WOMEN'S HEALTH AND PAEDIATRICS

MATERNITY UNIT

Antenatal Cardiotocography

Amendments			
Version	**Date**	**Comments**	**Approved by**
1	May 2020	Introduction of Antenatal Cardiotocography Guideline	Perinatal Governance Group
2	Dec 2023	New flow chart for Management if Criteria not met at 60 minutes	Perinatal Governance Group

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In consultation with: Perinatal Governance Group

Ratified by: Perinatal Governance Group

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Target audience: All health professionals within the maternity services

Equality impact assessment: Perinatal Governance Group

Comments on this document to: Perinatal Governance Guideline Group

Contents

Flow Chart for commencing cCTG

Confirm the rationale for CTG.

Is there a maternal or fetal condition or disease that will negatively impact fetal development?

Is there an indication for an antenatal CTG? If the woman is in early or established labour, refer to intrapartum fetal monitoring guidance.

No → CTG **NOT** Indicated

Is the pregnancy beyond 26^{+0} weeks?

CTG's between 26 – 28 weeks require senior obstetrician decision

No → CTG **NOT** indicated.

Auscultate with Pinards stethoscope or sonicaid

Yes

Commence Dawes Redman recording
(The first result is available at 10 minutes and every 2 minutes thereafter until a maximum of 60 minutes)

There must be no deceleration or artefact at the end of the recording

CRITERIA MET
Visually review and classify the CTG. If this is normal and there are no other ongoing clinical concerns, the analysis can be **stopped**.
This can be with as little as 10 minutes recording time.
The printer will produce a report of the analysis results.

Do not review the numeric data as the CTG has been classified as normal and this data is, therefore, insignificant

CRITERIA NOT MET BEFORE 60 MINUTES
Unless there are clear abnormal features, or any cause for concern, continue the recording until the criteria are met.
Short-term variation (STV) is uninterpretable prior to 60 minutes; do not review the numeric data.

DO NOT prematurely stop the recording. If the analysis has been stopped before criteria are met and before 60 minutes IT IS NOT VALID

CRITERIA NOT MET AFTER 60 MINUTES OF ANALYSIS
Indicates that normality has not been demonstrated
In the context of antenatal CTG classification, this is an abnormal outcome.
A senior obstetric review must take place and an individualised plan made based on reasons for failure, visual trace review and holistic review of the pregnancy.

The STV should be taken into account and the trend reviewed if previous analysis has been performed. It has a predictive value for fetuses at risk of metabolic acidaemia and IUD.
STV cannot be assessed visually. It can only be analysed with a full 60 minutes.
STV MUST NOT be used in isolation as an indicator of fetal condition
STV Values:
≥4 ms is normal <4 ms is low
<3 ms is abnormal
<2 ms is highly abnormal

DO NOT act on the basis of the CTG analysis alone, which is an aid to pregnancy management, not a diagnostic tool

Managing Criteria Not Met at 60 Minutes

Confirm the rationale for CTG.

Is there a maternal or fetal condition or disease that will negatively impact fetal development?

YES

Has fetal growth restriction been identified previously?

Pregnancies affected by intrauterine growth restriction are managed by fetal medicine consultants using a combination of ultrasound features and the STV from the computerised CTG (eg TRUFFLE protocol).

YES → Assess the STV and follow documented management plan regarding further monitoring and delivery. If in doubt, discuss with FMU consultant.

NO

What is the STV?

STV is single most important individual CTG marker for ruling out fetal hypoxia and a low STV has predictive value for fetuses at risk of metabolic acidaemia and IUD.

Less than 5% of cCTG will not meet D.R criteria at term and this should prompt a senior obstetric review Registrar / consultant).

There should be a low threshold for offering induction of labour/expediting planned delivery, the timing of which will depend on the clinical situation. Women who choose expectant management should have a documented plan for further fetal monitoring.

STV ≤ 3.5ms

This represent a STV less than the 1st centile, a high risk of fetal hypoxia and an increased risk of intrauterine fetal demise within 24-48 hours.

The cCTG should be continued or repeated within 4 hours.

If STV is persistently ≤ 3.5 it requires immediate review by a senior obstetrician and should prompt discussions regarding expediting delivery.

This should include consideration of administering corticosteroids and magnesium sulphate prior to delivery if appropriate for the estational age. Same day ultrasound should be considered if available but should not delay arrangements for delivery.

STV 3.5ms to 6.0ms

This represents a STV between the 1st and 10th centile in normal pregnancies and should prompt obstetric review of the overall situation, including an assessment beyond STV as to why criteria were not met.

If no other concerning features or indications for delivery, repeat the cCTG within 24 hours.

If STV remains below 6.0 on repeat cCTG, ultrasound should be arranged within 72 hours (if no ultrasound within the last 2 weeks).

Repeat cCTG daily until ultrasound performed. This can be as an outpatient if no other indication for admission.

STV ≥ 6.0ms

This represents a low risk of fetal hypoxia at the time of assessment.

Evaluation of the overall clinical situation should occur by an obstetrician.

This should include an assessment of why the criteria were not met beyond the STV. An individualised management plan should be made, including frequency of any further cCTG monitoring.

If no ultrasound within the last 2 weeks, an ultrasound to assess fetal growth and wellbeing should be arranged and performed within 5-7 days.

NOT MEETING CRITERIA AT A PRETERM GESTATION IS NOT AN INDICATION FOR DELIVERY BY ITSELF

Antenatal Cardiotocography

1.0 Introduction

Cardiotocography (CTG) is a widely used tool for fetal assessment in the antenatal period. At present antenatal CTG is not thought to be useful as a method of routine fetal assessment in low risk pregnancies and its use in the antenatal period implies that a risk factor has been identified.

The most recent systematic review on Antenatal Cardiotocography for fetal assessment in high risk pregnancies (Cochrane 2015) concluded that:

- Comparison of traditional (visual) vCTG versus no CTG showed no significant difference identified in perinatal mortality or potentially preventable deaths.
- Similarly, there was no significant difference identified in caesarean sections.
- However, comparison of computerised CTG versus visual vCTG showed a significant reduction in perinatal mortality with computerised CTG. These have been found to be non-significant, however cCTG may reduce inter- and intra-observer variations in interpretation because it is more objective than visual CTG (vCTG) interpretation and therefore may also improve care by reducing time spent in hospital and the need for further investigations (Baker et al., 2021).

For effective clinical decision-making, a full clinical risk assessment is required for both vCTG and cCTG.

CTG contributes to decision-making related to timing, place and mode of delivery but there is considerable variation in the interpretation of CTGs which affects the reliability of the test. Computerised fetal heart rate analysis systems or computerised CTG (cCTG) have been developed to allow the automated evaluation of the CTG with the aim of bringing objectivity and reliability to CTG interpretation. It is derived from the world's largest CTG database linked to outcomes and analyses certain features on the CTG and applies 12 criteria, known as Dawes Redman (DR), to evaluate the CTG.

There is no definitive national guidance on antenatal electronic fetal monitoring. RCOG and NICE guidelines focus on use of intrapartum CTG and they have no guidance on its use in antenatal period (NICE 2022, RCOG 2011). Antenatal CTG monitoring is widely used as a method of assessing fetal wellbeing, predominantly in pregnancies with risk factors for complications (Grivell et al, 2015). Saving Babies' Lives version 3 recommends the use of antenatal computerised CTG, as human error in antenatal visual CTG interpretation has been identified as a significant cause of stillbirth and serious brain injury (NHS England, 2023). However, it is important to be aware that CTG may not show abnormalities for non-hypoxic risk factors or complications.

The aim of this guideline is to help identify fetuses demonstrating signs of hypoxia on antenatal CTG by providing guidance on:

- The use of cCTG and DR Criteria
- How to approach situations where the DR criteria are not met on cCTG
- Visual interpretation where cCTG is inappropriate for use

Therefore, clinical decisions should be based on a full clinical assessment and CTG should not be used in isolation for decision-making. It only provides information about fetal condition at the time of recording, and it is not a predictive tool.

2.0 Antenatal Cardiotocography

Fetal monitoring may be carried out antepartum either on an in-patient or outpatient basis for on-going surveillance of the fetus. All women who present with an antepartum problem should have at least auscultation of the fetal heart at any gestation. If there is clinical indication then computerised electronic fetal monitoring should be performed.

CTG should only be performed in the antenatal period for fetal surveillance as per clinical indications. *All Women will be offered computerised CTG if a CTG is indicated in the antenatal period.* This includes the CTG prior to commencing IOL but following Propess, Prostin or ARM, traditional CTG should be used (see Intrapartum fetal heart rate monitoring).

Principles of holistic care and whole clinical picture review as outlined for intrapartum care (NICE, 2022) also apply to antenatal care and interpretation of fetal monitoring prior to labour.

- Make a documented systematic assessment of the condition of the woman and unborn baby.
- Do not make any decision about a woman's care based on CTG findings alone.
- Consider the women's preferences, antenatal risk factors, current wellbeing, and signs of labour.
- Ensure the focus of care remains on the woman and baby rather than the CTG trace in isolation.

2.1 Documentation and CTG Storage

- Rationale for antenatal CTG documented in maternal notes.
- At the start of the CTG, enter the woman's name, date of birth, NHS number, hospital number, maternal pulse and indication and legible name, designation and signature of the midwife
- Add the Maternal pulse at the start of the CTG
- Add the patients details on to the Central monitoring system on commencing the CTG.
- Check printing speed 1cm/min

- At the end of the CTG, the above classification is documented with the date, time and legible staff name, signature and designation.
- Close the CTG on the Central monitoring system to ensure a copy of CTG is stored electronically.
- Antenatal CTG paper print outs must be stored in the CTG envelope and be stored within the purple files until after delivery when they will be uploaded to Evolve.
- The envelope must be identified with the patient's name, NHS number and hospital number; include the date, reason for CTG and legible name, designation and signature of the midwife.

2.2 Gestational Age and CTG

26-30 weeks: At early gestations, the fetal autonomic nervous system is not mature and therefore the patterns of fetal heart rate (FHR) which may be expected at later gestations may not be present. Also there is increased possibility of signal loss and poor quality in CTG's at earlier gestations.

The Dawes/Redman criteria are based upon the normal distribution at 32 weeks. Gestations below 32 weeks may take longer to achieve criteria due to immature central nervous system.

Traces should always be compared with previous FHR tracings and suspicious features may include any change in baseline rate, variability and/or presence of decelerations. If a 26-30 week CTG trace does not fall into the Normal category the women should be reviewed by a Registrar/Consultant

3.0 Computerised Antenatal CTG

3.1 Criteria for the use of cCTG

The use of cCTG is valid for any gestation beyond 26+0 weeks, but should only performed when clinically indicated or at maternal request.

DR criteria can be used to monitor twin pregnancies. The analysis does not take into account fetal movement when analysing twins. Care should be taken to assess the suitability for cCTG of those women with risk maternal or fetal risk factors.

If there is uterine activity, do not use cCTG. In this situation, visual interpretation must be employed (see below). Intrapartum CTG interpretation must not be applied to an antenatal CTG interpretation.

Women will be offered computerised CTG if a CTG is indicated in the antenatal period unless there is a reason not to (and this should be documented within the clinical notes). This includes a cCTG prior to commencing IOL but following Propess, Prostin or ARM, traditional (visual) CTG should be used (see Intrapartum fetal heart rate monitoring).

3.2 When cCTG is not appropriate

- Women showing any signs of labour or uterine activity as determined by symptoms (contractions reported by the woman) or palpation of contractions (See Fetal Monitoring in Labour Guideline)
- After induction of labour has commenced (see Induction of Labour guideline).

3.3 Prior to commencing a cCTG

Ensure an in-depth medical and obstetric history has been obtained and documented looking at the whole clinical situation, including completion of risk assessment and the rationale for performing the CTG and gestational age.

Explain to the woman:

• The reasons of performing a continuous CTG

• The benefits, risks and limitations of CTGs

• That she will be included in discussions and plans regarding her care

If the woman or birthing person declines monitoring, discuss her reasons/concerns and document in the digital records

3.4 Documentation of an Antenatal CTG

Documentation of the antenatal CTG should follow the DR Q BRAVADO pattern:

Define **R**isk
Quality
Baseline **R**ate
Variability
Accelerations
Decelerations
Overall view – normal / abnormal
Dawes Redman met / not met (at time)
Plan.

3.5 Computerised CTG (cCTG)

Computerised CTG is an objective analysis of CTG. It eliminates the problems associated with highly subjective interpretation based on visual interpretation and is reproducible and consistent. It uses the computerised numerical analysis of the CTG, which is derived from the world's largest CTG database linked to outcomes and is known as Dawes Redman CTG analysis. It works in a 2-stage process where it derives a dataset similar to the traditional interpretation process and then applies the Dawes Redman criteria to this dataset. The final clinical judgement should be based on the entire clinical assessment with computerised CTG forming a part of this holistic approach to pregnancy management.

The Dawes Redman criteria are derived from the following dataset:

1) **Signal Loss:** Percentage of the trace length for which there is no FHR data.
2) **Movements:** As per traditional technique based on movements perceived by the patient. This is not used in monitoring twin pregnancies as movements cannot be attributed to a particular fetus.
3) **Basal heart rate:** This is different from baseline heart rate and is calculated by the software. It may deviate significantly from the visual assessment of baseline heart rate particularly during periods of prolonged high or low rates.
4) **Contractions:** Are recorded as per the traditional technique.
5) **Accelerations:** Same as conventional CTG definition but are quantified and presented in 2 groups (amplitude >10bpm and amplitude >15bpm).
6) **Decelerations:** The number of decelerations is defined as per conventional CTG but additionally, they are quantified in terms of ">20 Lost Beats"- a measure of the depth and duration of the deceleration.
7) **Reactivity of fetal heart beat**: Fetal heart rate variation has been shown to be the most useful computerised CTG indicator of antepartum fetal well-being. Two normal sources of FHR variation are gestational maturity and episodic changes in fetal behavioural states after 28 weeks gestation. The system was designed to take into account the episodic changes in fetal heart rate and fetal movement's characteristic of sleep states. Even in the absence of acceleration in a normal fetus, there is at least one episode of high FHR variation from 28 weeks onwards.
    - **Long term variation (LTV)** is in the form of high and low episodes in minutes. Variation in the pulse interval or rate from the baseline gives a measure of LTV. Periods for which LTV or beat-to-beat variation is >32 milliseconds for five or six consecutive minutes are described as high episodes and when the LTV is low the period is described as low episodes.
    - **Short term variation (STV):** Is similar to baseline variability, and LTV, but measured over a much smaller interval of just 3.75s (typically 7 to 10 beats). A significant benefit is that it is independent of baseline rate. The mean STV increases as gestational age advances.
    - Overall the thresholds of abnormal STV are as below:

      < 4ms: Low
      < 3ms: Abnormal
      < 2ms: Highly abnormal.

STV CANNOT be assessed visually from looking at the trace. It is NOT the same as beat-to-beat variability. It MUST NOT be used in isolation as an indicator of fetal condition – you can have

normal STV with a severely compromised fetus. It is only significant as part of a full 60-minute analysis

3.6 On-going outpatient monitoring:

For women who require regular outpatient monitoring, an individual plan will be made.

3.7 Inpatient Monitoring

Women who are inpatients on the antenatal wards should have at least daily assessment of the fetal heart using computerised CTG. Conventional monitoring should be used once the woman either goes into labour spontaneously or following prostaglandin administration / ARM if induction of labour.

4.0 Performing computerised CTG (cCTG):

4.1 Applying the Dawes Redman criteria:

The computer software assesses the above mentioned dataset and creates a report. The first result is after 10 minutes and is updated every 2 mins up to max of 60 mins.

There are 2 possible outcomes:

- Criteria met
- Criteria not met

4.1.1 What to do when Criteria are met:

This can be met after as little as 10 minutes (i.e. after the first analysis). It indicates a normal trace. The CTG can be stopped subject to visual assessment and clinical judgement. Do not rely on the analysis in isolation. It may not always identify unusual or pathological patterns that may be more obvious from visual interpretation, holistic assessment of, and knowledge of, the whole clinical scenario.

In some clinical scenarios such as the monitoring as severely growth restricted fetuses, analysis may need to continue for an hour, EVEN IF the criteria are met. This will be on an individual patient basis.

4.1.2 What to do when Criteria not met BEFORE 60 minutes:

This simply indicates that the criteria have not YET been met and normality has not been demonstrated. There are many reasons why a trace may not meet the criteria for a while, including uncertain basal rate determination and fetal behavioural state (e.g. sleep state). Reasons for failure to meet the criteria are shown as reason codes. Unless there are clear pathological features, or any cause for concern, continue the trace until the criteria are met.

4.1.3 What to do when Criteria are not met AT 60 minutes:

In the context of the antenatal CTG test, this must be considered an abnormal outcome and appropriate case review and action must be taken, based on the reasons for failure, visual trace review, and an holistic assessment of the pregnancy, in accordance with local / international guidelines & protocols. The review should be performed by a Registrar/Consultant to plan further management.

Refer to flow chart on Managing Criteria Not Met at 60 Minutes (hyperlink) – based on pathways used at St Georges Hospital (Network Fetal Medicine referral centre for ASPH).

Do NOT act on the basis of the CTG analysis alone, as it is an aid to pregnancy management, not a diagnostic tool.

The reasons why the trace did not meet the criteria are highlighted as coded numbers alongside the CRITERIA NOT MET message

Below are descriptions of each CRITERIA NOT MET CODES and may help to advise further management but THIS DOES NOT REPLACE AN INDIVIDUAL RISK ASSESSMENT AND CLINICAL REVIEW.

Dawes Redman CRITERIA NOT MET codes:

1. Basal Heart Rate outside normal range (110 – 160)
2. Large decelerations
3. No episodes of high variation
4. No movements and fewer than 3 accelerations
5. Baseline fitting is uncertain
6. Short-term variation is less than 3ms
7. Possible error at end of the record
8. Deceleration at the end of the record
9. High-frequency sinusoidal rhythm
10. Suspected sinusoidal rhythm
11. Long-term variation in high episodes below acceptable level
12. No accelerations

1. Basal Heart Rate outside normal range (110-160)

It is agreed in the NICE guidelines that an acceptable rate for a term fetus is 110 – 160 beats per minute (recent NICE 2017 suggests 100 is acceptable for a lower limit) but for extremely pre-term fetuses under 28 weeks gestation, baseline rates under 140 are unusual and in this event further assessments of fetal wellbeing should be discussed with the on call Obstetric Consultant.

2. Large decelerations

If the trace is otherwise normal this can be noted as an unprovoked variable deceleration but does not require immediate action and the trace should be repeated later.

3. No episodes of high variation

This is different to baseline variability. Important evidence of normality is the episodic variation in the baseline heart rate. In deep sleep the fetal heart rate is relatively constant with lower short-term variation but this should not normally exceed 50 minutes. In this event, if the short-term variation is normal and/or there are any accelerations the trace may be discontinued and repeated in 4 – 8 hours

4. No movements and fewer than 3 accelerations

This is significant and requires review by the obstetric team.

5. Baseline fitting is uncertain

If all else is fine, and the baseline falls within normal parameters, then this can be ignored.

6. Short-term variation (STV) is less than 3ms

Short-term variation is a computerized measure of the micro fluctuations of the fetal heart that are much shorter than the macro fluctuations. It is inversely proportional to the fetal heart rate and does not depend on the baseline.

The absence of an episode of high variation (a non-reactive trace) is strongly linked to the development of metabolic acidaemia and impending intrauterine death

STV (ms)	**<2.6**	**2.6-3.0**	**>3.0**
Metabolic acidaemia	4.0%	2.7%	
IUD	24.1%	4.3%	0.0%

7. Possible error at end of the record

This occurs when the machine detects a possible abnormality at the end of the trace which would otherwise be passed as CRITERIA MET.

In this event the trace may be continued or, if the clinical evaluation is that it is significantly abnormal, for example prolonged deceleration, then action should be taken as appropriate.

8. Deceleration at the end of the record

In this event the trace should be continued and action taken as appropriate.

9. High frequency sinusoidal rhythm

Sinusoidal FHR patterns are associated with either severe fetal anemia or severe/prolonged fetal hypoxia with acidosis and are associated with poor fetal outcomes.

These traces can be easily missed clinically and the analysis of the Dawes Redman system should be **acted on immediately** probable delivery – **should be discussed with Consultant on call**.

10. Suspected sinusoidal rhythm

Sinusoidal FHR patterns are associated with either severe fetal anaemia or severe/prolonged fetal hypoxia with acidosis and are associated with poor fetal outcomes.

Sinusoidal FHR needs to be distinguished from a Pseudosinusoidal FHR which, while it closely resembles a sinusoidal pattern, is usually transient, resolves spontaneously and is associated with a good fetal outcome.

Distinguishing between Sinusoidal and Pseudosinusoidal FHR Patterns)

Where a diagnosis of Sinusoidal FHR pattern is made, immediate intervention is required with probable delivery if intrauterine resuscitation is not appropriate.

The CTG should be continued and the mother informed of the seriousness of the situation.

Maternal blood should be taken for an urgent Kleihauer test to assess the degree of any feto-maternal haemorrhage.

The Neonatal Paediatricians should be alerted and the Obstetric Consultant and Obstetric Anaesthetic Consultant informed of possible need for emergency delivery.

11. Long-term variation in high episodes below acceptable level

This should be acted upon in the same way as STV.

12. No accelerations

In this event the CTG trace should be **continued but should be reviewed by Obstetric Registrar ST3 and above or Obstetric Consultant**.

4.2 Frequency of computerised CTG in high-risk pregnancies:

Women who are inpatients on the antenatal wards after 26+0 should have at least daily assessment of the fetal heart using computerised CTG. Conventional monitoring should be used once the woman either goes into labour spontaneously or following prostaglandin administration / ARM if induction of labour.

The STV can deteriorate very quickly especially at less than 32 weeks gestation in cases where there is either maternal disease such as pre-eclampsia with fluctuations of maternal blood pressure and in cases of severe growth restriction with abnormal blood flow through the placenta. This may necessitate the need for the cCTG to be repeated more than once daily - a plan needs to be made by a Senior Obstetrician regarding frequency.

5.0 Antenatal CTG – Visual Interpretation

In certain circumstances, where computerised CTG is contraindicated or required to remain in progress following Dawes Redman analysis, it is necessary to make a systematic assessment of the CTG using visual interpretation.

These situations include:

- During the induction of labour process (After any prostaglandin / balloon).

  Note: cCTG can be used PRIOR to the first induction agent being administered.

- Situations where there are evolving risk factors or while stabilising maternal condition

These principles should be applied for assessment of fetal wellbeing and consider all other existing risk factors as well as the fetal heart rate tracing. All reviews should take into consideration the full clinical picture.

CTG must be longer than 20 minutes before the CTG can be visually interpreted and classified (this does not apply to computerised CTG). However, if there are clear abnormal features, or any cause of concern escalation should be sooner.

During this time regular visual inspections of the CTG should be made. Each feature of the CTG should be reviewed in turn:

- Is the Baseline rate appropriate for gestation and stable?
- Is there normal variability and cycling?
- Are accelerations present?
- Presence/absence of decelerations

All 4 features must be normal after a maximum of 40 minutes for the CTG to be categorised as normal.

The categories for a CTG in a non-labouring woman are therefore:

- Normal
- Abnormal

Consider the full clinical picture, document all risk factors present and your overall impression and document this with a comprehensive management plan.

Where assessment is difficult or there is a difference of opinion between staff, a review by a senior midwife or obstetrician (ST3 or above) is encouraged using fresh eyes and should be obtained.

All CTG ongoing for >60 minutes require hourly fresh eyes (see intrapartum fetal monitoring for details)

6.0 Training Plan

6.1 Competency using the equipment

All staff who commence/monitor/discontinue and review antenatal CTGs must have undergone training including how to start and set up the machine and the Dawes Redman analysis, teaching on local action plans or lessons learnt which involve antenatal fetal monitoring, how to interpret the Dawes Redman criteria, taking a holistic view and considering the full clinical picture and the contents of this guideline.

All Obstetric and midwifery staff are required attend at an annual fetal monitoring training day to ensure they are compliant with current guidance in relation to interpretation and assessment of the fetal heart rate. This can be achieved as by attending the training as part of their induction day, PROMPT training day and weekly CTG meetings

6.2 Escalation and appropriate response

Tools available to help deal with challenges and barriers to escalation, safety critical language and encouraging psychological safety within the unit to improve escalation and ensure an appropriate response can be found at https://www.rcog.org.uk/about-us/groups-and-societies/the-rcog-centre-for-quality-improvement-and-clinical-audit/each-baby-counts-learn-support/.

References

Saving Babies Lives v3 (NHSE, 2023)

NICE Antenatal Care Guidance NG201 (2021)

NICE Fetal monitoring in labour Guidance NG 229 (2022)

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