we did while she was with us made those babies stay in, nothing we did prevented her labour, she was somewhere where should she labour she'd be in a good place to be".

4.2.7 The difference in the level of monitoring and advice on mobilisation between the two different Trusts created concern for Sarah. At the time of her care, national guidelines did not recommend bed rest, and currently there is no evidence base on the optimum level of mobilisation. Sarah's wish to transfer her care was not reflected in the clinical decisions made but a willingness to provide additional communication between the Trusts involved aimed to compensate for this.

4.3 Decision making related to intrapartum care in preterm labour

Judgement on timing of birth in preterm labour

4.3.1 Sarah was admitted at 29+2 weeks pregnant and the consultant obstetricians judged that her labour would now be expected to progress based on her symptoms. The pattern of her contractions, usually a sign of a progressing labour, was difficult for staff to interpret as the contractions were not described as strong or in a consistent pattern. Sarah recalls hourly contractions.

4.3.2 The guidelines relevant to preterm labour provide limited information on the definitive signs or symptoms of preterm labour with a description of 'abdominal pain' as the main indicator (National Institute for Health and Care Excellence, 2019a). An additional quality statement provided by NICE and based on expert opinion describes signs and symptoms of preterm labour as follows: watery, mucus or bloody vaginal discharge, regular or frequent (often painless) contractions or uterine tightening, ruptured membranes, pelvic or lower abdominal pressure, constant low, dull backache, mild abdominal cramps, with or without diarrhoea (National Institute for Health and Care Excellence, 2019c). NICE indicates the uncertainty surrounding clinical symptoms which can be predictive of preterm labour, stating that 'many women thought to be in preterm labour on a clinical assessment will not give birth preterm' (National Institute for Health and Care Excellence, 2019a).

4.3.3 The investigation heard from clinicians and Sarah that although she was initially showing signs of labour the signs became less evident as the day progressed.

4.3.4 Sarah told the investigation that in her opinion when the magnesium sulphate was started the contractions stopped. The records suggest she experienced contractions that were intermittent and of variable strength. The night-time obstetrician reflected that magnesium sulphate can "take away strength of contractions" and potentially as Sarah's contractions were mild it may have had more of an effect. Despite her cervix being 5cm dilated, the lack of established contractions was judged to indicate that birth was not imminent. This reflects the NICE definition of established preterm labour from 4cm of cervical dilation and 'regular' contractions (National Institute for Health and Care Excellence, 2019a). The investigation heard from consultant obstetricians, including an SMA, that it is not unusual for women/pregnant people at risk of preterm labour to have cervical dilation for a prolonged period.

4.3.5 A pattern of starting and stopping of magnesium sulphate reflects the challenge presented in managing the variability in Sarah's contractions. Staff try to estimate how imminent labour is to ensure sufficient magnesium sulphate has been delivered to reduce the risk of neural harm to unborn babies while avoiding magnesium toxicity for the woman/pregnant person. The obstetricians included in the investigation all recalled the national guidelines and endeavoured to deliver magnesium sulphate as soon as there were signs labour might be imminent (National Institute for Health and Care Excellence, 2019a). Since Sarah's pregnancy an app called the QUiPP app has been developed based on scientific evidence to support obstetricians to consider the probability of preterm labour for a woman/pregnant person. This includes the use of several metrics for single or multiple pregnancy which can consider cervical length and levels of fibronectin (a protein within the soft tissue, tested for via a swab of the tissue around the woman's/pregnant person's cervix) to provide a judgement on the likelihood of premature labour.

Decision making on the need to intervene in the progression of labour

4.3.6 When Sarah was admitted with signs of labour, between 29+2 weeks and 29+4 weeks pregnant, three senior obstetricians reviewed her care. There was a consensus that there should be conservative management to prolong the pregnancy rather than augment the labour (stimulate the uterus to move labour along) as Sarah and the babies were showing no signs of distress or infection. Sarah was aware of the potential medical support if labour did not progress, which included the breaking of her membranes or the need for a caesarean section.

4.3.7 The activity data for the delivery suite indicates that at the time Sarah was on the delivery suite, 14 women/pregnant people in labour were being cared for there. On the day the twins were delivered the number of planned midwives was seven; six were available for duty to support five women/pregnant people in labour. This included three women/pregnant people, other than Sarah, who were all considered to have a high level of complexity and safety concerns relative to either the wellbeing of the women/pregnant people or their babies. The investigation heard from a midwife and the night-time obstetrician that this was considered a high workload:

“... one of those horrible nights with multiple complex pregnancies to manage.”

4.3.8 Sarah told the investigation that at 23:00 hours she was experiencing low frequency contractions but suggested as her cervix was 10cm dilated that she wanted to “get them out as there was no point of return”. She recalls requesting a caesarean section at this time but was reminded that a vaginal delivery had been agreed and shortly after this discussion the night-time obstetrician was called away to an emergency. The night-time obstetrician’s caseload within the delivery unit meant they had to distribute their attention across all the women/pregnant people on the unit and focus their attention based on the priority and concern for each patient at any moment in time. Sarah told the investigation she recalls again saying to the midwife caring for her that she wanted to “get them out” and asking how they would progress the labour. She suggested her wishes may not have been considered in the decisions made. Obstetric staff said there was no clinical reason for a caesarean section at this time.

4.3.9 The on-call consultant obstetrician told the investigation that having finished in the operating theatre they completed a review of all the patients on the delivery suite with the night-time obstetrician at 00:00 hours. The acuity of the unit was considered alongside Sarah’s clinical signs of her fully dilated cervix but no concerns about the CTG recordings. The on-call consultant obstetrician was covering obstetrics and gynaecology services and patients. The decision not to augment the labour at this time was based on the absence of clinical signs of active labour.

4.3.10 Several obstetricians and the SMA told the investigation that where no significant clinical concerns existed the capacity of the delivery unit and the neonatal team were both factors which informed decision making on the induction of a labour. The night-time obstetrician told the investigation that there were a number of factors that influenced their thinking that evening, which included concern for the delivery of preterm twins in the middle of the night, the knowledge that the on-call neonatal colleague was covering both paediatrics and neonates and that they had a background as a community paediatrician rather than in neonatal care. The option to call a consultant neonatal clinician was considered, but the clinical pattern of labour was not considered sufficient during the night to suggest delivery would be imminent.

4.3.11 The night-time obstetrician told the investigation that with a full-term pregnancy, the NICE guideline clearly sets out the process for CTG monitoring and the duration of time before intervening if there has been no progress with labour (National Institute for Health and Care Excellence, 2017). This guideline considers 'full dilatation of the cervix before or in the absence of involuntary expulsive contractions' as the passive second stage of labour and although it mentions twin pregnancies it makes no mention of preterm labour. This finding was confirmed with other obstetricians who suggested that there was no guideline to direct their decision making on when to augment a preterm labour once a woman's/pregnant person's cervix is fully dilated. There was a consensus across the obstetricians who engaged with the investigation that "you would ask different people and get different answers".

4.3.12 This opinion was also expressed independently by the SMA and national stakeholders, who explained the need to assess the risk to the babies of a premature birth if there were no signs of distress, taking into account the level of support available in the hospital. Furthermore, the SMA explained that operative intervention (a caesarean section) may also need to be more carefully considered in the case of a preterm pregnancy as outcomes may be more dependent on the gestation at delivery rather than CTG findings, and operative intervention can be complex.

4.3.13 Sarah's medical records suggest there was monitoring and consideration of markers of infection. At 29+2 weeks there was a record of a slight increase in Sarah's temperature and leucocytes in her urine (a potential sign of infection). At 29+4 weeks records of the results and a discussion between two consultant obstetricians suggested a slight concern about infection but the clinical signs were addressed by administering antibiotics and daily monitoring of bloods and urine and CTG recording.

4.3.14 The investigation heard from consultant obstetricians about the dilemma of definitively identifying intrauterine infections and questions that remain around the decision or need to augment a preterm labour. They described the challenge of exposed membranes and the potential risk of infection, which may outweigh the risk of preterm labour:

“... is that baby more at risk by the prematurity of birth or being exposed to a day or week or two in utero with those inflammatory processes going on?”

These comments were made in the context and knowledge that currently there is no way of safely testing for infection (chorioamnionitis).

4.3.15 In the absence of clear clinical signs of infection or distress within the woman/pregnant person or babies, there is no guideline or best practice that recommends augmenting a preterm labour. The current inability to accurately determine the presence of intrauterine infection impedes clinicians' decision making.

4.3.16 The investigation was told that the Trust's medical record indicates that after the birth of the twins the placenta was not sent for a review of the histology (studying cells using a microscope) in line with the tissue pathway for histopathological examination of placentas (The Royal College of Pathologists, 2017). The Trust could not explain why this may have occurred. The absence of histology of the placentas after the birth of the babies prevented an opportunity for greater knowledge and evidence to understand any complications relevant to Sarah's pregnancy. The Trust has since introduced a policy that all preterm births should have placentas sent for histology.

CTG recording and interpretation

4.3.17 The investigation initially explored the CTG recording with the Trust and separately with the SMA. This highlighted differences in the presentation and perspective of the CTG recordings between obstetricians and even for the same obstetrician, who changed their opinion when shown the original trace relied upon during Sarah's care. These findings will be explained in the sections below and indicate how variability in interpretation of CTG recordings during and after labour may occur because of the quality and consistency of the graphical presentation.

4.3.18 The medical records indicate an electronic CTG recording at 06:07 hours was of adequate quality, categorised as 'normal' and the babies' heart rates were within the expected range (between 110 and 160 beats per minute). At approximately 06:30 hours the medical records indicate the neonatal team were called and attended. At 06:40 hours the CTG equipment was unable to continually record one of the babies' heart rates. At 7:04 hours the CTG recording indicated a poor connection and concern was raised that the CTG traces were of the same twin. The night-time obstetrician used an ultrasound transducer (a device that uses sound waves to record a trace of the heart rate trace onto a screen) to locate the babies' heart rates. At 07:19 hours (see figures 1 and 2) staff questioned whether the CTG recording represented both babies' heart rates; again the obstetrician used the ultrasound transducer to

confirm the presence of two separate heart rates. Subsequently, there was continuous electronic CTG recording of the heart rates during labour except at 07:52 hours during a brief power cut. The records do not include any further formal classification of the CTG after 06:07 hours until 09:05 hours, shortly before Sarah was transferred to the operating theatre. The investigation heard that all of the heart rates documented in the medical records would have been obtained from the electronic CTG recording. The presentation of the CTG traces differs between the original electronic CTG (**figure 1**) used by clinicians during the labour and the 'pdf' version (**figure 2**) viewed through the maternity notes, which is used retrospectively to review a labour after the birth.

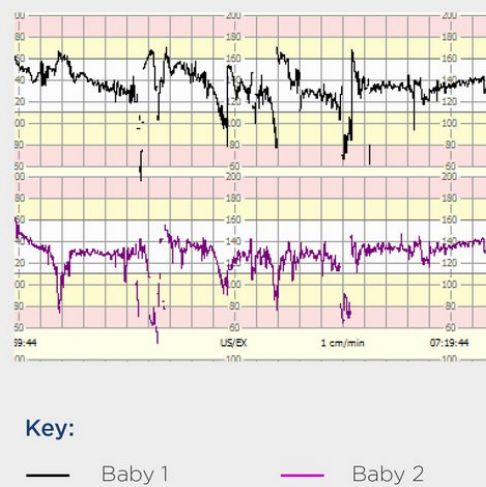


Figure 1 Electronic CTG viewed at the time of the labour



Figure 2 Pdf copy of the CTG trace used retrospectively to provide opinion on the management of labour

4.3.19 The SMA explained that at approximately 07:50 hours the CTG indicated several decelerations in heart rate recorded for one twin on the CTG, presenting a “confusing picture”. The Trust told the investigation that it considered these decelerations were normal in the context of preterm babies of 29 weeks and occurred as a protective mechanism during labour. The SMA also described that preterm babies often had frequent decelerations and this was considered normal, which reflects some findings emerging from current research (Lopez-Justo et al, 2021). The CTG met the criteria for categorisation as a ‘reassuring’ trace and no intervention was warranted (National Institute for Health and Care Excellence, 2017).

4.3.20 The baseline electronic CTG trace of the heart rate for one twin began to rise at approximately 07:52 hours. The SMA indicated this was not as easy to read from the electronic CTG used on the night, where one square vertically is equivalent to 20 heartbeats, compared to the pdf version where an additional line indicates a rise of 10 heartbeats. The scale on the electronic recording made the graph and specific recordings less prominent and subtle changes less visible compared to the pdf version. The investigation heard there is variability in how background scales are presented in CTG traces.

4.3.21 There are no guidelines or criteria for clinicians to consider in their interpretation of a CTG trace for a preterm baby. Some guidelines do recognise the challenge of how the representation of scales used in CTGs may influence pattern recognition of a CTG trace (Ayres-de-Campos et al, 2015).

4.3.22 The SMA considered that the characteristics of the CTG recording at 08:20 hours were becoming 'suspicious'. Consent was recorded as obtained at 08:35 hours for a caesarean section; Sarah recalls completing the consent just prior to the oxytocin infusion which was started at 07:19 hours. The Trust's review in response to the family's concerns concluded that the CTG was 'pathological' (a description of the heart rate which would require a review by another obstetrician and midwife) by 08:45 hours. The medical records state the CTG as 'suspicious' at 09:05 hours. There are differences in opinion as to when the opportunity arose to consider the CTG trace as 'pathological'. The classification of a CTG trace relies upon certain characteristics within the trace remaining for a duration of time, for example 30 minutes (National Institute for Health and Care Excellence, 2017). In hindsight, when reviewing a CTG trace, it is easier to see when, and for how long, certain characteristics have been present. The difference between the interpretation in real time and with hindsight may explain the discrepancy between when the classification of 'pathological' may be suggested. The investigation heard about the challenge that exists for clinical staff in interpreting CTG recordings. This was evident in discussions about the presentation of the CTG trace and variability in interpretations across staff internal and external to the Trust. There was variability between staff but also variability in an individual's perspective at different times when using different formats of the CTG trace.

4.3.23 A CTG reading provides one piece of information to indicate the potential of risk for a baby. The NICE guideline for preterm labour suggests there is a lack of evidence regarding the value of CTG monitoring to improve the outcome of preterm labour (National Institute for Health and Care Excellence, 2019a). Furthermore, the NICE guideline for a twin and triplet pregnancy specifically highlights the lack of evidence for the use of CTG in multiple births, but later suggests it might be used to make decisions during labour beyond 26 weeks (National Institute for Health and Care Excellence, 2019b). There is a wide range of opinion on the reference event to when intervention and augmentation of the births was reasonable considering the CTG recorded. This is mainly as the gestation was preterm and there are no national guidelines for preterm gestation CTG and national guidance for term gestation can guide but not be directly extrapolated in such a case. Operative intervention may also need to be more carefully considered as outcomes may be more dependent on the gestation at delivery rather than CTG findings, and operative intervention can be complex.

Use of oxytocin

4.3.24 Sarah was started on an oxytocin infusion at 07:19 hours at a rate of 6ml/hr as indicated in the local Trust policy and agreed with a senior obstetrician. The babies' heart rates based on the pdf version of the CTG recording remained within the expected range (110 to 160 beats per minute) until approximately 08:00 hours (National Institute for Health and Care Excellence, 2017). The heart rates for both babies were recorded in the medical records as being within the expected range (based on the NICE 2017 guidance for full-term pregnancies) between 06:07 hours and 08:27 hours. At 08:20 hours the CTG was considered by the SMA and the Trust as 'suspicious'. Guidelines for full-term labour suggest introducing at least one conservative intervention when a CTG is categorised as 'suspicious'. This may include stopping oxytocin to reduce contractions. Sarah's oxytocin was stopped at 09:20 hours. The SMA said this may occur when examination under anaesthetic was intended and potentially a vaginal birth is still being considered as an option.

4.3.25 The infusion was increased every 15 minutes. The investigation was unable to locate guidance on the dose and duration of oxytocin in the second stage of labour and one current scientific trial was identified suggesting the role of oxytocin in second stages of labour is yet to be established (US National Library of Medicine, 2021). The SMA provided their opinion which was that when starting oxytocin in the second stage of labour, an increase in the dose every 15 minutes is an accepted obstetric practice. This reflects a pragmatic approach when time to delivery is perceived to be limited.

4.3.26 Sarah recalled expressing that although she was pushing, there was "something inside me telling me not to push and stopping me", which she described to staff at the time. The obstetrician told the investigation that once contractions were well established and the labour had been augmented they completed a vaginal examination and attempted to flex the head of the leading baby to improve the baby's position. The obstetrician described the need to be "more gentle" with a preterm baby but it was not achievable. The medical records document '? [possible] Brow attempted flexion gently unable'. The obstetrician described feeling stressed as this differed from previous experiences of delivering preterm twins: "... with preterm babies usually deliver quite quickly." Sarah's perception and recollection of the attempts to reposition the baby were described as "a lot of force as trying to get this baby out".

4.3.27 Earlier that afternoon a scan by a senior obstetrician recorded the baby as being 'low in pelvis'. Sarah recalls the obstetrician commenting that the baby was looking up and out at the scan and suggested she interpreted that as "presumably brow position".

4.3.28 A baby is considered to be in a malposition when the baby's head is considered to be in a position that does not facilitate the passing of the head through the woman's/pregnant person's pelvis. A brow presentation implies the brow of the baby's head is leading into the woman's/pregnant person's pelvis and in full-term babies is recognised as stopping a labour (World Health Organization, n.d.).

4.3.29 The investigation heard from senior obstetricians and the SMA that a malposition in preterm labour is considered less of an issue for delivery due to the smaller size of a preterm baby's head compared to a full-term baby. The investigation was unable to find any guidance or recommendations on the management of preterm labour in twins and the impact or management of a suspected brow presentation. The only reference made was to the potential need to intervene with a breech position (when the baby's feet or bottom are positioned in the woman's/pregnant person's pelvis) (National Institute for Health and Care Excellence, 2019b). It is unclear if the malposition of one twin may explain the lack of progress of Sarah's labour.

Progression to caesarean section

4.3.30 At 08:07 hours at 29+5 weeks pregnant the midwife handed over Sarah's care to the daytime midwife. Sarah recalls contractions coming continually and that a midwife wasn't present; she was informed that staff were involved in handover as the staff on the next shift arrived.

4.3.31 At 08:07 hours a vaginal examination by the obstetrician indicated a lack of progress in the labour. The obstetrician made the decision to take Sarah to the operating theatre to complete an examination under anaesthesia and a caesarean section as required. The medical notes, written in retrospect by the obstetrician at 08:35 hours, recorded Sarah's consent; Sarah recalls asking to sign the consent prior to receiving the oxytocin.

4.3.32 At 08:40 hours the heart rate of one of the babies was recorded as being 169 beats per minute, which is above the expected range (110 to 160 beats per minute) as cited in NICE guidelines. However, these guidelines are not specific to preterm labour (National Institute for Health and Care Excellence, 2017).

4.3.33 The night-time obstetrician recalls leaving the room to hand over to the day shift obstetrician. They informed the daytime obstetrician that Sarah should be transferred to the operating theatre with a plan for a vaginal examination in case a vaginal delivery could be achieved, or a caesarean section as required. They believed this would be an immediate action to enable delivery within the next 45 minutes. The investigation has been unable to speak to the daytime obstetrician as they have since left the Trust. The night-time obstetrician recalls being surprised, on returning to the handover before leaving the hospital, to see Sarah was not in the operating theatre. The investigation heard that the night-time obstetrician implied in their communication to the daytime obstetrician but did not state this was intended to be a category 2 caesarean section, (no immediate life-threatening situation for the woman/pregnant person or babies), which would need to occur within 75 minutes (National Institute for Health and Care Excellence, 2021). The records indicate the daytime obstetrician entered Sarah's room and

conducted a vaginal examination. The consultant obstetrician was engaged in other duties on the delivery suite and told the investigation they recall being “slightly frustrated” as this was not the plan and delayed Sarah’s progress to the operating theatre.

4.3.34 Sarah described when the obstetrician left the room to hand over, she felt that her care had become of less importance: “... my birth wasn’t valued.” She described considerable distress from the experience of not knowing when she would be moved to the operating theatre and having extreme levels of pain. Sarah’s mother described that “she was writhing her body was under such distress”. The investigation heard that Sarah had received counselling to deal with the trauma that she experienced at this time. Sarah’s mother told the investigation she questioned the daytime obstetrician when they suggested a further assessment was required: “Why? We know she has to go to theatre we’ve been told she’s having a caesarean.” Following the examination, the family recall a high level of urgency as staff moved Sarah into the operating theatre.

4.3.35 The timing of the progress in labour coincided with the handover of all staff caring for Sarah. This appears to have delayed the intention for the immediate action of a caesarean section.

4.4 Summary

4.4.1 The investigation has heard that there was a high level of uncertainty in, and absence of, the scientific evidence which informed the knowledge of the pattern and management of preterm labour of twins at the time of the reference event. This is summarised by a comment made to the investigation by a consultant obstetrician not directly involved in Sarah’s care:

“... the fact is an awful lot of what we are giving an opinion on there’s absolutely no evidence whatsoever and if you ask 10 obstetricians you won’t get 10 different opinions you’ll probably get 15 because you can ask the same one on a different day and they’ll give a different opinion ... because we are not dealing with hard facts based on national evidence.”

An uncertainty in information for the best action required as Sarah’s pregnancy progressed had the impact of increasing her level of anxiety and her confidence in the opinions provided to her.

5 Analysis and findings – the wider investigation

This section describes the investigation’s findings in the context of ongoing national work around preterm labour and birth.

The reference event highlights a lack of scientific evidence and specific guidelines for the management of preterm labour and birth in the context of twin pregnancies to inform the decision making of clinicians. The investigation spoke with national stakeholders to discuss the reference event and gain their insight into the current state of knowledge available to inform the management of preterm labour of twin pregnancies. Stakeholders considered the reference event showed most of the components of the recommended care pathway, intended to optimise the management of preterm babies, had been implemented.

Stakeholders highlighted that sadly the reference event is not an unusual scenario and preterm labour of twins is considered challenging for healthcare professionals. The challenge was primarily due to the lack of evidence or guidelines specific to this scenario.

The lack of scientific evidence to assist clinicians creates an uncomfortable context for obstetricians to deliver evidence-based or guideline-driven practices for families. This may be unrecognised by the public, who may assume that the knowledge surrounding the management of preterm twin pregnancy and labour is further ahead than is currently the case.

The investigation identified a large volume of national work in the field of preterm labour and birth that has begun since the reference event. A full national investigation was not considered to be appropriate by HSIB while this work remained in the relative early stages.

This section describes the national challenges identified via the reference event and a selection of relevant ongoing national work to illustrate how these challenges are being addressed.

5.1 Predicting preterm labour

5.1.1 The investigation heard from stakeholders that the pattern of labour in preterm labour has not been fully studied.

5.1.2 Between 2015 and 2019 research was completed to develop a decision aid tool to assist with the risk assessment and complex management of preterm labour (Watson et al, 2020). This tool has been developed into an app called QUiPP. The QUiPP app supports clinical decision making to judge the risk of preterm labour in women/pregnant people who aren't showing symptoms. The app requires information to be entered which may include cervical length and the presence of fibronectin. The app has been validated clinically and can estimate the likelihood of a preterm labour in both singleton and twin pregnancies.

5.1.3 Another line of research has considered the characteristics of vaginal bacteria to understand if there are any markers that could indicate the likelihood of preterm labour (Flaviani et al, 2021). This research indicates that inflammatory processes influenced by the vaginal bacteria may reduce the normal cervical defences to preserve a pregnancy. This research

indicates that ethnicity and previous obstetric history may have an influence on differences in vaginal bacteria. Further research is intended to understand how this can inform risk identification and management.

5.1.4 A recent study was identified that suggested distinct differences may exist between the mechanism and influencers of preterm and full-term labour (Phung et al, 2022). Other studies have suggested different risks may be associated across different cultures and populations. One study highlights women from ethnic minority groups as being at greater risk of preterm birth. This study indicated that ethnicity and social disadvantage should be considered in future research and care programmes to manage the greater risk of preterm birth (Puthussery et al, 2019).

5.1.5 There remains a lack of understanding of the variables that influence preterm birth for different populations of women/pregnant people, for example Black, Asian and ethnic minority populations or those from different levels of social deprivation.

HSIB makes the following safety observations

Safety observation O/2022/187:

It may be beneficial if further research aimed to generate additional knowledge to predict and prevent preterm labour for twin pregnancies among different groups of women/pregnant people.

5.2 Treatment of threatened preterm labour

5.2.1 There has been a limited amount of research into the management and effectiveness of recognised methods to manage the risk of preterm labour in a twin pregnancy. The treatment options available to a woman/pregnant person with a reduced cervical length and a singleton pregnancy include:

- progesterone pessary
- Arabin pessary (a ring of silicon inserted into a woman's/pregnant person's vagina and under their cervix)
- cerclage stitch.

5.2.2 These treatments are still under debate for use in twin pregnancies. This may not always be clear to women/pregnant people and their families. The information accessible to the public relating to twin pregnancies cite preterm labour as a greater risk (NHS England and NHS Improvement, 2019b). However, the information about treatments available to prevent preterm

labour does not always reflect national guidelines (NHS England, 2020). National Institute for Health and Care Excellence (NICE) guidelines do not recommend any of these treatments for a twin pregnancy (National Institute for Health and Care Excellence, 2019b).

HSIB makes the following safety observation

Safety observation O/2022/188:

It may be beneficial to increase awareness among the public and healthcare professionals of the limitations of interventions for the prevention of preterm labour of multiple births.

5.2.3 The Study Of Progesterone for the Prevention of Preterm Birth In Twins (STOPPIT) has informed national guidelines and clinical practice. There were two key studies, the first of which, 'STOPPIT-1', was reported on in 2009 (Norman et al, 2009). The authors concluded from the research and the literature that progesterone pessaries did not reduce the risk of premature delivery or intrauterine death (the death of a baby while it is still inside the uterus) in a twin pregnancy.

5.2.4 The second study, 'STOPPIT-2', considered the effectiveness of Arabin pessaries in twin pregnancies (Norman et al, 2022). The findings concluded that Arabin pessaries do not reduce undesirable outcomes for women/pregnant people with twin pregnancies and a short cervix.

5.2.5 A review of evidence on the use of a cerclage stitch for multiple births has indicated that there is no evidence that this intervention will reduce preterm births for gestations less than 32 weeks. There is also some evidence of risks in the use of a cerclage stitch to preserve twin pregnancies and therefore it is not recommended (Shennan and Story, 2022). This review of evidence on the use of a cerclage stitch is based on small numbers of women/pregnant people and the authors suggest the need for further studies. There are two current ongoing studies to consider the benefit of a cerclage stitch but these will not include twin pregnancies (Hodgetts-Morton et al, 2021; Hezelgrave et al, 2016).

5.2.6 Leading researchers told the investigation that there were no evidence-based treatments to manage the risk of preterm labour in twin pregnancies. They reflected that some differences remain between the approaches adopted by clinicians. Some clinicians may still offer treatments such as progesterone pessaries as these are considered not to be harmful.

5.2.7 This reflects Sarah's experience, when at 22 weeks of pregnancy she had a shortened cervix outside of the expected range. She was presented with the current evidence for interventions at that time, but clinicians were unable to provide greater direction to assist her

decision making. Despite further studies since the time of the reference event there remains no further intervention available if this situation were to arise again. The investigation heard of a need for further research for twin pregnancies, where there is an additional risk factor for preterm birth, to consider the potential for treatment options that are effective for singleton pregnancies.

5.3 Impact of magnesium sulphate on symptoms of preterm labour

5.3.1 Magnesium sulphate has been proven and recommended to be a useful medication to protect the brain of a baby when preterm labour seems inevitable (World Health Organization, 2015). Currently NICE guidelines advise that it should not be used for longer than 24 hours but administered no more than 24 hours before birth (National Institute for Health and Care Excellence, 2022; Wilson et al, 2021). This requires clinicians to make an estimation in a situation where it is recognised that signs of preterm labour do not follow those of a full-term labour. The exact dosage and timing of magnesium sulphate remains unclear and further research has been recommended (National Institute for Health and Care Excellence, 2022).

5.3.2 Magnesium sulphate is classed as a tocolytic drug (a drug which reduces muscle contractions). Tocolytic drugs have historically been used to delay labour (Wilson et al, 2021). The investigation heard that although magnesium sulphate had been used to delay preterm labour, the World Health Organization does not recommend the use of tocolytic drugs if preterm labour is imminent. This appears to be a contradiction for the clinician and further evidence is required to understand the value of tocolytic drugs. Research is currently in progress to review existing scientific studies to interpret the effectiveness of tocolytics in the improvement of neonatal outcomes (Wilson et al, 2021).

5.4 Management of preterm labour

5.4.1 The investigation heard from the clinicians at the reference event Trust and from stakeholders that traditionally teaching on managing a potential preterm labour is to prolong the pregnancy as long as possible – “every day matters, every hour matters”. This reflects what is currently practised in healthcare when considering the need to augment a labour.

5.4.2 The complexity of decision making associated with managing a preterm labour has been described to the investigation. The investigation found an understanding that there was value in sharing this decision making across a multidisciplinary team to review clinical signs. The lack of sensitive measures to reflect the intrauterine conditions reduces the quality of information available to clinicians to accurately assess a baby's condition. The lack of scientific evidence in many areas of preterm labour and birth means that obstetricians deliver care with limited guidelines or evidence base.

5.4.3 NICE recognises that its guideline on managing and monitoring twin babies during labour (intrapartum) are largely based on extrapolation of evidence from full-term singleton pregnancies (National Institute for Health and Care Excellence, 2019b).

5.4.4 The investigation heard that clinicians extrapolate from guidelines specific to singletons to inform the management of labour involving twins. Since the reference event there have been a number of evidence-based pathways, updated guidelines and governance to optimise the management of all preterm labour and birth, but these are not specifically focused on twin pregnancies.

5.4.5 One obstetric stakeholder described to the investigation the act of monitoring through the use of cardiotocography (CTG) as follows: "... monitoring in preterm twins is nearly impossible ... intrapartum interpretation is a complete minefield." The effectiveness of CTG monitoring in twins and during the second stage of labour is challenging. Loss of the CTG signal and monitoring the same twin are both recognised risks to be managed by clinicians. The presentation of the CTG trace was considered within the reference event and suggests some challenge to the technical design of this equipment and its suitability to ensure reliable interpretations in the context of twins. Previous HSIB investigations have highlighted the need for trusts to consider the user testing of CTG equipment (**Healthcare Safety Investigation Branch, 2019**). A safety recommendation was made to the Department of Health in a further HSIB report. This safety recommendation has been actioned and will enable research to be commissioned to consider the design, usability and interpretation of CTG interfaces and outputs. This specifically requires consideration of singleton, twin and preterm pregnancies (**Healthcare Safety Investigation Branch, 2021**).

5.5 Predicting intrauterine infection

5.5.1 Intrauterine infection remains an unknown factor in the context of preterm labour and impact on birth outcomes. The signs clinicians usually rely on to identify infection, for example high temperature, are not sensitive enough to identify intrauterine infection during a pregnancy. Research continues to ask the question of how to identify and manage the impact of inflammatory responses associated with intrauterine infections (Agrawai and Hirsch, 2012).

5.5.2 A leading researcher in this field told the investigation that despite large-scale research studies to identify alternative approaches to early recognition of intrauterine infection, there remains no way of identifying all intrauterine infections. The results of studies have not provided the information hoped for and the stakeholder told the investigation that "we don't have the tools".

5.5.3 The lack of ability to reliably monitor and identify intrauterine infection impedes decision making for clinicians. Several obstetricians spoken to by the investigation reiterated there would be little justification to risk early induction of a preterm baby without obvious signs of infection. The risks of premature birth are balanced with the risk of infection; if there are no clinical signs of infection, a medical intervention to induce labour cannot be justified.

5.5.4 The unreliability of the diagnosis of infection in preterm babies during pregnancy makes it difficult to determine the cause of harm to brain development (Ball et al, 2017). Research to understand factors influential to periventricular leukomalacia (PVL) (softening of the white matter of the brain – **see 1.2.3 to 1.2.4**) has included twin pregnancies. This has shown that prematurity and postnatal sickness had the strongest correlation to an outcome of PVL. Currently studies indicate the most likely connection is between infections within the woman/ pregnant person or baby during pregnancy, which have the consequence of an inflammatory response within the baby (Ahya and Suryawanshi, 2018).

5.5.5 The investigation heard that research to understand the cause of PVL and other preterm brain injuries is very complex and that it is a difficult area to study. The challenge lies in the many factors that may be influential and limitations in recognising and identifying intrauterine conditions. PVL was described by one stakeholder as “an immensely complicated thing that we are only scratching the surface of at the moment”. Research is focusing on the optimisation of conditions for preterm birth and stakeholders consider this as the most likely avenue to influence the frequency of a diagnosis of PVL (US National Library of Medicine, 2021).

Preterm labour guidelines

5.5.6 Since the reference event the NICE guideline for preterm labour and birth has been reviewed twice, in 2019 and 2022. This reflects the speed at which the evidence is evolving in this field.

5.5.7 NICE prefers to make recommendations where directly applicable scientific evidence is available. Where clinical evidence remains to be established NICE can make research recommendations, which may be considered by other national bodies as they prioritise and allocate funds.

5.5.8 The management of risks associated with preterm labour and twin pregnancies lacks a comprehensive scientific evidence base, and expert consensus is relied upon to inform the quality standards developed by NICE to support the interpretation of the guidelines. The investigation heard from NICE that lack of scientific evidence means some aspects of care and services to manage known risks cannot currently be provided.

5.5.9 The research into the use of progesterone, Arabin pessaries and cerclage stitch in twin pregnancies (**see 5.2**) does not indicate any need to amend the NICE guideline for twin and triplet pregnancies (National Institute for Health and Care Excellence, 2019b). The investigation heard there is a need to continue the drive for research specific to twin pregnancies with an emphasis on collaboration across academic organisations to address the challenges associated with these studies.

5.5.10 The NICE guideline for twin and triplet pregnancies (National Institute for Health and Care Excellence, 2019b) states the need for antenatal and intrapartum care to be managed by teams with 'enhanced' relevant knowledge and experience. However, the findings of a review in 2021 suggested a low probability of this occurring (MBRRACE-UK, 2021). The investigation also heard that trusts are now expected to have a lead consultant obstetrician with expertise in preterm birth to act as a champion within each trust. The need for collaboration across geographical regions to provide expertise and resources for the management of preterm births is recommended in the Ockenden report, as is the need to recognise and address staffing levels that reflect local unit requirements (Ockenden, 2022). The investigation heard that some trusts have created twin clinics to manage the specific risks recognised in twin pregnancies, but the provision of such services varies across the UK and the voluntary sector supports signposting families to these clinics (Twins Trust, n.d.).

5.5.11 Guidelines relevant to this investigation are highlighted in **section 1** and include NICE guidelines on the management of preterm labour and the birth of twins and triplets (National Institute for Health and Care Excellence, 2019a; 2019b). During this investigation NICE issued a new version of the guideline for preterm labour and birth for consultation. The investigation engaged with NICE to share the evidence from experts in the field of obstetrics and the literature on practices which involve milking the cord and the timing of the clamping of the cord. Some evidence relating to milking the cord suggests the potential for harm (National Institute for Health and Care Excellence, 2022; Katheria et al, 2019) and there were differences between the information clinicians rely upon relating to the delay in clamping of the cord. NICE told the investigation that it recognised that there may be new evidence emerging and highlighted that a further update to its guideline will be completed as required.

HSIB notes the following safety action

Safety action A/2022/054:

Following stakeholder feedback received during an update of the guideline for preterm labour and birth, the National Institute for Health and Care Excellence decided to delete the recommendation relating to milking the cord and amend the subsequent

recommendation on clamping of the cord to wait at least 60 seconds before clamping the cord of preterm babies unless there are specific maternal or fetal conditions that need earlier clamping.

5.5.12 The Royal College of Obstetricians and Gynaecologists (RCOG) has limited guidelines in this area as historically its documentation has been absorbed within NICE guidelines. Clinicians are signposted from the RCOG website to the NICE website for guidelines on the management of preterm labour, intrapartum care and the management of twin and triplet pregnancies (National Institute for Health and Care Excellence, 2019a; 2019b; 2017).

5.5.13 The most recent publication relevant to the area of preterm birth was produced by the RCOG in June 2022. This document is a guideline on the use of cervical cerclage and includes twin pregnancies and supports the NICE guideline for preterm labour and birth (National Institute for Health and Care Excellence, 2022). A full review of the available evidence on cervical cerclage is included within the RCOG publication and the RCOG makes the following recommendations (Shennan and Story, 2022):

- Cervical cerclage is of benefit in women with a singleton pregnancy and the experience of three or more previous preterm births.
- Ultrasound surveillance of cervical length is recommended and if the cervix is less than 25mm at 24 weeks, cervical cerclage should be offered to women with a history of one or more losses or preterm births.
- Cervical cerclage is not recommended with multiple pregnancies.

5.6 National maternity and neonatal safety improvement work

5.6.1 The NHS Long Term Plan includes an aim of reducing the rate of preterm births from 8% to 6% by 2025. This plan requires that every relevant trust in England is involved in the Maternity and Neonatal Safety Improvement Programme (MatNeoSIP) (NHS England, 2019).

5.6.2 The 'Saving babies' lives' care bundle (SBLCB) was developed by NHS England and NHS Improvement to promote best practice in specific elements of care recognised to improve outcomes for women/pregnant people and babies. Version two of this care bundle (SBLCBv2) includes an additional fifth element. Element 5 focuses on the evidence and best practice advice to develop pathways to support the management of preterm births (NHS England and NHS Improvement, 2019a). The SBLCBv2, element 5, outlines interventions relevant to the prediction, prevention and preparation for women at risk of imminent preterm birth. These include:

- optimisation of place of birth

- delivery of antenatal corticosteroids
- administration of magnesium sulphate within 24 hours of birth
- discussion with family on management of babies at birth.

5.6.3 This initiative also suggested several indicators to support units in evaluating their performance in delivering element 5 and the management of preterm birth. The rationale behind SBLCBv2 focused on singleton pregnancies. Although much of the care bundle is relevant to the management of a twin pregnancy, some of the interventions it sets out for the management of risk of a preterm labour are not recommended for a twin pregnancy (see 5.2).

5.6.4 Two funded regional quality improvement programmes, PReCePT and PeriPrem, have informed a national standard approach to optimising the care for women/pregnant people who are likely to experience a preterm birth.

5.6.5 The PReCePT study (West of England Academic Health Science Network, 2021) focused on increasing the uptake of magnesium sulphate for all eligible women/pregnant people. Between 2016 and 2020 it ensured all 152 maternity units had adopted PReCePT and met the target rate of 85% of eligible women/pregnant people receiving magnesium sulphate.

5.6.6 The PERIPrem project (West of England Academic Health Science Network, 2020) aimed to optimise the outcomes for premature babies across the southwest of England. The project offers open access and support to other parts of the UK to implement an evidence based neonatal care bundle for premature babies. PERIPrem developed a passport which can be given to every woman/pregnant person to explain all of the requirements illustrated in the preterm optimisation care pathway (see figure 3). A clinical passport is also available to allow clinicians to tick off each intervention to provide a record for both the woman/pregnant person and staff.

5.6.7 These early initiatives have informed the national development of a preterm optimisation care pathway produced by the British Association of Perinatal Medicine (BAPM). The pathway includes four toolkits to support the implementation of evidence-based interventions to optimise preterm care. The investigation found most of the components of the pathway were already in place at the reference event Trust.

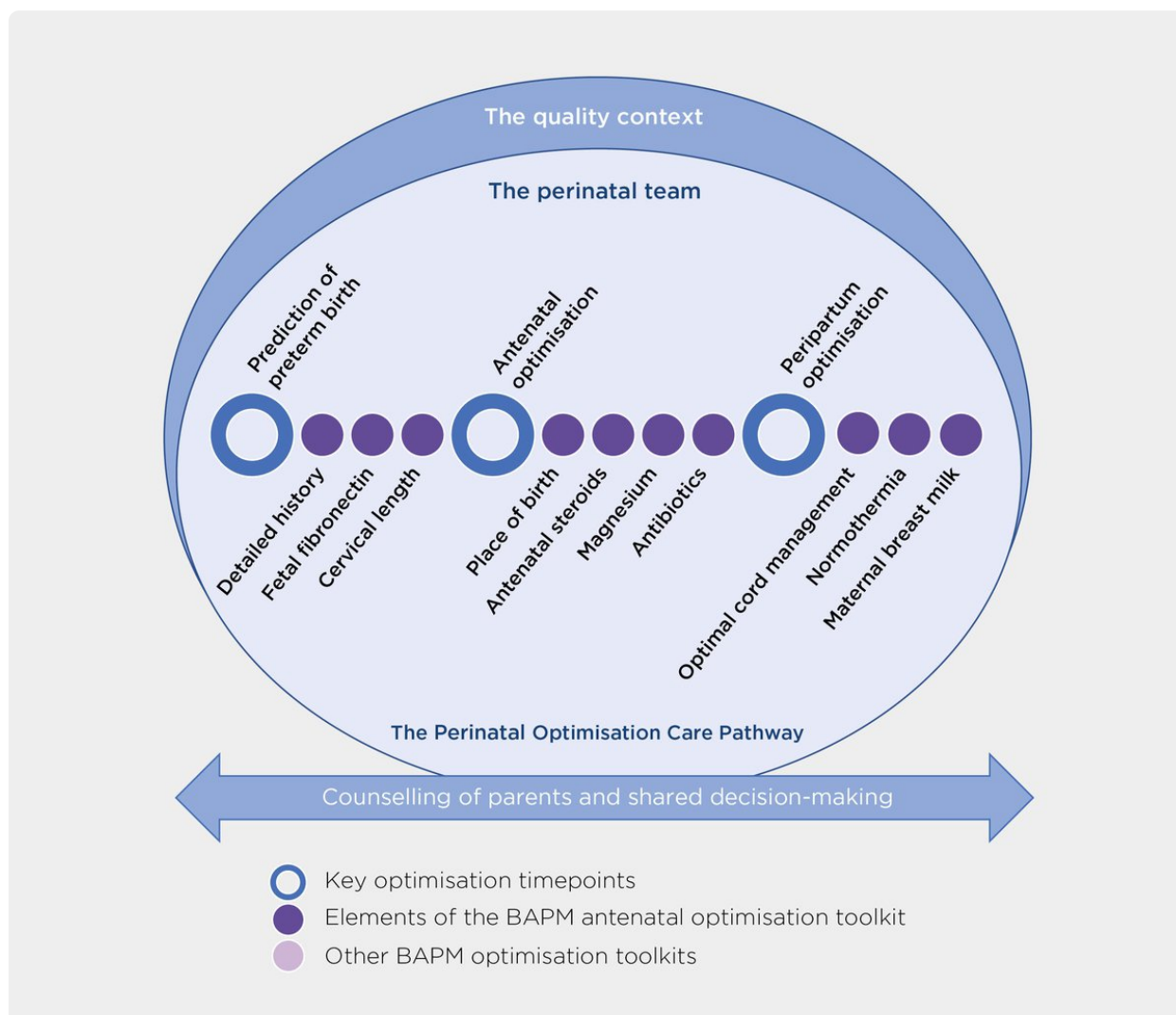


Figure 3 The Perinatal Optimisation Care Pathway (British Association of Perinatal Medicine, 2019, National Neonatal Audit Programme, 2019)

5.6.8 BAPM's work on the perinatal optimisation care pathway for preterm birth is in collaboration with the Maternity and Neonatal Safety Improvement Programme (MatNeoSIP) and the National Neonatal Audit Programme (NNAP). The NNAP monitors and 'captures' the data (including multiple births) relevant to the perinatal optimisation care pathway. The collaboration between MatNeoSIP, NNAP and BAPM supports trusts to deliver the pathway by introducing optimisation 'toolkits'. This approach aims to improve preterm outcomes by promoting compliance with evidence-based interventions (British Association of Perinatal Medicine, 2021).

5.6.9 A specific toolkit for the optimisation of cord clamping has been issued by BAPM to highlight the latest evidence on the optimal time of cord clamping. The optimisation of clamping the cord after birth may reduce the risk of death in preterm births by a third (British Association of Perinatal Medicine, 2020). BAPM encourages delayed clamping by at least 60 seconds

where possible but balancing the need for resuscitation (Resuscitation Council UK, 2021). One stakeholder believed the challenge to achieving this was that it required different teams to work cohesively to manage a preterm birth. The BAPM is currently producing resources to assist in the improvement of perinatal team culture.

5.6.10 The BAPM toolkit indicates that a delay of cord clamping is equally relevant for singleton and multiple births but will require 'well-orchestrated tasks' to achieve in the case of multiple births. This was echoed by investigation stakeholders who suggested that meeting this target in the case of multiple births would be a greater challenge. The investigation was unable to establish the timing of the cord clamping within the reference event.

5.7 Preterm data

5.7.1 National stakeholders reported that it was a challenge to collect high-quality and relevant data to support the learning and management of twin pregnancies and labour (Widdows et al, 2018). Asking clinicians to collect large volumes of data can create a high demand in the context of a busy maternity service. The need to co-design such systems with end users has been recommended as necessary to ensure high-quality data is recorded and accessible (Frøen et al, 2021).

5.7.2 The collection of English maternity data, reflecting demographics, interventions and outcomes, has grown over time. Historically, such data has been collected through local maternity information systems. This process has now been centralised in England within the NHS Digital Maternity Service Data Set (NHS Digital, 2022).

5.7.3 The National Maternity and Perinatal Audit (NMPA) uses the centralised maternity datasets to consider the reporting of best practice. A 'sprint' audit (an audit focused on a specific area) was completed and reported on multiple births in 2020 (Relph and National Maternity and Perinatal Audit Project Team, 2020). The audit team experienced some challenges due to lack of standardisation in data collected on multiple births and some data being absent. The report made several recommendations for additions to the fields collected and how data can and should be interpreted differently from data specific to singleton pregnancies. The investigation heard that there was ongoing work to review the type and reliability of data recorded.

5.7.4 A UK preterm clinical network has been created in recognition that research has struggled to provide conclusive evidence to understand the prediction and prevention of preterm labour (Carter et al, 2018). This group recognised the need for an internet-based database to collate data and build knowledge on the effectiveness of existing surveillance methods and interventions to manage preterm birth. The interrogation of the dataset is also intended to

generate and support future research. This database would appear to address the NICE recommendation to develop a national registry to assist with learning around interventions most suitable for use in preterm labour (National Institute for Health and Care Excellence, 2022).

5.7.5 There are 10 neonatal networks in England. A network refers to a selection of hospitals in a similar geographical region. These networks share knowledge and expertise relevant to the management of preterm babies. The investigation heard that they will also ensure data collected relevant to gestational age at birth, place of birth and interventions is reviewed. This data can be used to flag when a preterm baby is born in the 'wrong' place; this is based on the week of gestation and the required level of the maternity unit. These networks link the local maternity and neonatal care systems together to enable professionals in safety roles to review cases and consider the outcomes based on care received by women/pregnant people and babies. This can provide local intelligence to support improvement. The quality of this activity is reviewed by the Neonatal Implementation Board on behalf of the national Maternity Transformation Team.

5.7.6 The National Neonatal Audit Programme (NNAP) also work on a range of programmes to improve child health from quality improvement to workforce studies, from research in the UK to global child health programmes (National Neonatal Audit Programme, 2019).

5.7.7 The value of collecting and interrogating data is clear to target improvement and research, while monitoring standards. The opportunity to use data on multiple births, which carry the greatest risk of preterm labour, for targeted learning and research does not appear to be as regularly considered within the maternity system.

HSIB makes the following safety observation

Safety observation O/2022/189:

It may be beneficial to regularly analyse data on multiple births so the interpretation of this data can inform learning and research.

5.8 Summary

5.8.1 The research into preterm labour and birth is a fast-moving area with a number of critical questions being explored, with some evidence emerging as promising. This includes the research looking to understand intrauterine infection and vaginal bacteria. Effective interventions to manage the threat of preterm labour remain inconclusive for twins but research

continues. Research and in particular clinical studies of twin pregnancies has been described as a challenging area with an acknowledgement that some national databases, which now consider twin pregnancies are able to assist this field of research.

5.8.2 There are a considerable number of data repositories that collect, collate and allow for analysis of maternity and neonatal care and outcomes. There is a clear value in using this data to target improvement and research, while monitoring standards. These datasets appear to focus on the majority of births, namely singletons, which has enabled national initiatives and research agendas to standardise and enhance best practice. This does not appear to be the same for multiple births, which, although less frequent, are recognised to have greater risk for preterm labour and birth.

5.8.3 The investigation found that a considerable amount of work has been completed to develop, implement and assure the effectiveness of evidence-based interventions to improve the management of preterm labour and birth. The 'Saving babies' lives version two' care bundle and the BAPM perinatal optimisation care pathway provides a comprehensive approach to address many of the risks associated with preterm birth. The national initiatives identified by the investigation indicate that the healthcare system has developed processes to evaluate and implement emerging evidence and guidelines in the field of preterm labour and birth.

6 Summary of findings, safety observations and safety action

6.1 Findings

- There are currently no proven treatments available to reduce the risk of preterm labour for twin pregnancies.
- There are gaps in scientific knowledge and challenges to completing research in the field of preterm labour and birth. This creates a challenge for the development of detailed guidelines to support clinical decision making.
- Guidelines and equipment recommended for managing and monitoring singleton (one baby) and full-term pregnancies are used to assist with clinical decision making about preterm twin pregnancies; some interventions within the guidelines are unproven for use in preterm twin pregnancies.
- Research and national improvement initiatives, such as the British Association of Perinatal Medicine perinatal optimisation care pathway and NHS England and NHS Improvement 'Saving babies' lives care bundle version two' and the Maternity and Neonatal Safety Improvement Programme are improving the standardisation and implementation of evidence-based interventions.

- Intelligence from national data gathered by maternity units can support the learning on preterm labour and birth in twin pregnancies.

HSIB makes the following safety observations

Safety observation O/2022/187:

It may be beneficial if further research aimed to generate additional knowledge to predict and prevent preterm labour for twin pregnancies among different groups of women/pregnant people.

Safety observation O/2022/188:

It may be beneficial to increase awareness among the public and healthcare professionals of the limitations of interventions for the prevention of preterm labour of multiple births.

Safety observation O/2022/189:

It may be beneficial to regularly analyse data on multiple births so the interpretation of this data can inform learning and research.

HSIB notes the following safety action

Safety action A/2022/054:

The National Institute for Health and Care Excellence (NICE) agreed to delete from its guideline for preterm labour and birth the recommendation relating to milking the cord. NICE also agreed to amend the subsequent recommendation on clamping of the cord; the guidance now recommends waiting at least 60 seconds before clamping the cord of preterm babies unless there are specific maternal or fetal conditions that need earlier clamping

7 References

Agrawai, V. and Hirsch, E. (2012) Intrauterine infection and preterm labor. Seminars in fetal and neonatal medicine, 17(1),1-8 [Online]. DOI:10.1016/j.siny.2011.09.001.

Ahya, K. and Suryawanshi, P. (2018) Neonatal periventricular leukomalacia: current perspectives. Research and Reports in Neonatology [Online]. DOI:org/10.2147/RRN.S125575.

Ayres-de-Campos, D., Spong, C. and Chandrachud, E. (2015) FIGO consensus guidelines on intrapartum fetal monitoring: Cardiotocography. International Journal of Gynecology and Obstetrics, 131, 13-24 [Online]. DOI:org/10.1016/j.ijgo.2015.06.020.

Ball, G., Aljabar, P., Nongena, P., Kennea, N., Gonzalez-Cinca, N., Falconer, S., Chew, A.T., Harper, N., Wurie, J., Rutherford, M.A. and Counsell, S.J. (2017) Multimodal image analysis of clinical influences on preterm brain development. Annals of Neurology, 82(2), 233-246 [Online]. DOI: 10.1002/ana.24995.

British Association of Perinatal Medicine. (2019) Perinatal Management of Extreme Preterm Birth before 27 weeks of gestation A Framework for Practice [Online]. Available at https://hubble-live-assets.s3.amazonaws.com/bapm/file_asset/file/30/Extreme_Preterm_28-11-19_FINAL.pdf (Accessed 23 November 2021).

British Association of Perinatal Medicine. (2020) Optimal Cord Management in Preterm Babies A Quality Improvement Toolkit [Online]. Available at https://hubble-live-assets.s3.amazonaws.com/bapm/redactor2_assets/files/831/OCM_Toolkit_Full_For_Launch.pdf (Accessed 17 February 2022).

British Association of Perinatal Medicine. (2021) Antenatal Optimisation Toolkit: Antenatal Optimisation for Preterm Infants less than 34 weeks: A Quality Improvement Toolkit [Online]. Available at <https://www.bapm.org/pages/194-antenatal-optimisation-toolkit> (Accessed 6 May 2022).

Carter, J., Tribe, R., Sandall, J. and Shennan, A. (2018) The Preterm Clinical Network (PCN) Database: a web-based systematic method of collecting data on the care of women at risk of preterm birth. BMC Pregnancy Childbirth, 18(1) [Online]. DOI:10.1186/s12884-018-1967-y

Deng, W. and Pleasure, J. (2008) Progress in Periventricular Leukomalacia. JAMA Neurology, 65(10) [Online]. DOI:10.1001/archneur.65.10.1291.

Department of Health. (2016) Safer Maternity Care: Next steps towards the national maternity ambition [Online]. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/560491/Safer_Maternity_Care_action_plan.pdf (Accessed 22 November 2021).

Draper, E., Gallimore, I., Smith, L., Fenton, A., Kurinczuk, J., Smith, P., Bobby, T. and Manktelow, B. (2021) MBRRACE-UK Perinatal Mortality Surveillance Report, UK Perinatal Deaths for Births from January to December 2019. The Infant Mortality and Morbidity Studies, Department of

Health Sciences, University of Leicester. Leicester: MBRRACE-UK [Online]. Available at <https://www.hqip.org.uk/wp-content/uploads/2021/10/Ref.-325-MNI-Perinatal-Surveillance-Main-report-FINAL.pdf> (Accessed 25 May 2022).

Flaviani, F., Hezelgrave, N., Kanno, T., Prosdocimi, E., Chin-Smith, E., Ridout, A., von Maydell, D; Mistry, V; Wade, W; Shennan, A; Dimitrakopoulou, K; Seed, P; Mason, J; Tribe, R. (2021) Cervicovaginal microbiota and metabolome predict preterm birth risk in an ethnically diverse cohort. *Journal of Clinical Investigation* [Online]. DOI: 10.1172/jci.insight.149257.

Frøen, J., Bianchi, A., Moller, A., Jacobsson, B. and Birth., the FIGO working group for Preterm Birth. (2021) FIGO good practice recommendations on the importance of registry data for monitoring rates and health systems performance in prevention and management of preterm birth. *International Journal of Gynecology Obstetrics*, 155, 5–7 [Online]. DOI: 10.1002/ijgo.13847.

Healthcare Safety Investigation Branch. (2019) Suitability of equipment and technology used for continuous fetal heart rate monitoring. Available at <https://www.hsib.org.uk/investigations-and-reports/suitability-of-equipment-and-technology-used-for-continuous-fetal-heart-rate-monitoring/> (Accessed 26 May 2022).

Healthcare Safety Investigation Branch. (2021) Intrapartum stillbirth: learning from maternity safety investigations that occurred during the COVID-19 pandemic 1 April to 30 June 2020 [Online]. Available at <https://www.hsib.org.uk/investigations-and-reports/intrapartum-stillbirth-during-covid-19/> (Accessed 26 May 2022).

Hezelgrave, N., Watson, H., Ridout, A., Diab, F., Seed, P., Chin-Smith, E., Tribe, R and Shennan, A. (2016) Rationale and design of SuPPoRT: a multi-centre randomised controlled trial to compare three treatments: cervical cerclage, cervical pessary and vaginal progesterone, for the prevention of preterm birth in women who develop a short cervix. *BMC Pregnancy Childbirth*, 16(358) [Online]. DOI:10.1186/s12884-016-1148-9.

Hodgetts-Morton, V. H., Leighton, L., Pilarski, N., Molloy, E., Hinshaw, K., Norman, J., Waugh, J., Stock, S., Thornton, J., Tooze-Hobson, P., Johnston, T., Coomarasamey, A., Thangaratinam, S., Mol, B., Pajkrt, E., Marlow, N., Roberts, T., Middleton, L., Brocklegurst, P. and Morris, K. (2021) C-STICH2: emergency cervical cerclage to prevent miscarriage and preterm birth—study protocol for a randomised controlled trial. *Trials*, 22(529) [Online]. DOI: 10.1186/s13063-021-05464-6.

Hoffman, R., Crandall, B. and Shadbolt, N. (1998) Use of the Critical Decision Method to Elicit Expert Knowledge: A Case Study in the Methodology of Cognitive Task Analysis. *Human Factors*, 40(2), 254-276 [Online]. DOI: 10.1518/001872098779480442.

Katheria, A., Reister, F., Essers, J., Mendler, M., Hummler, H., Subramaniam, A., Carlo, W., Tita, A., Truong, G., Davis-Nelson, S., Schmolzer, G., Chari, R., Kaempf, J., Tomlinson, M., Yanowitz, Back, S., Simhan, H., Dempsey, E., O'Donoghue, K., Bhat, S., Hoddman, M., Faksh, A., Arnel, K., Rich, W., Finer, N., Vaucher, Y., Khanna, P., Meyers, M., Varner, M., Allman, P., Szychowski, J., Cutter, G. (2019). Association of Umbilical Cord Milking vs Delayed Umbilical Cord Clamping With Death or Severe Intraventricular Hemorrhage Among Preterm Infants. JAMA, 322 (19), 1877-1886. DOI: 10.1001/jama.2019.16004.

Klein, G. A., Orasanu, J., Calderwood, R. and Zsombok, C. E. (1993) Decision making in action : models and methods. New Jersey: Norwood.

MBRRACE-UK. (2020) Perinatal Mortality Surveillance Report: UK Perinatal Deaths for Births from. Available at <https://www.hqip.org.uk/wp-content/uploads/2020/12/Ref.-203-MNI-Perinatal-surveillance-report-2018-Full-report-FINAL.pdf> (Accessed 6 May 2022).

MMBRACE-UK. (2021) Perinatal Confidential Enquiry: Stillbirths and neonatal deaths in twin pregnancies [Online]. Available at https://www.npeu.ox.ac.uk/assets/downloads/mbrance-uk/reports/perinatal-report-2020-twins/MBRRACE-UK_Twin_Pregnancies_Confidential_Enquiry.pdf (Accessed 5 May 2022).

National Institute for Health and Care Excellence. (2010) Neonatal specialist care. Quality standard [QS4] [Online]. Available at <https://www.nice.org.uk/guidance/qs4> (Accessed 15 November 2021).

National Institute for Health and Care Excellence. (2017) Intrapartum care for healthy women and babies. Clinical guideline [CG190] [Online]. Available at <https://www.nice.org.uk/guidance/cg190> (Accessed 15 November 2021).

National Institute for Health and Care Excellence. (2019a) Preterm labour and birth. NICE guideline [NG25] [Online]. Available at www.nice.org.uk/guidance/ng25 (Accessed 12 October 2021).

National Institute for Health and Care Excellence. (2019b) Twin and triplet pregnancy. NICE guideline [NG137] [Online]. Available at <https://www.nice.org.uk/guidance/ng137/resources/twin-and-triplet-pregnancy-pdf-66141724389829> (Accessed 21 October 2021).

National Institute for Health and Care Excellence. (2019c) Preterm labour and birth. Quality standard [QS135]. Quality statement 1: providing information about potential signs and symptoms of preterm labour [Online]. Available at <https://www.nice.org.uk/guidance/QS135/chapter/Quality-statement-1-Providing-information-about-potential-signs-and-symptoms-of-preterm-labour> (Accessed 16 November 2021).

National Institute for Health and Care Excellence. (2021) Caesarean birth. NICE guideline [NG192] [Online]. Available at <https://www.nice.org.uk/guidance/ng192/chapter/Recommendations> (Accessed 17 November 2021).

National Institute for Health and Care Excellence. (2022) Guideline. Preterm labour and birth. Draft for consultation, February 2022 [Online]. Available at <https://www.nice.org.uk/guidance/GID-NG10245/documents/draft-guideline> (Accessed 31 March 2022).

National Library of Medicine. (2021) PubChem [Online]. Available at <https://pubchem.ncbi.nlm.nih.gov/compound/Magnesium-sulfate> (Accessed 22 November 2021).

National Neonatal Audit Programme. (2019) A guide to the 2020 audit measures [Online]. Available at https://www.rcpch.ac.uk/sites/default/files/2019-11/nnap_2020_audit_measures_guide_v1.0_191119_0.pdf (Accessed 30 March 2022).

NHS Digital. (n.d.) Maternity Services Monthly Statistics June 2019 [Online]. Available at <https://digital.nhs.uk/data-and-information/publications/statistical/maternity-services-monthly-statistics/june-2019> (Accessed 12 October 2021).

NHS Digital. (2022) Maternity Services Data Set [Online]. Available at <https://digital.nhs.uk/data-and-information/data-collections-and-data-sets/data-sets/maternity-services-data-set> (Accessed 13 May 2022).

NHS England. (2019) The NHS Long term Plan [Online]. Available at <https://www.longtermplan.nhs.uk/publication/nhs-long-term-plan/> (Accessed 14 February 2020).

NHS England. (2020) Premature labour and birth [Online]. Available at <https://www.nhs.uk/pregnancy/labour-and-birth/signs-of-labour/premature-labour-and-birth/> (Accessed 22 November 2021).

NHS England and NHS Improvement. (n.d.) Maternity and Neonatal Safety Improvement Programme [Online]. Available at <https://www.england.nhs.uk/mat-transformation/maternal-and-neonatal-safety-collaborative/> (Accessed 02 August 2022).

NHS England and NHS Improvement. (2019a) Saving Babies' Lives Version Two. London: NHS England and NHS Improvement [Online]. Available at <https://www.england.nhs.uk/wp-content/uploads/2019/03/Saving-Babies-Lives-Care-Bundle-Version-Two-Updated-Final-Version.pdf> (Accessed 21 April 2021).

NHS England and Improvement. (2019b) Giving birth to twins or more [Online]. Available at <https://www.nhs.uk/pregnancy/labour-and-birth/what-happens/giving-birth-to-twins-or-more/> (Accessed 5 May 2022).

Norman, J., MacKenzie, F., Owen, P., Mactier, H., Hanretty, K. and Cooper, S. (2009) Progesterone for the prevention of preterm birth in twin pregnancy (STOPPIT): a randomised, double-blind, placebo-controlled study and meta-analysis. *The Lancet*, 373 (9680), 2034-2040 [Online]. DOI: 10.1016/S0140-6736(09)60947-8.

Norman, J., Norrie, J., MacLennan, G., Whyte, S., Chowdhry, S., Cunningham-Burley, S., Neilson, A. R., Mei, X. W., Smith, J. B., Shennan, A., Robson, S. C., Thornton, S., Kilby, M. D., Marlow, N., Stock, S. J., Bennett, P. R. and Denton, J. (2022) The Arabin pessary to prevent preterm birth in women with a twin pregnancy and a short cervix: the STOPPIT 2 RCT. *Health Technology Assessment*, 25 (144) [Online]. DOI: 10.3310/hta25440.

Ockenden, D. (2022) Ockenden report – final. Findings, conclusions and essential actions from the independent review of maternity services at the Shrewsbury and Telford Hospital NHS Trust [Online]. Available at <https://www.gov.uk/government/publications/final-report-of-the-ockenden-review> (Accessed 22 April 2022).

Office for National Statistics. (n.d.) Birth characteristics in England and Wales: 2018 [Online]. Available at <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/bulletins/birthcharacteristicsinenglandandwales/2018> (Accessed 22 November 2021).

Phung, J., Wang, C., Reeders, J., Chan, E.-C., Riveros, C., Zakar, T., Paul, J. W., Pennell, C. E. and Smith, R. (2022) Preterm labor is a distinct process from term labor following computational analysis of human myometrium. *American Journal of Obstetrics and Gynecology*, 226 (1), 106.e1-106.e16 [Online]. DOI: 10.1016/j.ajog.2021.07.002.

Puthussery, S., Li, L., Tseng, P.-C., Kilby, L., Kapadia, J., Puthusserry, T. and Thind, A. (2019) Ethnic variations in risk of preterm birth in an ethnically dense socially disadvantaged area in the UK: a retrospective cross-sectional study. *BMJ Open*, 9 (3), e023570 [Online]. DOI: 10.1136/bmjopen-2018-023570.

Rasmussen, J. (1985) The role of hierarchical knowledge representation in decisionmaking and system management. *IEEE Transactions on Systems, Man and Cybernetics*, 15 (2), 234-243 [Online]. DOI: 10.1109/TSMC.1985.6313353.

Relph, S. and National Maternity and Perinatal Audit Project Team. (2020) NHS maternity care for women with multiple births national maternity and perinatal audit and their babies. A study on feasibility of assessing care using data from births between 1 April 2015 and 31 March 2017 in England, Wales and Scotland [Online]. Available at <https://maternityaudit.org.uk/FilesUploaded/NMPA%20Multiple%20Births%20Report%202020.pdf> (Accessed 22 April 2022).

Rennie, J. and Robertson, N. (2012) Rennie and Robertson's Textbook of Neonatology 5th edition. London: Churchill Livingstone.

Resuscitation Council UK. (2021) Newborn life support [Online]. Available at <https://www.resus.org.uk/library/2021-resuscitation-guidelines/newborn-resuscitation-and-support-transition-infants-birth> (Accessed 03 August 2022).

Royal College of Paediatrics and Child Health. (2019) National Neonatal Audit Programme 2019 annual report on 2018 data [Online]. Available at <https://www.rcpch.ac.uk/sites/default/files/2020-01/NNAP%202019%20annual%20report%20on%202018%20data%2009.01.20.pdf> (Accessed 22 November 2021).

The Royal College of Pathologists. (2017) Tissue pathway for histopathological examination of the placenta [Online]. Available at <https://www.rcpath.org/uploads/assets/ec614dfa-007c-4a93-8173cb202a071a72/tissue-pathway-for-histopathological-examination-of-the-placenta.pdf> (Accessed 16 November 2021).

Shennan, A. and Story, L. (2022) Cervical cerclage. British Journal of Obstetrics and Gynaecology, 129, 1178-1210 [Online]. Available at <https://obgyn.onlinelibrary.wiley.com/doi/epdf/10.1111/1471-0528.17003> (Accessed 25 May 2022).

Torchin, H. and Ancel, P. (2016) Epidemiology and risk factors of preterm birth. Journal of Gynaecology Obstetrics and Biological Reproduction, 45 (10), 1213-1230 [Online]. DOI: 10.1016/j.jgyn.2016.09.013.

Twins Trust. (n.d.) Find your twins/multiples clinic [Online]. Available at <https://twinstrust.org/let-us-help/pregnancy-and-birth/twin-clinics.html> (Accessed 5 May 2022).

University College London. (n.d.) EPICure. EGA Institute for Women's Health. About [Online]. Available at <https://www.ucl.ac.uk/womens-health/research/neonatology/epicure/about> (Accessed 23 November 2021).

US National Library of Medicine. (2021) ClinicalTrials.gov. The role of oxytocin in the second stage of labour (ROSSoL) [Online]. Available at <https://www.clinicaltrials.gov/ct2/show/NCT04303702> (Accessed 19 November 2021).

US National Library of Medicine. (2022) Clinical Trials.gov. Periventricular leukomalacia [Online]. Available at <https://clinicaltrials.gov/search/?term=Periventricular%20Leukomalacia> (Accessed 26 May 2022).

Watson, H., Seed, P., Carter, J., Hezelgrave, N., Kuhrt, K., Tribe, R. and Shennan, A. (2020) Development and validation of predictive models for QUIPP App v.2: tool for predicting preterm birth in asymptomatic high-risk women. *Ultrasound in Obstetrics and Gynecology* [Online]. Available at <https://obgyn.onlinelibrary.wiley.com/doi/full/10.1002/uog.20401> (Accessed 26 May 2022).

Weckman, A., Ngai, M., Wright, J., McDonald, C. and Kain, K. (2019) The impact of infection in pregnancy on placental vascular development and adverse birth outcomes. *Microbiology*, 10, 1924 [Online]. DOI: 10.3389/fmicb.2019.01924.

West of England Academic Health Science Network. (2020) PERIPrem project [Online]. Available at <https://www.weahsn.net/our-work/transforming-services-and-systems/periprem/periprem-project/> (Accessed 5 May 2022).

West of England Academic Health Science Network. (2021) PReCePT [Online]. Available at <https://www.weahsn.net/our-work/transforming-services-and-systems/precept/> (Accessed 5 May 2022).

Widdows, K., Roberts, S., Camacho, E. and Heazell, A. (2018) Evaluation of the implementation of the Saving Babies' Lives Care Bundle in early adopter NHS Trusts in England. University of Manchester, Maternal and Fetal Health, Manchester [Online]. Available at <https://www.e-lfh.org.uk/wp-content/uploads/2020/02/SPiRE-evaluation.pdf> (Accessed 6 May 2022).

Wilson, A., Hodgetts-Morton, V., Marson, E., Markland, A., Larkai, E., Papadopoulou, A., Coomarasamy, A., Tobias, A., Chou, D., Oladapo, O. T., Price, M., Morris, K. and Gallos, I. D. (2021) Tocolytics for delaying preterm birth: a network meta-analysis (Protocol). *Cochrane Database of Systematic Reviews* [Online]. DOI: 10.1002/14651858.CD014978.

World Health Organization. (n.d.) Managing complications in pregnancy and childbirth [Online]. Available at https://hetv.org/resources/reproductive-health/impac/Symptoms/Malpositions_malpresentations_S69_S81.html (Accessed 16 November 2021).

World Health Organization. (2015) WHO recommendations on interventions to improve preterm birth outcomes [Online]. Available at <https://www.ncbi.nlm.nih.gov/books/NBK321166/?report=reader#!po=70.0000> (Accessed 23 May 2022).

World Health Organization. (2018) Preterm birth [Online]. Available at <https://www.who.int/news-room/fact-sheets/detail/preterm-birth> (Accessed 22 November 2021).

Providing feedback and comment on reports

We welcome feedback on our investigation reports. Please complete our [online feedback form](#) or email enquiries@hssib.org.uk.

We aim to provide a response to all correspondence within five working days.

This document, or parts of it, can be copied without specific permission providing that the source is duly acknowledged, the material is reproduced accurately, and it is not used in a derogatory manner or in a misleading context.