National Institute for Health and Care Excellence

Draft for Consultation

Twin and Triplet Pregnancy

[C2] Evidence review for fetal monitoring during labour

NICE guideline tbc

Evidence reviews

March 2019

Draft for Consultation

These evidence reviews were developed by the National Guideline Alliance hosted by the Royal College of Obstetricians and Gynaecologists

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The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or service users. The recommendations in this guideline are not mandatory and the guideline does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or their carer or guardian.

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ISBN:

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3 What is the most effective method of fetal monitoring during labour in improving outcomes for
4 babies and mothers?

5 Introduction

6 The aim of this review is to determine the most effective methods of fetal monitoring during
7 labour for twin pregnancies by comparing use of internal and external techniques and
8 computerised assessment where there is no suspicion of fetal distress and the additional use
9 of fetal blood sampling where fetal distress is suspected.

10 Monitoring for triplet births will not be included in this review because prolonged monitoring
11 would not be required for caesarean section, and vaginal birth of triplets is rare and
12 monitoring would be on an individual basis.

13 Summary of the protocol

14 Table 1 summarises the Population, Intervention, Comparator, and Outcome (PICO)
15 characteristics of this review.

16 **Table 1: Summary of protocol (PICO table)**

Population	Twin pregnancies only **Comparisons 1 and 2** • Women in labour with twins >32^{+0} weeks' gestation with first twin cephalic and any other presentation in the second twin **Comparisons 3 and 4** • Women in labour with twins >32^{+0} weeks' gestation with first twin cephalic and any other presentation in the second twin, with suspected fetal distress in Twin 1
Intervention	**Comparison 1** • Twin 1 - continuous electronic fetal monitoring (EFM) conducted internally using a fetal scalp electrode (FSE) • Twin 2 - continuous EFM using an external transducer **Comparison 2** • Twin 1 - continuous EFM conducted internally using FSE • Twin 2 - continuous EFM using an external transducer with computer assessment **Comparison 3** • Twin 1 - continuous EFM (conducted internally using FSE or using an external transducer) and fetal blood sampling (FBS) • Twin 2 - continuous EFM using an external transducer • For both twins where an external transducer is used repositioning or manual positioning or ultrasound positioning having been tried. **Comparison 4** • Twin 1 - continuous EFM (conducted internally using FSE or using an external transducer) with computer assessment and fetal blood sampling (FBS) • Twin 2 - continuous EFM using an external transducer with computer assessment • For both twins where an external transducer is used repositioning or manual positioning or ultrasound positioning having been tried.

Comparator	**Comparison 1** • Twin 1 and Twin 2 - continuous EFM using an external transducer (with repositioning or manual positioning or ultrasound positioning having been tried) **Comparison 2** • Twin 1 and Twin 2 - continuous EFM using an external transducer (having tried repositioning or manual positioning or ultrasound positioning) with computer assessment **Comparison 3** • Twin 1 - continuous EFM (conducted internally using FSE or using an external transducer) • Twin 2 - continuous EFM using an external transducer • For both twins where an external transducer is used repositioning or manual positioning or ultrasound positioning having been tried. **Comparison 4** • Twin 1 - continuous EFM (conducted internally using FSE or using an external transducer) with computer assessment • Twin 2 - continuous EFM using an external transducer with computer assessment • For both twins where an external transducer is used repositioning or manual positioning or ultrasound positioning having been tried
Outcomes	**Critical** **For the woman:** • Mode of birth **For the baby:** • Perinatal mortality (either or both twins) • Hypoxic-ischemic encephalopathy (Grade 2 and 3) **Important** **For the woman:** • Infection • Maternal satisfaction **For the baby:** • Fetal acidosis/acidemia • Admission to neonatal intensive care unit

For full details see the review protocol in appendix A.

Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual 2014. Methods specific to this review question are described in the review protocol in appendix A and for a full description of the methods see supplementary document C.

Declaration of interests were recorded according to NICE's 2014 conflicts of interest policy from March 2017 until March 2018. From April 2018 onwards they were recorded according to NICE's 2018 conflicts of interest policy. Those interests declared until April 2018 were reclassified according to NICE's 2018 conflicts of interest policy (see Interests Register).

Clinical evidence

Included studies

A systematic review of the clinical literature was conducted but no studies were identified which were applicable to this review question.Conference abstracts published within the 2 last years were also assessed for a potential inclusion (for critical outcomes only) but no relevant evidence was identified.

See also the literature search strategy in appendix B, study selection flow chart in appendix C.

Excluded studies

Studies not included in this review with reasons for their exclusions are listed in appendix K.

Summary of clinical studies included in the evidence review

No studies were included in this review.

Quality assessment of clinical studies included in the evidence review

No studies were included in this review.

Economic evidence

Included studies

A systematic review of the economic literature was conducted but no economic studies were identified which were applicable to this review question.

See the appendix B for the economic search strategy and appendix G for the economic evidence selection flow chart for further information.

Excluded studies

Studies not included in this review with reasons for their exclusions are listed in appendix K.

Summary of studies included in the economic evidence review

No economic studies were identified which were applicable to this review question.

Economic model

No economic modelling was undertaken for this review because the committee agreed that other topics were higher priorities for economic evaluation.

Evidence statements

No studies were included in this review.

The committee's discussion of the evidence

Interpreting the evidence

The outcomes that matter most

The committee prioritised mode of birth as a critical outcome because an emergency caesarean section after previous vaginal birth is associated with the greatest risk of adverse maternal and fetal outcomes. Perinatal mortality and hypoxic-ischaemic encephalopathy Grade 2 and 3 were prioritised as critical outcomes because they have lifelong adverse effects on the baby or babies and the family.

The committee agreed that maternal infection was an important outcome because maternal morbidity after birth is associated with an adverse effect on maternal mobility, breastfeeding, and woman's birth and labour experience. Maternal satisfaction was chosen as an important outcome because it measures the effectiveness of the intervention from the woman's perspective. Fetal acidemia was prioritised as an important outcome as it may be associated with adverse neurological outcomes. Admission to NICU was chosen as an important outcome because of the separation between the woman and the baby or babies, and resource implications to the NHS.

No evidence was found for this review.

The quality of the evidence

No evidence was found for this review, and the committee used their expertise and experience of current practice to make recommendations.

Benefits and harms

As no evidence was found for this review, the committee made recommendations based on their experience and expertise. Despite the lack of evidence the committee decided that strong recommendations are needed for this topic because they agreed that there would be an increased risk of perinatal morbidity and mortality if there is no monitoring during labour.

Planning birth: information and support

The committee decided, based on their experience and knowledge, that discussions about birth plans are important and that such discussions should enable the woman to make an informed decision about childbirth. At such a life changing time her wishes and preferences should be explored and information should be tailored to each woman. She can then feel better prepared which may ease some of her concerns and anxieties. Such discussions (including fetal monitoring) should be conducted at the latest by week 28 of her pregnancy because of the high risk of preterm birth. The committee also acknowledged that the best practice on how to provide information and how to communicate with adults is described in NICE's guideline on patient experience in adult NHS services and cross referred to it.

Antenatal information for women

Based on their experience and expertise, the committee agreed that it was important to address any concerns the woman with a twin pregnancy may have about continuous cardiotocography antenatally (by 28 weeks' gestation) and that the recommendations on the cardiotocography are based on evidence from singleton pregnancies (NICE guideline on intrapartum care for healthy women and babies – CG190). They also discussed and agreed that health care professionals should explain to the woman and her family members or carers the potential benefits and harms of continuous cardiotocography, for example what the procedure involves and why it is used. They agreed that recommending this by week 28 of her pregnancy would give the woman time to make an informed decision and also address

the issue of frequent premature birth in twins. They considered that it was important for the woman to know that this would be consistent with other NICE guidance on fetal monitoring in women with a singleton pregnancy (CG190), particularly since there is no evidence of monitoring with cardiotocography for twins. Based on their knowledge the committee noted that twins are at an increased risk of acute and chronic hypoxaemia and acidemia during labour, especially the second twin. That is why they agreed to recommend continuous fetal monitoring as it is the only modality that could assess both twin fetal heart rates simultaneously and continuously during established labour.

Intrapartum monitoring

The committee recommended offering continuous cardiotocography to women in active labour with a twin pregnancy over 26 weeks' gestation because at this gestation neonatal survival rates are favourable and the risk of neonatal morbidity from preterm birth is falling. Care of the babies during labour should be optimised to achieve the best likelihood of neonatal survival and wellbeing at birth. This was recommended in line with guidance made for a singleton pregnancy in CG190.

The committee agreed, based on their experience and expertise, to recommend performing a portable (bedside) ultrasound scan at the commencement of active labour to confirm presentation and aid location of both fetal heart rates. Malpresentation is more common in twin when compared to singleton pregnancies and may indicate the need for an emergency caesarean section if the first twin is presenting in the breech position. A portable (bedside) ultrasound scan also aids initial allocation of each twin to its cardiotocograph recording.

The committee discussed and agreed not to recommend offering intermittent auscultation to women who are in established labour and are more than 26 weeks' pregnant. They discussed that the advantages of cardiotocography over intermittent monitoring include the ability to assess baseline variability and monitor continuously. This level of monitoring is recommended for babies at higher risk of hypoxia and acidaemia in labour (CG190). Additionally, in twin pregnancy cardiotocography, monitoring both babies simultaneously (unlike intermittent auscultation), improves the ability to ensure both babies are monitored rather than erroneously monitoring the same baby twice. The ability of cardiotocography in this regard can also be enhanced by monitoring the presenting twin with a fetal scalp electrode, which when indicated has the additional advantage of accurately assigning each twin to its heart rate recording.

However, they also discussed some of the disadvantages of the use of continuous cardiotocography, particularly that it is a screening and not a diagnostic test for fetal hypoxia and acidaemia. Therefore, its use is known to be associated with false reassurance and false anxiety of the babies' condition. The latter is likely to result in an increased intervention rate such as birth by caesarean section. Suspicious fetal heart rate patterns are also likely to increase woman's anxiety, including for example, when she hears changes in the fetal heart rates.

They recommended that a senior obstetrician should be involved in the discussion with the woman and her family members or carers of how twins should be monitored in established premature labour (23^{+0} to 25^{+6} weeks' gestation) which is in line with the NICE guidance on premature labour and birth in singleton pregnancies (CG190).

Based on their experience and expertise the committee recommended dual channel monitors to make sure simultaneous display and therefore assessment of both twins' hearts is accurate. The committee discussed that the babies move around during labour and therefore to be able to interpret these signals it is important to clearly document which trace belongs to which baby. They suggested monitoring maternal pulse electronically and also displaying it simultaneously so that the maternal heart rate is not mistaken for any fetal heart rate.

The committee also discussed and recommended considering separation of fetal heart rates by 20bpm in cases (which is a technical option of the machine) where there is a difficulty differentiating between the two fetal heart rates as it may aid cardiotocograph interpretation.

The committee discussed and agreed that the recommendations regarding the classification and interpretation of cardiotocography should be broadly consistent with that for singleton babies born at term as per monitoring during labour in CG190. However, in their recommendations the committee stressed that twin pregnancy should be considered a fetal clinical risk factor when classifying a cardiotocograph finding as 'abnormal' or 'non-reassuring' (see table 10 in CG190), which results in a lower threshold for categorising it as 'pathological' (see table 11 in CG190) for the purpose of managing the pregnancy. They also agreed to recommend that fetal scalp stimulation should not be performed in twin pregnancy to gain reassurance following a cardiotocograph that is categorised as 'pathological', as evidence to support such practice is lacking, particularly for babies of a pregnancy at increased risk of compromise, such as twin pregnancy.

Reviewing cardiotocography

Based on their experience and expertise the committee recommended systematically assessing both cardiotocographs hourly or even more frequently if there are concerns and documenting classification of cardiotocograph traces of both babies at these time points.

Management based on cardiotocography

In case of an unsuccessful abdominal monitoring or if there are concerns regarding synchronicity of fetal hearts, the committee agreed to recommend applying a fetal scalp electrode to the first twin (>34 weeks' gestation) in the absence of contraindications such as HIV, hepatitis, or maternal thrombocytopenia. This should be done (whilst continuing abdominal monitoring of the second twin) because failure to adequately monitor one or both babies may result in an adverse perinatal outcome. They recommended that, if monitoring remains unsatisfactory, they suggested performing a caesarean section to avoid missing opportunity to detect intrapartum hypoxia.

In case of a 'suspicious' cardiotocography (see table 11 in CG190) in the first twin during established labour, the committee recommended escalating to a senior healthcare professional. This is to address possible reversible causes (dehydration, infection or positional loss of contact). A fetal scalp electrode is applied to the first twin (>34 weeks' gestation) when there are no contraindications such as HIV, hepatitis, or maternal thrombocytopenia whilst continuing abdominal monitoring of the second twin. This will ensure correct allocation of each twin to its heart rate recording and subsequent management options are correctly considered.

In case of a 'pathological' cardiotocography (see table 11 in CG190) in the first twin during the first stage of labour, the committee recommended escalating to a senior health care professional. There can then be a discussion with the woman and her family members or carers about the possible use of fetal blood sampling of the first twin (>34 weeks' gestation) if the benefits are likely to outweigh the potential risks such as avoiding a second stage caesarean section, which increase maternal morbidity and mortality. They also recommended explaining to the woman and her family members or carers that if a blood sample cannot be obtained then she is likely to need a caesarean section. In cases where the results of a fetal blood sample are not available within 20 minutes or if a fetal blood sample is contraindicated the committee recommended offering an immediate caesarean section as continuing labour with ongoing concern of the baby's wellbeing is likely to have an increased risk of adverse perinatal outcomes.

The committee discussed that in case of a 'pathological' cardiotocography (see table 11 in CG190) in the first twin during the second stage of labour, it should be escalated to a senior

health care professional, an individual assessment should be performed to see whether an assisted vaginal birth is possible. A caesarean section should be offered if vaginal birth cannot be achieved within 20 minutes because the risk of adverse perinatal outcomes will increase with length of ongoing intrapartum compromise of the baby.

In case of a 'suspicious' or 'pathological' cardiotocography (see table 11 in CG190) in the second twin prior birth of the first twin during an established labour, the committee recommended escalating to a senior health care professional and also discussing with the woman and her family members or carers that if vaginal birth of the second twin cannot be achieved within 20 min a caesarean section is to be offered. The committee agreed that as fetal blood sampling of the second twin cannot be performed and the second twin is at increased risk of intrapartum hypoxia there should be a low threshold for caesarean birth.

After the birth of the first twin the committee recommended continuing cardiotocographic monitoring of the second twin and, in case there are 'suspicious' or 'pathological' cardiotocography (see table 11 in CG190). If vaginal birth cannot be achieved (including by an expedited assisted vaginal birth) within 20 minutes a caesarean section should be offered to reduce the risk of adverse perinatal outcomes.

Based on their experience and expertise after the birth of both twins, the committee recommended double clamping of the cord which would allow umbilical cord blood gases to be sampled. Twins are at increased risk of adverse perinatal outcomes when compared with singletons. Pair cord samples will assist with the newborn assessment at birth.

Triplet pregnancy

Monitoring for triplet births was not included in this review because prolonged monitoring would not be required for caesarean section, and vaginal birth of triplets is rare and monitoring would be on an individual basis.

Further research

Despite the limited evidence, the committee decided to prioritise other areas addressed by the guideline for future research and therefore made no research recommendations.

Cost effectiveness and resource use

In the absence of any economic evidence or original analysis, the committee made a qualitative assessment about the cost effectiveness of fetal monitoring during labour.

The committee noted that whilst the monitors for continuous cardiotocography require an initial capital outlay, they are currently available on labour wards for fetal monitoring in high risk pregnancies as part of established current practice and that adequately modern machines are dual channel monitors. Therefore, they concluded that their recommendations would not lead to a change in practice or have a resource impact.

They noted that their recommendations were in line with CG190 but also, that cardiotocography in twins confers additional advantages over intermittent auscultation, when compared to a singleton pregnancy, as it allows both babies to be monitored simultaneously. Whilst recognising that there was no evidence that continuous cardiotocography improves outcomes compared with intermittent auscultation, it is widely seen as a step-up in monitoring which, based on the committee's experience and expertise, is justified and likely to be cost effective in the context of the higher risk of complications in twin pregnancies.

Other factors the committee took into account

The committee discussed and stressed that healthcare professionals looking after the woman with twin pregnancy in labour should have adequate training and competency in

intrapartum fetal heart monitoring in twin pregnancies. However, training was not part of this evidence review and they therefore did not make a recommendation for this. They noted that 'specialist care' is covered in section 1.3 of the guideline which includes a recommendation that 'members of the enhanced team should have experience and knowledge relevant to twin and triplet pregnancies'.

References

No evidence was identified for this review so no references are listed.

Appendices

Appendix A – Review protocols

Review protocol – review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

Table 2: Review protocol for fetal monitoring during labour

ID	Field (based on PRISMA-P)	Content
I	Review question	What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?
II	Type of review question	Intervention
III	Objective of the review	Using intermittent auscultation for monitoring twin and triplet pregnancies is impractical as it is seldom possible to distinguish the fetal heartbeats that may have similar rates and if the maternal heart rate is also high, distinctions can become even more difficult. Because of this and because twin and triplet pregnancies are clinically considered to be high risk, monitoring is always performed electronically. However, monitoring each fetus's heartbeat can still be difficult to achieve in practice. Computerised assessment is available that assists clinicians by distinguishing the babies' heartbeats by providing overlapped or separate traces. In twin pregnancies, if the first twin is difficult to monitor during labour, then a fetal scalp electrode can be placed onto the first twin's head but clearly this is not an option for the second twin. Fetal blood sampling allows assessment of fetal distress caused by hypoxia and acidosis. The birth of the first twin causes changes in position of the second twin and repositioning of the transducer is required to continue monitoring the second twin's heart. This occurs at the same time that the fetus is most at risk for example from changing blood flow, placental separation or cord entanglement that can cause acute hypoxia. The aim of this review is to determine the most effective methods of fetal monitoring during labour for twin pregnancies by comparing use of internal and external techniques and computerised assessment where there is no suspicion of fetal distress and the additional use of fetal blood sampling where fetal distress is suspected. Monitoring for triplet births will not be included in this review because prolonged monitoring would not be required for caesarean section and vaginal birth of triplets is rare and monitoring would be on an individual basis
IV	Eligibility criteria – population/disease/condition/issue/domain	**Comparisons 1 and 2** Women in labour with twins > 32^{+0} weeks' gestation with first twin cephalic and any other presentation in the second twin

ID	Field (based on PRISMA-P)	Content
		Comparisons 3 and 4 Women in labour with twins > 32^{+0} weeks' gestation with first twin cephalic and any other presentation in the second twin, with suspected fetal distress in Twin 1
V	Eligibility criteria – interventions	**Comparison 1** Twin 1 - continuous electronic fetal monitoring (EFM) conducted internally using a fetal scalp electrode (FSE) Twin 2 - continuous EFM using an external transducer **Comparison 2** Twin 1 - continuous EFM conducted internally using FSE Twin 2 - continuous EFM using an external transducer with computer assessment **Comparison 3** Twin 1 - continuous EFM (conducted internally using FSE or using an external transducer) and fetal blood sampling (FBS) Twin 2 - continuous EFM using an external transducer For both twins where an external transducer is used repositioning or manual positioning or ultrasound positioning having been tried **Comparison 4** Twin 1 - continuous EFM (conducted internally using FSE or using an external transducer) with computer assessment and fetal blood sampling (FBS) Twin 2 - continuous EFM using an external transducer with computer assessment For both twins where an external transducer is used repositioning or manual positioning or ultrasound positioning having been tried
VI	Eligibility criteria – comparators	**Comparison 1** Twin 1 and Twin 2 - continuous EFM using an external transducer (with repositioning or manual positioning or ultrasound positioning having been tried) **Comparison 2** Twin 1 and Twin 2 - continuous EFM using an external transducer (having tried repositioning or manual positioning or US positioning) with computer assessment **Comparison 3** Twin 1 - continuous EFM (conducted internally using FSE or using an external transducer) Twin 2 - continuous EFM using an external transducer For both twins where an external transducer is used repositioning or manual positioning or ultrasound positioning having been tried **Comparison 4**

ID	Field (based on PRISMA-P)	Content
		Twin 1 - continuous EFM (conducted internally using FSE or using an external transducer) with computer assessment Twin 2 - continuous EFM using an external transducer with computer assessment For both twins where an external transducer is used repositioning or manual positioning or ultrasound positioning having been tried
VII	Outcomes and prioritisation	**Critical** For the woman: • mode of birth For the baby: • perinatal mortality (either or both twins) • hypoxic-ischemic encephalopathy Grade 2 and 3 **Important**: For the woman: • infection • maternal satisfaction For the baby: • fetal acidosis/acidemia • admission to neonatal intensive care unit
VIII	Eligibility criteria – study design	Systematic reviews of randomised controlled trials Randomised controlled trials If insufficient trial evidence is available: Cohort studies (prospective cohort studies will be prioritised over retrospective). Conference abstracts will be considered if there is no other evidence available and if published within the last two years, for critical outcomes only
IX	Other inclusion exclusion criteria	Exclusions: • women with a quadruplet or higher-order pregnancy as per scope • women with known serious fetal anomaly • studies that do not report results specifically for twin and/or triplet pregnancies • studies that include <5 pregnant women • structural or chromosomal anomalies • intra-uterine death at study entry
X	Proposed sensitivity/sub-group analysis, or meta-regression	No subgroup analyses are planned The following groups will used to explore any significant heterogeneity identified: • parity • previous caesarean section • comorbidities such as obesity (BMI ≥30) and pre-existing medical conditions • different types of monitoring equipment for multiple pregnancies
XI	Selection process – duplicate	Formal duplicate screening will not be undertaken for this question (as it has not been prioritised for economic analysis), although there will be senior supervision of the

ID	Field (based on PRISMA-P)	Content
	screening/selection/analysis	selection process. Hard copies of retrieved papers will be read by two reviewers and any disputes will be resolved in discussion with the Topic Advisor. Data extraction will be supervised by a senior reviewer. Draft excluded studies and evidence tables will be discussed with the Topic Advisor, prior to circulation to the Topic Group for their comments. Resolution of disputes will be by discussion between the senior reviewer, Topic Advisor and Chair
XII	Data management (software)	NGA STAR software will be used for generating bibliographies/citations, study sifting and data extraction and recording quality assessment using checklists Meta-analyses will be performed using Cochrane Review Manager (RevMan5) and WinBUGS if available data permit 'GRADEpro' will be used to assess the quality of evidence for each outcome. A full description of this is provided in the methods in supplementary material C
XIII	Information sources – databases and dates	Sources to be searched: Medline, Medline In-Process, CCTR, CDSR, DARE, HTA, Embase Search limits: • Limit to English language • Limit to human-only studies Apply standard animal/non-English language exclusion Limit to randomised controlled trials (RCTs) and systematic reviews in first instance but download all results
XIV	Identify if an update	This is a new area in the guideline.
XV	Author contacts	Developer: National Guideline Alliance https://www.nice.org.uk/guidance/indevelopment/gid-ng10063
XVI	Highlight if amendment to previous protocol	For details please see section 4.5 of Developing NICE guidelines: the manual 2014
XVII	Search strategy – for one database	For details please see appendix B
XVIII	Data collection process – forms/duplicate	A standardised evidence table format will be used, and published as appendix D (clinical evidence tables) or H (economic evidence tables)
XIX	Data items – define all variables to be collected	For details please see evidence tables in appendix D (clinical evidence tables) or H (economic evidence tables)
XX	Methods for assessing bias at outcome/study level	Quality assessment of individual studies will be performed using the following checklists: AMSTAR for systematic reviews, Cochrane risk of bias for RCTs, Newcastle-Ottawa scale for cohort studies For details please see section 6.2 of Developing NICE guidelines: the manual 2014 The risk of bias across all available evidence will be evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the

ID	Field (based on PRISMA-P)	Content
		international GRADE working group http://www.gradeworkinggroup.org/
XXI	Criteria for quantitative synthesis (where suitable)	For details please see section 6.4 of Developing NICE guidelines: the manual 2014
XXII	Methods for analysis – combining studies and exploring (in)consistency	A full description of this is provided in the methods in supplementary material C
XXIII	Meta-bias assessment – publication bias, selective reporting bias	For details please see section 6.2 of Developing NICE guidelines: the manual 2014 If sufficient relevant RCT evidence is available, publication bias will be explored using RevMan software to examine funnel plots. Trial registries will be examined to identify missing evidence: Clinical trials.gov, NIHR Clinical Trials Gateway
XXIV	Assessment of confidence in cumulative evidence	For details please see sections 6.4 and 9.1 of Developing NICE guidelines: the manual 2014
XXV	Rationale/context – Current management	For details please see the introduction to the evidence review. Please see also CG190 Addendum 2017 for recommendations in singleton pregnancy and Chapter 4.9 Computerised systems versus human interpretation
XXVI	Describe contributions of authors and guarantor	A multidisciplinary committee developed the guideline. The committee was convened by the National Guideline Alliance and chaired by Anthony Pearson in line with section 3 of Developing NICE guidelines: the manual 2014. Staff from the National Guideline Alliance undertook systematic literature searches, appraised the evidence, conducted meta-analysis and cost-effectiveness analysis where appropriate, and drafted the guideline in collaboration with the committee. A full description of this is provided in the methods in supplementary material C
XXVII	Sources of funding/support	The National Guideline Alliance is funded by NICE and hosted by the Royal College of Obstetricians and Gynaecologists
XXVIII	Name of sponsor	The National Guideline Alliance is funded by NICE and hosted by the Royal College of Obstetricians and Gynaecologists
XXIX	Roles of sponsor	NICE funds the National Guideline Alliance to develop guidelines for those working in the NHS, public health, and social care in England
XXX	PROSPERO registration number	This protocol is not registered with PROSPERO

AMSTAR: Assessing the Methodological Quality of Systematic Reviews; CDSR: Cochrane Database of Systematic Reviews; CCTR: Cochrane Controlled Trials Register; CI: confidence interval; DARE: Database of Abstracts of Reviews of Effects; GRADE: Grading of Recommendations Assessment, Development and Evaluation; HTA: Health Technology Assessment; NICE: National Institute for Health and Care Excellence; NGA: National Guideline Alliance; ROBIS: Risk of Bias in Systematic Reviews

Appendix B – Literature search strategies

Literature search for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

Clinical searches

Date of initial search: 24/04/2018

Database(s): Embase Classic+Embase 1947 to 2018 April 24, Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present

Date of updated search: 11/09/2018

Database(s): Embase Classic+Embase 1947 to 2018 September 11, Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present

#	Searches
1	exp Pregnancy, Multiple/ use ppez
2	exp multiple pregnancy/ use emczd
3	((multiple* or twin* or monozygotic or dizygotic) adj3 (birth* or pregnan* or gestation* or f?etus* or f?etal)).tw.
4	(chorionicity or monochorionic or dichorionic).tw.
5	or/1-4
6	exp fetus monitoring/
7	echocardiography/
8	electrocardiography/ or fetus electrocardiography/
9	Doppler ultrasonography/
10	Doppler echocardiography/
11	Doppler flowmetry/
12	fetus distress/di
13	fetus heart rate/
14	fetus heart/
15	auscultation/ or heart auscultation/
16	obstetric ultrasound transducer/
17	uterine activity monitoring/
18	scalp/ and electrode/
19	(or/6-18) use emczd
20	exp Fetal Monitoring/
21	Echocardiography/
22	Electrocardiography/
23	Cardiotocography/

24	Ultrasonography, Doppler/
25	Fetal Distress/di
26	Heart Rate, Fetal/
27	Fetal Heart/dg
28	Auscultation/ or Heart Auscultation/
29	*Transducers/
30	Uterine Monitoring/
31	Scalp/ and Electrodes/
32	(or/20-31) use ppez
33	19 or 32
34	((f?etal* or f?etu*) adj3 (monitor* or assess* or sampl* or analy* or heart* or distress* or lactat* or electrod* or evaluat* or auscultat* or cardiotocogra* or echocardiogra* or electrocardiogra* or fetoscop* or foetoscop* or CTG or EFM or ECG* or EKG or FHR or doppler* or flowmet* or ultraso* or sonogra*)).tw.
35	(scalp* adj3 electrode*).tw.
36	auscultat*.tw.
37	or/33-36
38	5 and 37
39	limit 38 to english language
40	Letter/ use ppez
41	letter.pt. or letter/ use emczd
42	note.pt.
43	editorial.pt.
44	Editorial/ use ppez
45	News/ use ppez
46	exp Historical Article/ use ppez
47	Anecdotes as Topic/ use ppez
48	Comment/ use ppez
49	Case Report/ use ppez
50	case report/ or case study/ use emczd
51	(letter or comment*).ti.
52	or/40-51
53	randomized controlled trial/ use ppez
54	randomized controlled trial/ use emczd
55	random*.ti,ab.
56	or/53-55
57	52 not 56
58	animals/ not humans/ use ppez
59	animal/ not human/ use emczd
60	nonhuman / use emczd
61	exp Animals, Laboratory/ use ppez
62	exp Animal Experimentation/ use ppez

63	exp Animal Experiment/ use emczd
64	exp Experimental Animal/ use emczd
65	exp Models, Animal/ use ppez
66	animal model/ use emczd
67	exp Rodentia/ use ppez
68	exp Rodent/ use emczd
69	(rat or rats or mouse or mice).ti.
70	or/57-69
71	39 not 70
72	remove duplicates from 71

Cochrane Library

Date of initial search: 24/04/2018

The Cochrane Library, issue 4 of 12, April 2018

Date of updated search: 11/09/2018

The Cochrane Library, issue 9 of 12, September 2018

ID	Search
#1	MeSH descriptor: [Pregnancy, Multiple] explode all trees
#2	((multiple* or twin* or monozygotic or dizygotic) near/3 (birth* or pregnan* or gestation* or foetus* fetus or foetal or fetal))
#3	(chorionicity or monochorionic or dichorionic)
#4	{or #1-#3}
#5	MeSH descriptor: [Fetal Monitoring] explode all trees
#6	MeSH descriptor: [Echocardiography] this term only
#7	MeSH descriptor: [Electrocardiography] this term only
#8	MeSH descriptor: [Cardiotocography] this term only
#9	MeSH descriptor: [Ultrasonography, Doppler] explode all trees
#10	MeSH descriptor: [Fetal Distress] this term only and with qualifier(s): [Diagnosis - DI, Diagnostic imaging - DG]
#11	MeSH descriptor: [Heart Rate, Fetal] this term only
#12	MeSH descriptor: [Fetal Heart] explode all trees and with qualifier(s): [Diagnostic imaging - DG]
#13	MeSH descriptor: [Auscultation] explode all trees
#14	MeSH descriptor: [Transducers] this term only
#15	MeSH descriptor: [Uterine Monitoring] this term only
#16	MeSH descriptor: [Scalp] this term only
#17	MeSH descriptor: [Electrodes] this term only
#18	#16 and #17
#19	{or #5-#15}
#20	#18 or #19

ID	Search
#21	((foetal* or fetal or foetu* or fetu*) near/3 (monitor* or assess* or sampl* or analy* or heart* or distress* or lactat* or electrod* or evaluat* or auscultat* or cardiotocogra* or echocardiogra* or electrocardiogra* or fetoscop* or foetoscop* or CTG or EFM or ECG* or EKG or FHR or doppler* or flowmet* or ultraso* or sonogra*))
#22	(scalp* near/3 electrode*)
#23	{or #20-#22}
#24	#4 and #23

Health Economics Searches

(For the Cochrane Library, see above)

Date of initial search: 24/04/2018

Database(s): Embase Classic+Embase 1947 to 2018 April 24, Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present

Date of updated search: 11/09/2018

Database(s): Embase Classic+Embase 1947 to 2018 September 11, Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present

#	Searches
1	exp Pregnancy, Multiple/ use ppez
2	exp multiple pregnancy/ use emczd
3	((multiple* or twin* or monozygotic or dizygotic) adj3 (birth* or pregnan* or gestation* or f?etus* or f?etal)).tw.
4	(chorionicity or monochorionic or dichorionic).tw.
5	or/1-4
6	exp fetus monitoring/
7	echocardiography/
8	electrocardiography/ or fetus electrocardiography/
9	Doppler ultrasonography/
10	Doppler echocardiography/
11	Doppler flowmetry/
12	fetus distress/di
13	fetus heart rate/
14	fetus heart/
15	auscultation/ or heart auscultation/
16	obstetric ultrasound transducer/
17	uterine activity monitoring/
18	scalp/ and electrode/
19	(or/6-18) use emczd
20	exp Fetal Monitoring/
21	Echocardiography/
22	Electrocardiography/

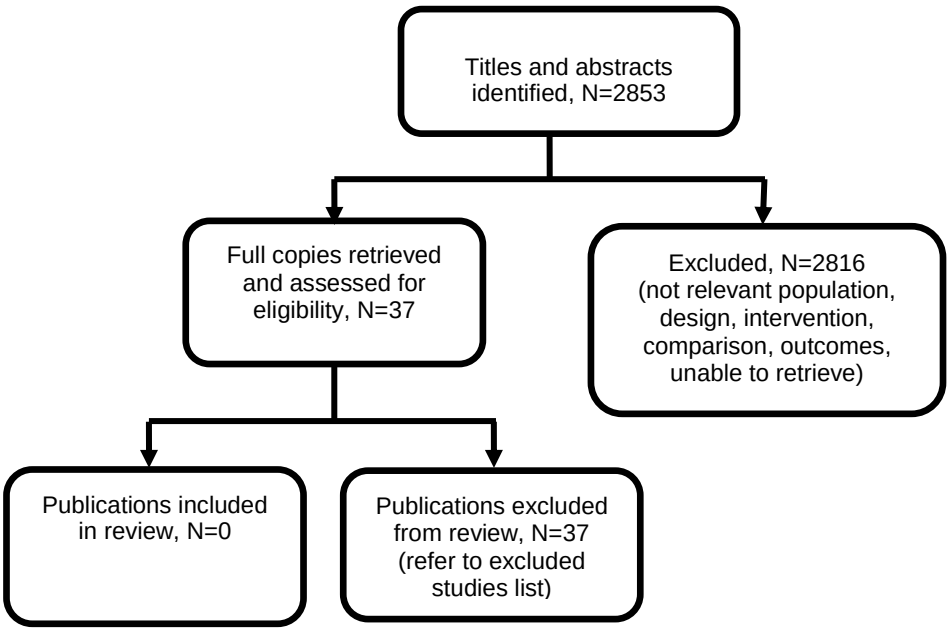
#	Searches
23	Cardiotocography/
24	Ultrasonography, Doppler/
25	Fetal Distress/di
26	Heart Rate, Fetal/
27	Fetal Heart/dg
28	Auscultation/ or Heart Auscultation/
29	*Transducers/
30	Uterine Monitoring/
31	Scalp/ and Electrodes/
32	(or/20-31) use ppez
33	19 or 32
34	((f?etal* or f?etu*) adj3 (monitor* or assess* or sampl* or analy* or heart* or distress* or lactat* or electrod* or evaluat* or auscultat* or cardiotocogra* or echocardiogra* or electrocardiogra* or fetoscop* or foetoscop* or CTG or EFM or ECG* or EKG or FHR or doppler* or flowmet* or ultraso* or sonogra*)).tw.
35	(scalp* adj3 electrode*).tw.
36	auscultat*.tw.
37	or/33-36
38	5 and 37
39	limit 38 to english language
40	Letter/ use ppez
41	letter.pt. or letter/ use emczd
42	note.pt.
43	editorial.pt.
44	Editorial/ use ppez
45	News/ use ppez
46	exp Historical Article/ use ppez
47	Anecdotes as Topic/ use ppez
48	Comment/ use ppez
49	Case Report/ use ppez
50	case report/ or case study/ use emczd
51	(letter or comment*).ti.
52	or/40-51
53	randomized controlled trial/ use ppez
54	randomized controlled trial/ use emczd
55	random*.ti,ab.
56	or/53-55
57	52 not 56
58	animals/ not humans/ use ppez
59	animal/ not human/ use emczd
60	nonhuman / use emczd
61	exp Animals, Laboratory/ use ppez
62	exp Animal Experimentation/ use ppez
63	exp Animal Experiment/ use emczd
64	exp Experimental Animal/ use emczd
65	exp Models, Animal/ use ppez
66	animal model/ use emczd
67	exp Rodentia/ use ppez
68	exp Rodent/ use emczd
69	(rat or rats or mouse or mice).ti.
70	or/57-69

#	Searches
71	39 not 70
72	remove duplicates from 71
73	Economics/
74	Value of life/
75	exp "Costs and Cost Analysis"/
76	exp Economics, Hospital/
77	exp Economics, Medical/
78	Economics, Nursing/
79	Economics, Pharmaceutical/
80	exp "Fees and Charges"/
81	exp Budgets/
82	(or/73-81) use ppez
83	health economics/
84	exp economic evaluation/
85	exp health care cost/
86	exp fee/
87	budget/
88	funding/
89	(or/83-88) use emczd
90	budget*.ti,ab.
91	cost*.ti.
92	(economic* or pharmaco?economic*).ti.
93	(price* or pricing*).ti,ab.
94	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
95	(financ* or fee or fees).ti,ab.
96	(value adj2 (money or monetary)).ti,ab.
97	or/90-96
98	82 or 89 or 97
99	72 and 98

Appendix C – Clinical evidence study selection

Clinical evidence study selection for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

Figure 1: Flow diagram of clinical article selection for fetal monitoring during labour



Appendix D – Clinical evidence tables

Clinical evidence tables for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

No studies were included in this review

Appendix E – Forest plots

Forest plots for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

No meta-analysis was undertaken for this review and so there are no forest plots.

Appendix F – GRADE tables

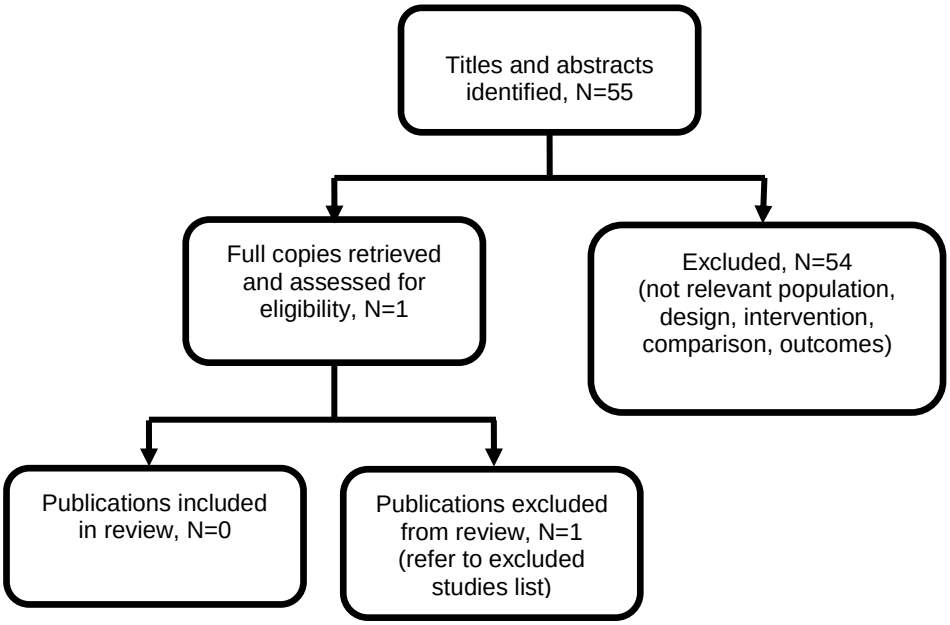
GRADE profiles for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

No studies were included in this review.

Appendix G – Economic evidence study selection

Economic evidence study selection for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

Figure 2: Flow diagram of economic article selection for the most effective method of fetal monitoring during labour



Appendix H – Economic evidence tables

Economic evidence tables for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

No economic evidence was identified for this review.

Appendix I – Economic evidence profiles

Economic evidence profiles for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

No economic evidence was identified for this review.

Appendix J – Economic analysis

Economic analysis for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

No economic analysis was conducted for this review.

Appendix K – Excluded studies

Excluded studies for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

Clinical studies

Study	Reason for Exclusion
Alfirevic, Z., Devane, D., Gyte, G. M. L., Cuthbert, A., Continuous cardiotocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour, Cochrane Database of Systematic Reviews, 2017 (2) (no pagination), 2017	Systematic review - relevant studies were assessed for a potential inclusion
Alfirevic, Zarko, Stampalija, Tamara, Dowswell, Therese, Fetal and umbilical Doppler ultrasound in high-risk pregnancies, The Cochrane database of systematic reviews, 6, CD007529, 2017	Systematic review - relevant studies were assessed for a potential inclusion
Ayoubi,J.M, Audibert,F, Vial,M, Pons,J.C, Taylor,S, Frydman,R., Fetal heart rate and survival of the very premature newborn, American Journal of Obstetrics and Gynecology, 187, 1026-1030, 2002	No separate data for twins and triplets were reported
Bakker,P.C, Colenbrander,G.J, Verstraeten,A.A, van Geijn,H.P., Quality of intrapartum cardiotocography in twin deliveries, American Journal of Obstetrics and Gynecology, 191, 2114-2119, 2004	Non relevant outcome as the study examines fetal signal loss during labour in twin pregnancies
Berceanu, C., Ultrasound and management of specific complications in monochorionic twins, Journal of Perinatal Medicine, 45 (Supplement 2), 72, 2017	Conference abstract about the complications specific to monochorionic twins and their management
Brocklehurst, P., Field, D., Greene, K., Juszczak, E., Keith, R., Kenyon, S., Linsell, L., Mabey, C., Newburn, M., Plachcinski, R., Quigley, M., Schroeder, E., Steer, P., Computerised interpretation of fetal heart rate during labour (INFANT): a randomised controlled trial, The Lancet, 389, 1719-1729, 2017	No relevant comparison was reported. The study examines outcomes in women with singleton and twin pregnancies having continuous electronic fetal monitoring with decision support (the INFANT system) during labour and compares them to women with no decision support
Brocklehurst, P., Field, D., Greene, K., Juszczak, E., Kenyon, S., Linsell, L., Mabey, C., Newburn, M., Plachcinski, R., Quigley, M., Steer, P., Schroeder, L., Rivero-Arias, O., Computerised interpretation of the fetal heart rate during labour: A randomised controlled trial (INFANT), Health Technology Assessment, 22, 1-218, 2018	No relevant comparison was reported. The study examines outcomes in women with singleton and twin pregnancies having continuous electronic fetal monitoring with decision support (the INFANT system) during labour and compares them to women with no decision support
Brown, R. E., Doppler ultrasound in obstetrics, JAMAJama, 218, 1395-9, 1971	Narrative article about the clinical use of doppler ultrasound in twin pregnancies
Cox, W. L, Forestier, F, Capella-Pavlovsky, M, Daffos, F., Fetal blood sampling in twin pregnancies. Prenatal diagnosis and management of 19 cases, Fetal TherapyFetal Ther, 2, 101-8, 1987	No relevant comparison was reported. The paper describes the indications for blood sampling in twin pregnancies

Study	Reason for Exclusion
D'Addario, V., Ultrasonic monitoring of twin pregnancies, Journal of Perinatal Medicine, 45 (Supplement 2), 93, 2017	Conference abstract about different protocols of ultrasound monitoring for monochorionic twins.
Daw, E., Continuous foetal heart rate monitoring of twins during labour, Clinical & Experimental Obstetrics & Gynecology, 15, 151-3, 1988	Narrative article about the continuous fetal monitoring during labour in twin pregnancies.
de Veciana, M., Major, C., Morgan, M. A., Labor and delivery management of the multiple gestation, Obstetrics & Gynecology Clinics of North America, 22, 235-46, 1995	Narrative article about intrapartum management of twin pregnancies
Dicker, P., Burke, G., McAuliffe, F., Geary, M., Daly, S., Higgins, J., Hunter, A., Morrison, J. J., Higgins, S., Mahony, R., Tully, E., Malone, F. D., Breathnach, F., Low resistance in umbilical artery vascular flow is associated with antepartum hemorrhage and PPROM-Results of the Multicenter ESPRiT twin study, American Journal of Obstetrics and Gynecology, 218 (1 Supplement 1), S151-S152, 2018	Conference abstract about low resistance in umbilical artery flow in twin pregnancies (a secondary analysis of the ESPRiT prospective twin cohort)
East, Christine E, Leader, Leo R, Sheehan, Penelope, Henshall, Naomi E, Colditz, Paul B, Lau, Rosalind, Intrapartum fetal scalp lactate sampling for fetal assessment in the presence of a non-reassuring fetal heart rate trace, Cochrane Database of Systematic Reviews, 2015	Non relevant comparison, that is fetal blood sampling for pH and lactate analysis
Erol, N., Ayhan, Y. I., Goynumer, F. G., Frequency of cardiac pathology in fetal echocardiography, Cardiology in the Young, 27 (4), S283, 2017	Conference abstract about fetal echocardiography as a non-invasive method for diagnosing cardiac pathology
Figueras,F., Eixarch,E., Meler,E., Palacio,M., Puerto,B., Coll,O., Figueras,J., Cararach,V., Vanrell,A.J., Umbilical artery Doppler and umbilical cord pH at birth in small-for-gestational-age fetuses: valid estimate of their relationship, Journal of Perinatal Medicine, 33, 219-225, 2005	Not twin or triplet pregnancies
Giles, W, Bisits, A, O'Callaghan, S, Gill, A, Damp Study Group, The Doppler assessment in multiple pregnancy randomised controlled trial of ultrasound biometry versus umbilical artery Doppler ultrasound and biometry in twin pregnancy, BJOG: An International Journal of Obstetrics & GynaecologyBjog, 110, 593-7, 2003	Women not in labour
Haverkamp,A.D., Orleans,M., Langendoerfer,S., McFee,J., Murphy,J., Thompson,H.E., A controlled trial of the differential effects of intrapartum fetal monitoring, American Journal of Obstetrics and Gynecology, 134, 399-412, 1979	No separate data for twins were reported
Landy, H. J., Hill, M. C., Ultrasound of twin gestations, Ultrasound Quarterly, 7, 107-132, 1989	Narrative article about the use of ultrasonography in multiple pregnancies

Study	Reason for Exclusion
MacDonald,D., Grant,A., Sheridan-Pereira,M., Boylan,P., Chalmers,I., The Dublin randomized controlled trial of intrapartum fetal heart rate monitoring, American Journal of Obstetrics and Gynecology, 152, 524-539, 1985	Non relevant comparison, that is electronic fetal monitoring versus intermittent auscultation
Maeda, K., Fetal monitoring and actocardiogram in the evaluation of fetal behavior, Ultrasound Review of Obstetrics and Gynecology, 4, 12-25, 2004	Narrative article about the use of fetal heart rate monitoring and actocardiogram for fetal diagnosis and the classification of fetal behavioural states in singleton and twin pregnancies
Morin, L, Lim, K, Diagnostic Imaging, Committee, Special, Contributor, Genetics, Committee, Maternal Fetal Medicine, Committee, Ultrasound in twin pregnancies, Journal of Obstetrics & Gynaecology Canada: JOGCJ Obstet Gynaecol Can, 33, 643-656, 2011	Review of the literature regarding the use of diagnostic ultrasound in the management of twin pregnancies and recommendations for the use of ultrasound in twin pregnancies
Morin, L., Lim, K., No. 260-Ultrasound in Twin Pregnancies, Journal of Obstetrics and Gynaecology Canada, 39, e398-e411, 2017	Review of the literature regarding the use of diagnostic ultrasound in the management of twin pregnancies and recommendations for the use of ultrasound in twin pregnancies
Neldam,S., Osler,M., Hansen,P.K., Nim,J., Smith,S.F., Hertel,J., Intrapartum fetal heart rate monitoring in a combined low- and high-risk population: a controlled clinical trial, European Journal of Obstetrics, Gynecology, and Reproductive Biology, 23, 1-11, 1986	No separate data for twins
Nicolini,U, Pisoni,M.P, Cela,E, Roberts,A., Fetal blood sampling immediately before and within 24 hours of death in monochorionic twin pregnancies complicated by single intrauterine death, American Journal of Obstetrics and Gynecology, 179, 800-803, 1998	Article describes fetal blood sampling either before or after death, or both, in 8 cases of monochorionic twin pregnancies in which death of 1 twin occurred
Pasko, D. N., Blanchard, C. T., Szychowski, J. M., Mbah, R., Welty, E., Harper, L. M., Tita, A. T., Use of a novel device (Moyo) for intrapartum fetal monitoring in 1,000 consecutive pregnancies in Cameroon, Africa, American Journal of Obstetrics and Gynecology, 218 (1 Supplement 1), S524, 2018	Conference abstract about the use of a novel device (Moyo) for intrapartum fetal monitoring in high risk pregnancies
Pessel, C, Merriam, A, Vani, K, Brubaker, S. G, Zork, N, Zhang, Y, Simpson, L. L, Gyamfi-Bannerman, C, Miller, R., Do Doppler studies enhance surveillance of uncomplicated monochorionic diamniotic twins?, Journal of Ultrasound in Medicine, 34, 569-75, 2015	This article examines whether isolated abnormal doppler indices in otherwise uncomplicated monochorionic diamniotic twin pregnancies are associated with the development of adverse pregnancy outcomes
Read, J. A, Miller, F. C., Technique of simultaneous direct intrauterine pressure recording for electronic monitoring of twin gestation in labor, American Journal of Obstetrics & Gynecology, 129, 228-30, 1977	Narrative article about a technique of simultaneous direct intrauterine pressure recording for electronic fetal monitoring of twin pregnancies in labour
Renou,P., Chang,A., Anderson,I., Wood,C., Controlled trial of fetal intensive care, American	Not twin or triplet pregnancies

Study	Reason for Exclusion
Journal of Obstetrics and Gynecology, 126, 470-476, 1976	
Robinson,C., Chauhan,S.P., Intrapartum Management of Twins, Clinical Obstetrics and Gynecology, 47, 248-262, 2004	Narrative review on the intrapartum management of twin pregnancies
Salmanvandi, M., Einalou, Z., Separation of twin fetal ECG from maternal ECG using empirical mode decomposition techniques, Biomedical Engineering - Applications, Basis and Communications, 29 (6) (no pagination), 2017	A full-text copy of the article could not be obtained
Sherer, D. M, Onyeije, C. I, Bernstein, P. S, Kovacs, P, Manning, F. A., Utilization of real-time ultrasound on labor and delivery in an active academic teaching hospital, American Journal of Perinatology, 16, 303-307, 1999	Non relevant population as only 7% were with multiple gestations
Taylor, M. J. O., Smith, M. J., Thomas, M., Green, A. R., Cheng, F., Oseku-Afful, S., Wee, L. Y., Fisk, N. M., Gardiner, H. M., Non-invasive fetal electrocardiography in singleton and multiple pregnancies, BJOG: An International Journal of Obstetrics and Gynaecology, 110, 668-678, 2003	This article describes the duration of fetal cardiac time intervals in singleton pregnancies using a novel non-invasive fetal electrocardiography system and its potential application in multiple pregnancies
Vintzileos,A.M, Chavez,M.R, Kinzler,W.L., Use of ultrasound in the labor and delivery, Journal of Maternal-Fetal and Neonatal Medicine, 23, 469-475, 2010	Narrative article about the clinical use of ultrasound examination during labour and birth
Wax, J., Minkoff, H., Johnson, A., Coleman, B., Levine, D., Helfgott, A., O'Keefe, D., Henningsen, C., Benson, C., Consensus report on the detailed fetal anatomic ultrasound examination: Indications, components, and qualifications, Journal of Diagnostic Medical Sonography, 30, 107-113, 2014	Consensus report regarding the detailed fetal anatomic examination
Webber, L., Teoh, T. G., Intrapartum management of multiple gestations, Current Obstetrics and Gynaecology, 8, 141-146, 1998	Narrative review about the special circumstances surrounding the birth of multiple pregnancies
White,P.C, Cibils,L.A., Clinical significance of fetal heart rate patterns during labor. VIII. Breech presentations, Journal of Reproductive Medicine, 29, 45-51, 1984	This article describes fetal heart rate monitoring during breech prelabour and labour; the population includes singleton and multiple pregnancies

Economic studies

Study	Reason for Exclusion
Hickok, R. A., Walker, A. R., Caughey, A. B., Cost effectiveness of inpatient vs outpatient fetal monitoring in monochorionic-monoamniotic twin gestations, Obstetrics and Gynecology, 131 (Supplement 1), 202S, 2018	Conference abstract

Appendix L – Research recommendations

Research recommendations for review question: What is the most effective method of fetal monitoring during labour in improving outcomes for babies and mothers?

No research recommendation was made for this review.