

National Clinical
Guideline for
Intrapartum
Fetal Heart Rate
Monitoring
: Ireland



A National Clinical Guideline to minimise clinical variation in practice in the monitoring of the fetal heart rate during labour.

Consultation Process

The NWIHP would like to acknowledge the considerable time and work of the multidisciplinary Guideline Revision Group between June 2018 and May 2019, and the considered feedback shared during the extensive consultation process which was carried out between May and July of 2019.

Feedback was invited from the following:

- HSE Chief Clinical Officer
- HSE Quality Improvement
- HSE Quality Assurance and Verification
- Office of the National Director, HSE Acute Operations
- Quality and Patient Safety, HSE Acute Operations
- HSE National Clinical Programme for Neonatology
- Department of Health
- State Claims Agency
- Health Information and Quality Authority
- Health Products Regulatory Authority
- Dublin Midlands Hospital Group - Maternity Network
- Ireland East Hospital Group - Maternity Network
- RCSI Hospital Group - Maternity Network
- Saolta University Health Care Group – Maternity Network
- South/Southwest Hospital Group – Maternity Network
- University of Limerick Hospital Group – Maternity Network

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Disclaimer

Whilst every effort has been made by the authors of this document to ensure the information and material contained is complete, accurate and reflects international best practice, errors or omissions may occur.

This guideline is designed to aid clinical judgement and does not replace it.

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List of abbreviations

American College of Obstetricians and Gynecologists	ACOG
Beats Per Minute	BPM
Cerebral Palsy	CP
Caesarean Section	CS
Cardiotocography	CTG
Fetal Blood Sampling	FBS
International Federation of Gynecology and Obstetrics	FIGO
Fetal Heart Rate	FHR
Fetal Heart Rate Monitoring	FHRM
Health Service Executive	HSE
Hypoxic Ischaemic Encephalopathy	HIE
Intermittent Auscultation	IA
Institute Of Obstetricians and Gynaecologists	IOG
Multidisciplinary Team	MDT
National Women & Infants Health Programme	NWIHP
National Institute for Health and Care Excellence	NICE
Neonatal Encephalopathy	NE
Royal Australian and New Zealand College of Obstetrics and Gynaecology	RANZCOG
Royal College Of Obstetricians & Gynaecologists	RCOG
Society of Obstetricians and Gynaecologists of Canada	SOGC

Foreword

This is the second edition of the National Clinical Guideline for Intrapartum Fetal Heart Rate Monitoring to be published by the Health Service Executive. This Guideline was reviewed and edited from June 2018 to April 2019 by an expert Multidisciplinary Group.

Maternity care aims to minimise the inherent risks of pregnancy for both mother and baby; intrapartum care aims to minimise the inherent risks of labour. This objective is the same for all hospitals and professionals providing such care. Intrapartum fetal monitoring has a central role in avoiding some of the worst possible outcomes that follow on from those inherent risks, including perinatal death and brain injury. Fetal or neonatal death due to events in labour is rare. Unfortunately, neonatal brain injury is less rare.

Neonatal brain injury is a devastating outcome with possibly irreversible and lifelong consequences for the baby and his or her family. Moreover, it carries a substantial societal cost because of the litigation processes that inevitably follows many of these outcomes. Concern about these risks has to be offset by the knowledge that labour usually has a good outcome and that unnecessary intervention is in itself undesirable.

We hope that adherence to this Guideline will help to minimise adverse outcomes for women, and be of assistance to staff should they occur.

Therefore, prevention and eradication of these outcomes is one of the common objectives of all who are charged with caring for women and babies during labour.

This guideline will consider both intermittent auscultation (IA) and electronic fetal heart rate monitoring (EFHRM) with cardiotocography (CTG). It is recognised from the outset that CTG has been introduced incrementally into maternity care practices and that it has well documented limitations, including poor correlation with outcome, and interpretative subjectivity.

Key Recommendations

Quality of Care

		Grade & Reference
In assessing the wellbeing of both mother and baby in labour, the fetal heart is one of many parameters that should be taken into consideration.	This practice Guideline is limited to one facet of intrapartum care and is to be used alongside other clinical guidelines pertinent to labour care.	Good Practice Note
One-to-One midwifery care is the gold standard	One-to-One support of a midwife for labouring women is important and should be enhanced by the addition of peer support and opinion, known as ‘second eyes and ears’.	Good Practice Note
FIGO Classifications should be used in documentation	Fetal Heart Rate tracings must be classified and documented hourly (and more frequently as clinically indicated) in the woman’s record as Normal, Suspicious or Pathological, according to the Classification system (FIGO) described in this Guideline.	Consensus-Based Recommendation
If a concern arises following intermittent auscultation, continuous CTG should be started.	If continuous CTG has been commenced due to concerns arising from intermittent auscultation (IA), but the trace is normal after 20 minutes, it is appropriate to return to intermittent auscultation (IA) unless the woman asks to remain on continuous CTG.	Evidence-Based Recommendation B₁
Labour ward staff must have recent documented training	No professional involved in labour ward care should practice unless they have undergone recent documented training, every two years that demonstrates a thorough understanding of these Guidelines.	Consensus-Based Recommendation
Fetal scalp blood sampling should be avoided if there is sufficient CTG-based evidence to support expediting delivery	In the setting of clear evidence of acute fetal compromise (for example, a fetal bradycardia or a complex fetal tachycardia), fetal scalp blood sampling should be avoided. In this instance, time should not be wasted on fetal scalp blood sampling as an alternative to expediting birth.	Consensus-Based Recommendation

Intrapartum death, neonatal death, neonatal encephalopathy, and hypoxic ischaemic encephalopathy should be systematically reported and investigated

All intrapartum events that result in intrapartum death, neonatal death, neonatal encephalopathy, hypoxic ischaemic encephalopathy and therapeutic hypothermia must be systematically reported and investigated so that learning can be shared locally and nationally.

**Consensus-Based
Recommendation**

Choice

It is essential to provide women with information on fetal heart rate monitoring

During the course of antenatal care, women should be informed on fetal heart rate monitoring in labour and presented an information leaflet (appendix 13.1), and given the opportunity to discuss the advantages and disadvantages of both IA and CTG.

Grade & Reference

Consensus-Based Recommendation

All women should be offered intrapartum fetal heart rate monitoring (see exceptions on page 9)

All women should be offered intrapartum fetal heart rate monitoring. The type and level of monitoring chosen by the woman and her care providers will depend on the antenatal and intrapartum circumstances, perceived risks and individual preference.

Good Practice Note

A recommendation and an offer are influenced by the strength of evidence on the topic. Where evidence is strong, a recommendation should be followed. Where evidence is less strong and lacking consensus, it is appropriate to offer a choice of care.

Risk Evaluation

		Grade & Reference
A risk assessment must be carried out at admission and periodically thereafter	Risk status reflects antepartum risk and intrapartum risk. Risk assessment must be systematic on admission and on-going clinical assessment should be documented hourly in the first stage of labour; and every 15 minutes in the second stage of labour (see assessment example on page 25).	Good Practice Note (Consensus-Based)
An admission CTG is recommended for all women with known risk factors	A list of maternal, fetal and intrapartum risks are outlined on page 11. It is recommended that an admission CTG is carried out under such situations. As there are no differences in intervention rates among women regardless of risk status, it is appropriate to offer all women an admission CTG or IA.	Consensus-Based Recommendation Evidence-Based Recommendation A₁₉
Continuous CTG monitoring should be recommended to all women deemed to be at higher risk	Continuous intrapartum CTG monitoring should be recommended to all women with risk factors associated with perinatal asphyxia (page 11) or for situations where a pregnancy is otherwise perceived to be at heightened risk.	Evidence-Based Recommendation B₁ Good Practice Note
Continuous CTG monitoring should start when labour is diagnosed in women planning a VBAC	For women attempting a Vaginal Birth After Caesarean (VBAC), continuous CTG monitoring should start when labour is diagnosed.	Good Practice Note
Address underlying cause of a concerning trace before complications occur	When a suspicious or worsening CTG pattern is identified, the underlying cause must be addressed before a pathological tracing develops.	Evidence-Based Recommendation A_{1,5}
The primary caregiver must escalate concerns appropriately	The midwife, who is the primary caregiver in labour, must escalate any concerns to the shift leader. The shift leader must escalate their concerns to the appropriate level of obstetric care.	Good Practice Note

Safety for All

		Grade & Reference
CTG Machine usage is certified and required for all maternity staff	It is intended that all maternity care staff will have both interpretative and machine usage certification.	Good Practice Note (Consensus-Based)
Staff are advised to report concerns on machinery	Staff must report concerns relating to CTG equipment to the labour ward manager who is required to report this issue to the Health Products Regulatory Authority.	Good Practice Note (Consensus-Based)
A centralised procurement of FHRM machines is in place	The purchase of new equipment will be assessed by a Clinical Advisory Group (governed by HSE NWIHP) and centralised through HSE Medical Devices Office. Advisory Group members are multidisciplinary.	Good Practice Note (Consensus-Based)
FHRM machines and software are standardised	FHRM equipment must be standardised (insofar as is commercially feasible) with standardised software on FHRM machines throughout all 19 Hospitals/Units. This ensures staff moving between locations are trained appropriately.	Good Practice Note (Consensus-Based)
FBS should not be used in situations where there is a strong indication for emergency Caesarean section.	There is no evidence that fetal blood sampling (FBS) as an adjunct to CTG monitoring, reduces the incidence of emergency Caesarean delivery, or influences the reduction in neonatal seizures associated with continuous CTG monitoring (Alfirevic <i>et al.</i> 2017; Bloom <i>et al.</i> 2017).	Evidence-Based Recommendation A 1,4
Expedite delivery of breech fetuses by Caesarean if there is evidence of fetal compromise.	If a fetus presents in breech during labour and is exhibiting signs of fetal compromise that are not readily resolved, Caesarean delivery is appropriate.	Good Practice Note (Consensus-Based)

Excessive uterine activity is the most common cause of fetal hypoxaemia/acidaemia. This can be identified by documenting tachysystole in the CTG trace and palpation of the uterine fundus.

Uterine contractility is considered to be excessive ('uterine tachysystole') when the number of contractions exceeds 7 in 15 minutes, or alternatively for hospitals that count contraction frequency over 10 minute intervals, excessive contractions are defined as more than 7 in 15 minutes in a nulliparous patient or more than 5 in 15 minutes in a multiparous patient. Excessive activity can usually be reversed by:

- 1) Reducing or discontinuing oxytocin infusion
- 2) Removing administered prostaglandins (if possible)
- 3) Administering a tocolytic agent at the following doses:
 - a) Salbutamol – 100 micrograms intravenously
 - b) Terbutaline – 250 micrograms intravenously or subcutaneously
 - c) Nitroglycerine (NTG) spray - 400 micrograms sublingually

Evidence-Based Recommendation
A 29,C30

Given that oxytocin is less commonly required in multiparous patients, and given the potential for harm in this population, it is considered good practice to be more cautious in the infusion rate of oxytocin in multiparous patients. An upper limit of 5 contractions in every 15 minutes in multiparous patients is advised, adjusting the oxytocin infusion rate accordingly.

Governance

		Grade & Reference
An individual named midwife should be identifiable for a woman's labour care	At each stage of labour (from admission to the labour ward to discharge) an individual named midwife should be identifiable as the lead midwife responsible for intrapartum monitoring and care. The line of escalation to consultant level should be clear at all times. This information should be available and offered to the woman in labour.	Good Practice Note (Consensus-based)
Local escalation policies must be followed	A shift leader or experienced midwife should escalate concerns as per their local escalation policy.	Good Practice Note (Consensus-based)
Auditing compliance to this document and training is required annually	All Hospital Groups are required to audit compliance of this Guideline annually. In addition the outcome(s) of the audit must be put into action and any emerging trends must be considered nationally and locally. Non-compliance should be managed via the risk register in line with Risk Management Policy.	Good Practice Note (Consensus-Based)

Methods of Fetal Heart Rate Monitoring

		Grade & Reference
<p>In some circumstances, fetal monitoring is inappropriate, such as a lethal fetal abnormality</p>	<p>A strategy of ‘no fetal monitoring’ may be recommended if on the basis of prenatal information that a pregnancy is complicated by a lethal fetal abnormality, intrapartum FHRM may result in inappropriate iatrogenic intervention, and in such circumstances, a woman should not be subjected to an emergency Caesarean section in fetal interest.</p>	<p>Good Practice Note (Consensus-Based)</p>
<p>If a palliative approach is being taken, FHRM may not be used</p>	<p>In the event of pre-viability or peri-viability labour, a decision to adopt a palliative approach may be reached following inter-disciplinary consultation with parents, the perinatology team and neonatology. Under such complex circumstances, the decision to avoid FHRM in labour is an individualised decision, taking into account the interests of all stakeholders, most notably the wishes of the parents.</p>	<p>Good Practice Note (Consensus-Based)</p>
<p>In using IA, when identifying the baseline, regular assessments should occur as follows in the first and second stages of labour</p>	<p>First Stage: IA should occur every 15 minutes toward the end of a contraction and for a minimum of 60 seconds.</p> <p>Second Stage: IA should occur every 5 minutes toward the end and after a contraction and for a minimum for 60 seconds.</p>	<p>Consensus-Based Recommendation Evidence-Based Recommendation B₁</p>
<p>Clinicians and women should be aware that no evidence exists to validate adjunctive tests as alternatives to CTG monitoring with regards to reducing operative deliveries, neonatal seizures and perinatal morbidity.</p>	<p>There is no evidence that the intrapartum caesarean delivery rate is greater in units where FBS is unavailable. Information provided from FBS may assist in the retrospective review of intrapartum care in evaluating when fetal hypoxia may have been present. There is no evidence for a role for fetal pulse oximetry, nor fetal ECG ST-segment analysis (STAN) in reducing perinatal morbidity or operative deliveries (Alfirevic <i>et al.</i> 2017; Bloom <i>et al.</i> 2017).</p>	<p>Evidence-Based Recommendation A_{1,4}</p>

Grading of recommendations

Recommendation category		Description
Evidence-based recommendation	A	Body of evidence can be trusted to guide practice
	B	Body of evidence can be trusted to guide practice in most situations
	C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
	D	The body of evidence is weak and the recommendation(s) must be applied with caution
Consensus-based recommendation		Consensus-based recommendations based on expert opinion where the available evidence was inadequate or could not be applied to the Irish maternity care context
Good Practice Note		Practical advice and information based on expert opinion to aid in the implementation of the Guideline

The Working Group identified the above grading criteria, developed by the National Health and Medical Research Council of Australia (2009), appropriate for use in this Guideline.

1 Introduction: background and purpose

The Guideline was updated with the intention that it is applicable to both midwifery and obstetric staff, and is available to the public. The clinical objective of this Guideline is to provide recommendations concerning the application and documentation of fetal monitoring during the intrapartum period. The overarching goal of this Guideline is to decrease the incidence of intrapartum death and birth asphyxia while eliminating unnecessary obstetric intervention.

Both intrapartum death and birth asphyxia (as determined by the number of babies subjected to therapeutic hypothermia) are parameters/metrics currently collated by the National Perinatal Epidemiology Centre (NPEC), and thereby provide a measurable clinical objective.

The avoidance of adverse outcomes from intrapartum injury remains the objective of intrapartum monitoring. This practice Guideline is limited to one facet of intrapartum care and is to be used alongside other clinical guidelines pertinent to labour care (e.g., National Clinical Guideline on the diagnosis and management of pre-eclampsia and eclampsia, National Clinical Guideline on oxytocin to accelerate or induce labour, etc.). Whilst fetal heart rate monitoring (FHRM) is important in determining fetal health, clinicians must be aware that other factors should be considered for safe delivery (e.g. progress in labour, fetal presentation, bleeding, meconium, pyrexia and other maternal vital signs). Reliance on one parameter alone, i.e., fetal heart rate, will not predict adverse outcomes in all cases.

The quality of the evidence that underpins much of the practice in fetal heart rate monitoring is moderate at best. This Guideline is developed using best available evidence. Where insufficient high-level evidence was available, recommendations have been developed based on expert opinion and consensus, where possible.

It is universally accepted that monitoring the fetal heart either by Intermittent Auscultation (IA) or cardiotocography (CTG) is an essential part of labour. Exceptions to this standard may be considered on page 9. The goal of fetal monitoring is to detect potential fetal deterioration and to allow for timely and effective intervention to prevent adverse outcomes. This Guideline aims to direct practitioners as to the appropriate form of monitoring.

Antepartum factors are known to increase fetal susceptibility to hypoxic injury during labour (McIntyre, 2013). Two prominent examples are fetal growth restriction; the most dominant antenatal predictor of neonatal encephalopathy (NE) in the developed world (Kurinczuk, 2010), and fetal macrosomia sufficient to cause shoulder dystocia. Any strategy at national or institutional level aimed at reducing the incidence of perinatally-acquired hypoxic ischaemic encephalopathy requires attention to the importance of ensuring fetal health before the onset of labour. Institutional

or national policies aimed at screening for such risk factors are beyond the scope of this Guideline, but should be considered in the wider strategy to reduce birth-related neurological injury.

In preparing this Guideline we are aware of the importance of training in both IA and CTG interpretation. This includes the necessity to be trained on how individual CTG monitors work. Reviews of adverse outcomes following labour have highlighted not only the importance of correct interpretation of the CTG trace but also the ability to discriminate between fetal and maternal heart rate, and between individual heart rates in the setting of multiple pregnancy, where confusion may arise, particularly in the second stage of labour.

This practice Guideline is intended to define a role for FHRM in contemporary maternity care settings in Ireland, outlining available options for fetal monitoring and to issue recommendations most appropriate to each clinical scenario. By standardising the approach to fetal monitoring nationally, it is hoped that the Guideline will contribute to improved outcomes.

The purpose of this document is to guide clinical judgement and not replace it. In certain cases, a health care professional may, after careful consideration and senior consultation, decide not to follow a guideline if it is deemed to be in the best interests of the woman and baby. Such deviation from the Guideline, along with accompanying justification, must be documented in the woman's clinical record. This document sets out to offer consistent guidance in the form of recommendations for intrapartum fetal monitoring and the interpretation thereof. A woman may prefer to decline the recommendation that is presented to her. In that circumstance, her preferred level of monitoring should be recorded in the clinical record, along with a documented account of the risks and benefits of adhering to this Guideline.

In cases where the health care provider strongly believes that continuous electronic FHRM is necessary to safeguard the fetus and the woman refuses it (for any number of reasons), this should be regarded as clinical complexity and requires to be escalated to senior clinical personnel, such as a consultant obstetrician.

1.1 Initiation of Intrapartum Fetal Monitoring: When does Labour Begin?

The diagnosis of spontaneous labour is usually made by the woman who presents with a history which may include pains, a show or ruptured membranes.

The majority of women who present with a self-diagnosis of spontaneous labour are correct (Greulich and Tarrant; 2007; Gross *et al.* 2003) and this will be confirmed by the staff on examination and cervical assessment.

The history:

Women presenting with uterine contractions and a show or ruptured membranes in association with contractions and pain are more likely to be in labour than women presenting with contractions only (Greulich and Tarrant; 2007).

The examination:

The findings on cervical examination are different in multiparous from nulliparous at the start of labour. The cervix of most nulliparous women that is 2 cm dilated will also be fully effaced. Many multiparous women, by contrast, may reach 3-4 cm dilated without being fully effaced.

We suggest that the diagnosis of labour is most accurately made when the patient complains of regular painful contractions and in which there is vaginal examination evidence of cervical dilation and effacement. It is difficult to refute the diagnosis of labour without performing a vaginal examination.

Fetal monitoring should be used, in accordance with the guidance set out in this document, once a woman is deemed to be in labour.

2 Methodology

A multidisciplinary Working Group was formed in June 2018. The Group met once monthly until April 2019, with the exception of August when no meeting was held. Two maternity service user advocates were members of the Group. Members are named on page ii.

The Working Group formed a list of key questions to be addressed. The Working Group used the MiChe Guideline Appraisal Tool (Siebenhofer *et al.* 2016) to assess the systematic quality and applicability of the guidelines listed below. This validated rapid-assessment instrument was deemed appropriate for use given the limited timeframe allocated to the revision of the Guideline. The quality rating of this tool has compared highly to the AGREE II (Siebenhofer *et al.* 2016).

MiChe was used by seven group members to appraise a minimum of four international guidelines each. All five guidelines ranked highly; the highest ranking at 6.6/7 and the lowest ranking at 4/7. The overall quality rating showed a consistent level of agreement between appraisers.

This Guideline is informed by meta-analysed evidence presented in these five international guidelines for intrapartum fetal heart rate monitoring; published in the English language in developed countries within the past 10 years. These guidelines were developed by the following bodies;

- American College of Obstetricians and Gynecologists (ACOG)
- International Federation of Gynecology and Obstetrics (FIGO)
- National Institute for Health and Care Excellence (NICE)
- Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG)
- Society of Obstetricians and Gynaecologists of Canada (SOGC)

This Working Group considered these guidelines to be sufficiently high quality to advise the revision of the Irish Guideline (2012). The Group focused on the quality, acceptability and applicability of evidence to intrapartum monitoring in Ireland. Supplementary to the use of international guidelines, recommendations made are based on the best available evidence of clinical effectiveness.

Extensive feedback and comments were received since the edited version of September 2019. Many of these comments have been particularly helpful and have been integrated into this version (September 2021).

3 Clinical Guidance

3.1 Communications

This document is prepared for use in the Irish maternity setting and will be made available to all Hospital Groups, all maternity hospitals/units, the Higher Educational Institutes where maternity care is taught, and to anyone who wishes to read it. Additionally, an information leaflet is available shortened version for women and their family is available in appendix 13.1.

3.2 Standardising Fetal Heart Rate Monitoring

One of the fundamental objectives underpinning the production of a national Guideline is that midwives and doctors moving between different units will have a standardised approach to FHRM and the language that is used in FHR interpretation. Standardisation of approach is a key recommendation of the National Maternity Strategy, 2016-2026, Recommendation 70, Action, 70.4.

The following Reports have also recommended the standardisation of FHRM:

- Clinical Review of the Maternity Services at Portiuncula Hospital, 2018
- Investigation into the care and treatment provided to Mrs Conroy for the delivery of her Baby Róisín on the 14th November 2001, 2018
- National Standards for Safer Better Maternity Services, HIQA, 2016
- HSE Systems Analysis Review into the death of Baby Joshua Keyes, 2015
- HSE Midland Regional Hospital, Portlaoise Perinatal Deaths, 2014
- HSE Systems Analysis Review into the death of Baby Mark Molloy, 2013

4 Adverse Fetal Outcomes from Intrapartum Events

4.1 Death, Neonatal Encephalopathy and Cerebral Palsy

Intrapartum fetal death in Ireland is rare at a rate of 1.4 in 5,000 (NPEC, 2018). Outcomes more frequent than intrapartum death include Neonatal Encephalopathy (NE) and Hypoxic Ischaemic Encephalopathy (HIE), both of which may lead to a diagnosis of Cerebral Palsy (CP).

It is these latter events which give rise to many cases that involve litigation. Between 2010 and 2014 the total expenditure on claims made for maternity care was €233.1 million (States Claims Agency, 2015).

The incidence of HIE in Ireland in 2017 was 1.6 per 1,000 births (IMIS, 2018). The consequences of these outcomes for the infant, their family, maternity care providers and the wider society may be devastating.

Cerebral Palsy

CP is a chronic motor disorder as a result of an injury to a developing brain. Most cases of CP do not have intrapartum aetiology, but are the result of congenital, antenatal/postnatal factors, and prematurity. Because intrapartum factors are an infrequent cause of CP, assessing the efficacy of intrapartum monitoring against rates of CP is a crude measure.

Neonatal Encephalopathy

NE is defined by abnormal neurological behaviour, with the onset occurring at or soon after birth. NE is established by an abnormal level of consciousness, with or without the presence of seizures and is often accompanied by difficulty initiating and maintaining respirations, depressed tone and depressed reflexes, poor suck and swallow (Meaney *et al.* 2018). NE has many causes such as prenatal stroke, infection, cerebral malformation, and genetic disorders, as well as hypoxia. The Vermont Oxford Network Neonatal Encephalopathy Registry suggests that NE was caused by asphyxia in 15% of cases and by inflammation in 24% of cases (Nelson *et al.* 2012). NE has an estimated incidence of 3.0 per 1,000 live births (Kurinczuk *et al.* 2010).

Hypoxic Ischaemic Encephalopathy

HIE refers to the subset of NE that is accompanied by evidence of umbilical artery metabolic acidosis at birth in the absence of other possible causes such as infection, anomaly or inborn error of metabolism (Sarnat and Sarnat, 1976). It is frequently associated with low Apgar scores. The relative rarity of HIE in babies delivered by elective caesarean section suggests that labour is an important factor in most cases of babies that have HIE (Martinez-Biarge *et al.* 2013, Badawi *et al.* 1998). This is not an argument for elective caesarean section but for effective monitoring in labour

and for the standardised use of FHRM guideline recommendations across all maternity hospitals/units.

With the advent of therapeutic cooling, a standardised assessment of neonates with encephalopathy has assumed greater importance because utilising this therapeutic tool can result in improved neurologic outcome (Meaney *et al.* 2018). The success of intrapartum monitoring can usefully be measured by assessing the requirement for therapeutic cooling in the population, as a proxy indicator of perinatal asphyxia incidence.

4.2 Electronic Fetal Monitor Settings

All maternity hospitals and units are required to have their CTG machines' software standardised nationally to ensure a consistent approach to teaching and interpretation of EFM traces. This Guideline and machine instructions must be readily available to staff in hardcopy on the labour ward. Disregarding the instructions of a machine is considered 'abnormal use'.

Settings on a CTG machine should be standardised to enable a consistent approach to teaching and interpretation of EFM traces.

- A standard paper speed of 1cm per minute should be used.
- The date and time on each CTG machine should be validated at commencement of every CTG and synchronised with the clock in the room. .
- CTGs should be labelled with mother's name, hospital number, date and time of commencement.
- Maternal heart rate should be recorded and noted on CTG.
- Following birth, the midwife should sign and note the date, time and mode of delivery on the CTG.
- For units without MN-CMS; the CTG should be stored securely with the woman's clinical record.
- Tracer systems should be available for all CTGs if stored separately from the woman's notes.

Clinical staff should be aware whether or not the FHR monitor in use provides signal ambiguity detection technology (Freeman *et al.* 2012; General Electric Healthcare, 2019; Philips Healthcare, 2019a). Signal ambiguity is a FHRM artefact which occurs:

- (1) in single or multiple gestation when the presumed 'fetal' heart rate is actually the maternal pulse or
- (2) in multiple gestation when the presumed heart rate of one fetus (e.g. fetus A) is actually the heart rate of another fetus (e.g. Fetus B).(Neilson *et al.* 2008; Miller *et al.* 2017; Paquette *et al.* 2014)

Technology to detect signal ambiguity involves simultaneous recording of both the maternal pulse and the FHR. The maternal pulse and FHR are traced individually on the CTG paper. The emission of coincidence alarms where both the FHR and the maternal pulse are so close together that one must consider that the fetal heart rate may actually be the maternal pulse. In the case of multiple

gestations, when the fetal heart rate of twin A and B are so close together; one must consider whether only one of the two is actually being monitored (Freeman *et al.* 2012, Philips Healthcare 2019a, General Electric Healthcare 2019, Miller, 2017).

These technologies were developed in response to concerns regarding the difficulty to detect signal ambiguity that were raised after the introduction of autocorrelation algorithms. These algorithms were developed to provide cleaner appearing FHR signal output and on occasion, more difficult to detect, transitions between heart rate inputs (fetal to maternal or vice versa and/or fetal to fetal in multiple gestation)(Divon *et al.* 1985; Fukushima *et al.* 1985; Freeman *et al.* 2012; Kiely, 2015; Kiely 2018; Philips Healthcare, 2019a).

FHR monitor alarms must be acknowledged and the appropriate response taken and documented in the woman's medical record. The 'coincidence alarm' is a relatively new alarm on CTG machines and staff should be aware that this alarm is available on CTG monitors which have signal ambiguity detection technology and should be audible (Philips Healthcare 2019a, Philips Healthcare 2019b; General Electric Healthcare 2019).

Repositioning the transducers is the appropriate response to the coincidence alarm. If the problem is not rapidly and definitively resolved; then a clinician may carry out:

- (1) direct bedside ultrasound of the FHR
- (2) the application of a fetal scalp electrode

It is necessary to be aware that that a fetal scalp electrode may in certain circumstances capture the maternal pulse (Philips Healthcare 2019a, Philips Healthcare 2019b). Temporary bedside ultrasound for verification of the FHR should be considered whenever: signal ambiguity; doubling; or halving of the FHR are suspected. Ultrasound should also be carried out if there are any doubts on the accuracy of the FHR signal.

FHRM recording is sensitive to mobile phone technology and mobile phone use should be limited in close proximity to the machine during monitoring.

Central monitoring, the ability to view multiple fetal heart traces from a central location, is not a substitute for One-to-One care. If using a FHR monitor with signal ambiguity detection technology, one should be aware of whether coincidence alarms will or will not be displayed and/or recorded on the central monitoring system.

5 Methods of Intrapartum Heart Rate Monitoring

The options for determining fetal wellbeing during labour are as follows (listed in order of increasing intensity):

- No fetal monitoring
- Intermittent auscultation (IA) of the fetal heart
- CTG monitoring on admission (e.g. 20 minutes) followed by IA during labour
- Intermittent/periodic CTG monitoring
- Continuous CTG monitoring
- Continuous CTG monitoring with recourse to adjunctive testing in the event of non-reassuring fetal status

The level of intrapartum fetal monitoring recommended will depend on the clinical circumstances, as determined by the woman's care providers during labour. Fetal life should be assessed and documented in the woman's health record prior to any form of FHRM.

5.1 No Fetal Monitoring

No Fetal Monitoring

In some circumstances, fetal monitoring is inappropriate, such as a lethal fetal abnormality

A strategy of 'no fetal monitoring' may be recommended in some circumstances. For example, if it has been judged on the basis of prenatal information that a pregnancy is complicated by a lethal fetal abnormality, the woman should not be subjected to an emergency Caesarean section in fetal interest. In such circumstances, intrapartum FHRM may result in inappropriate iatrogenic intervention. In cases of previous Caesarean section the risk of uterine rupture remains, when the fetal heart is not being monitored.

If a palliative approach is being taken, FHRM may not be used

In the event of pre-viability or peri-viability labour, a decision to adopt a palliative approach may be reached following interdisciplinary consultation with parents, the perinatology team and neonatology. Under such complex circumstances, the decision to avoid FHRM in labour is an individualised decision, taking into account the interests of all stakeholders, most notably the wishes of the parents.

The objective of fetal heart rate monitoring is to allow recognition of abnormal patterns that may indicate fetal hypoxia sufficient to warrant intervention (e.g. emergency Caesarean section).

Where a decision is taken during the course of a pregnancy to avoid intrapartum FHRM the strategy of a palliative approach must be clearly documented in the woman's clinical record and facilitated by all care-givers during the course of labour.

5.2 Intermittent Auscultation of the Fetal Heart

IA of the fetal heart should be considered to represent the accepted standard for intrapartum fetal monitoring in the absence of the risk factors listed on page 12 or unless the pregnancy is otherwise judged to be at heightened risk for intrapartum complications. Intrapartum IA of the fetal heart should be performed and interpreted in the standardised manner.

For a healthy woman with an uncomplicated singleton pregnancy \geq 37 weeks gestation IA should be offered using either Doppler ultrasound or a Pinard stethoscope. During IA the practitioner must simultaneously monitor the maternal heart rate to differentiate between the two. A baseline rate is assessed by listening and counting beats between uterine contractions for 60 seconds, palpating the maternal pulse simultaneously.

On identifying the baseline, regular assessments should occur as follows:

First stage of labour IA should occur every 15 minutes toward the end of a contraction and for a minimum of 60 seconds.

Second stage of labour IA should occur every 5 minutes toward the end and after a contraction and for a minimum for 60 seconds.

! It is important to document findings.

When to transition to continuous CTG monitoring:

A move from IA to continuous CTG monitoring should occur if any of the following circumstances evolve:

- During IA the fetal heart rate baseline is detected less than 110bpm or greater than 160 bpm
- Any deceleration following a contraction

Note: *(Following 20 minutes of CTG, if no abnormal features are identified, consider returning to IA)*

- Meconium stained amniotic fluid
- Maternal Pyrexia of 38 degree Celsius on one occasion or $>$ 37.5 on 2 occasions
- Abnormal bleeding during labour
- Initiation of oxytocin – assuming contemporaneous CTG is normal
- Epidural analgesia
- Any other reason that gives the midwife/care-provider cause for concern that warrants conversion to continuous CTG monitoring
- Patient request

5.3 Intermittent/Periodic CTG Monitoring:

Intermittent/periodic CTG monitoring should be considered to represent a variation of IA, with no evidence that it represents a superior standard.

5.4 Continuous CTG monitoring

Continuous CTG monitoring is associated with halving the risk of neonatal seizures. Women should be informed that continuous CTG monitoring, when compared with IA, is associated with a halving of the risk of neonatal seizures. Irrespective of risk status, all women should be offered the option of continuous CTG monitoring. Owing to the limitation in mobility associated with CTG monitoring, women may prefer intermittent auscultation.

An admission CTG is recommended for all women with known risk factors. Continuous CTG monitoring is recommended in the setting of any of the following risk factors:

Maternal	
	Antepartum haemorrhage
	Hypertensive disorders of pregnancy
	Hypertonic uterus
	Induced/augmented labour
	Intrauterine infection/chorioamnionitis
	Pre-existing diabetes mellitus/gestational diabetes
	Preterm labour
	Previous Caesarean section
	Previous poor obstetric outcome (e.g., intrapartum injury, death)
	Post term pregnancy >42 weeks
	Prolonged membrane rupture >24 hours
	Significant maternal medical disease
	Vaginal bleeding
	BMI >35
	Poor compliance with schedule of antenatal appointments
Fetal	
	Intrauterine growth restriction
	Abnormal FHR on auscultation
	Abnormal umbilical artery Doppler
	Breech presentation
	Decreased fetal activity
	Isoimmunisation
	Meconium stained amniotic fluid (any grade)
	Multiple pregnancy
	Oligohydramnios
	Prematurity
Intrapartum	
	Meconium stained amniotic fluid
	Intrapartum bleeding
	Oxytocin
	Poor progression
	Pyrexia (38 degree Celsius on one occasion or ≥ 37.5 on 2 occasions, taken between 30 and 60 minutes apart.)

! This list is not exhaustive; there may be other circumstances where the care provider recommends continuous FHRM.

5.5 Continuous CTG monitoring with recourse to adjunctive testing in the event of non-reassuring fetal status

Clinicians and women should be aware that no evidence exists to validate adjunctive tests as alternatives to CTG monitoring with regards to reducing operative deliveries, neonatal seizures and perinatal morbidity. There is no evidence that the intrapartum caesarean delivery rate is greater in units where FBS is unavailable. Information provided from FBS may assist in the retrospective review of intrapartum care in evaluating when fetal hypoxia may have been present. There is no evidence for a role for fetal pulse oximetry, nor fetal ECG ST-segment analysis (STAN) in reducing perinatal morbidity or operative deliveries (Alfirevic *et al.* 2017; Bloom *et al.* 2017).

However, in the absence of evidence for a benefit to FBS in reducing perinatal morbidity or avoiding unnecessary Caesarean delivery, the availability of FBS facilities in all units should not be considered a requirement for safe provision of intrapartum care.

5.6 Advantages and Disadvantages of continuous CTG Monitoring in labour, when compared to Intermittent Auscultation

Continuous CTG monitoring in labour, when compared to intermittent auscultation of the fetal heart, has been shown to halve the risk of neonatal seizures (Alfirevic *et al.* 2017). It is important to note that some neonatal seizures are not associated with perinatal asphyxia; however, those that are associated with HIE are those potentially preventable with CTG monitoring that targets the detection of intrapartum hypoxia.

The recognised benefit of continuous CTG monitoring at reducing neonatal seizures should not be assumed to result in a significant reduction in CP rates, as CP is a wider symptom complex which is considered multifactorial in its origins.

Continuous CTG monitoring in labour may limit the woman's mobility.

There exists low quality evidence that indicates an increase in Caesarean section rate when continuous CTG monitoring is compared to intermittent auscultation (Alfirevic *et al.* 2017). This evidence is predominantly from the Dublin trial of 1985 that was conducted in the context of an

overall Caesarean section rate of 2.3%, and is therefore of uncertain relevance to today's clinical practice. While the importance of avoiding unnecessary obstetric intervention is recognised, it is acknowledged that the majority (50 - 60%) of Caesarean deliveries in Ireland today are performed in non-labouring women (Rotunda Hospital, 2017; Coombe Women and Infant's University Hospital, 2016). This must be borne in mind when considering the magnitude of impact that practice guidelines relating to method of FHRM are expected to exert on institutional or national Caesarean section rates.

In the event of fetal hypoxaemia/acidaemia, intervention in the form of expedited delivery is accepted as the course of action that can minimise risk to the neonate. Hypoxaemia/acidaemia may be confirmed in only a minority of cases of infants delivered because of concerning intrapartum fetal heart rate monitoring. However, for that minority, the decision to intervene can prove life-saving and neurology-sparing for the neonate. It is for this reason that any unit charged with the care of pregnant women in labour will witness a proportion of interventions where the baby is delivered in good condition (non-hypoxaemic and non-acidaemic) in spite of concerning fetal heart rate patterns. This should not be considered to be an adverse outcome in itself, but rather a reflection of the low specificity of CTG monitoring in predicting perinatal asphyxia, and should underscore the importance of adopting a standardized approach to acquisition and interpretation of FHR monitoring.

6 Classification of the Intrapartum Fetal Heart Rate Pattern

The International Federation of Gynecology and Obstetrics (FIGO) Classification System has been selected by this Consensus Group as the system most applicable to the Irish setting. FIGO represents national societies of obstetricians and gynaecologists; one of which is Ireland's Institute of Obstetricians and Gynaecologists. Consistency in description of CTG features is critically important to interpretation and to communication between care providers. The terminology used for CTG analysis is adapted from the FIGO Classification System and is described in the following sections. Illustrative examples of CTG tracings may be seen in appendix 13.3.

6.1 Evaluation of Basic CTG Features

The following definitions on CTG features were directly taken, with thanks, from the FIGO Classification System developed in 2015.

Baseline – this is the mean level of the most stable FHR segments and is estimated across time periods of 10 minutes and expressed in beats per minute (bpm).

The baseline FHR is considered to be normal when the value lies between 110 and 160 bpm. Preterm fetuses tend to have values towards the upper end of this range and post term fetuses towards the lower end.

Tachycardia – a baseline value above 160 bpm lasting more than 10 minutes. A rise of 20 bpm may indicate hypoxia.

Maternal pyrexia is the most frequent cause of fetal tachycardia, either owing to systemic maternal infection or associated with intrauterine infection. Epidural analgesia may also cause a rise in maternal temperature resulting in fetal tachycardia. In the initial stages of a non-acute fetal hypoxemia, catecholamine secretion may also result in tachycardia. Other less frequent causes are the administration of beta-agonist drugs (salbutamol, terbutaline) and fetal arrhythmias such as supraventricular tachycardia and atrial flutter.

Bradycardia – a baseline value below 110 bpm lasting more than 10 minutes.

Values between 100 and 110 bpm may occur in normal fetuses, especially in postdate pregnancies. Maternal hypothermia, administration of beta-blockers, and fetal arrhythmias such as atrio-ventricular block are other possible causes.

Variability: refers to the oscillations in the FHR signal, evaluated as the average bandwidth amplitude of the signal in one-minute segments.

Normal variability: bandwidth amplitude of 5-25 bpm.

Reduced variability: a bandwidth amplitude below 5 bpm for more than 50 minutes in baseline segments, or for more than 3 minutes during decelerations.

Reduced variability can occur due to central nervous system hypoxaemia/acidaemia and resulting decreased sympathetic and parasympathetic activity, but it can also be due to previous fetal cerebral injury, infection, administration of central nervous system depressants or parasympathetic blockers. During deep fetal sleep, variability is usually in the lower range of normality, but the bandwidth amplitude is seldom under 5 bpm. There is a high degree of subjectivity in the visual evaluation of this parameter, and therefore careful re-evaluation is recommended in borderline situations. Following an initially normal CTG, reduced variability due to hypoxia is very unlikely to occur during labour without preceding or concomitant decelerations and a rise in the baseline.

Increased variability (saltatory pattern): a bandwidth value exceeding 25 bpm lasting more than 30 minutes.

The pathophysiology of this pattern is incompletely understood, but it may be seen linked with recurrent decelerations, when hypoxaemia/acidaemia evolves very rapidly. It is presumed to be caused by fetal autonomic instability/hyperactive autonomic system.

Accelerations: abrupt (onset to peak in less than 30 seconds) increases in FHR above the baseline, of more than 15 bpm in amplitude, and lasting more than 15 seconds but less than 10 minutes.

Most accelerations coincide with fetal movements and are a sign of a neurologically responsive fetus that does not have hypoxaemia/acidaemia. Before 32 weeks' gestation, their amplitude and frequency may be lower (10 seconds and 10 bpm of amplitude). After 32-34 weeks, with the establishment of fetal behavioural states, accelerations rarely occur during periods of deep sleep, which can last up to 50 minutes. The absence of accelerations in an otherwise normal intrapartum CTG is of uncertain significance, but it is unlikely to indicate hypoxaemia/acidaemia.

Accelerations coinciding with uterine contractions, especially in the second stage of labour, suggest possible erroneous recording of the maternal heart rate, since the FHR more frequently decelerates with a contraction, while the maternal heart rate typically increases.

Decelerations: decreases in the FHR below the baseline, of more than 15 bpm in amplitude, and lasting more than 15 seconds.

Early decelerations: decelerations that are shallow, short-lasting, with normal variability within the deceleration and are coincident ('mirror image') with contractions. They are believed to be caused by fetal head compression and do not indicate fetal hypoxaemia/acidaemia.

Variable decelerations (V-shaped): decelerations that exhibit a rapid drop (onset to nadir in less than 30 seconds), good variability within the deceleration, rapid recovery to the baseline, varying size, shape and relationship to uterine contractions.

Variable decelerations constitute the majority of decelerations during labour, and they translate a baroreceptor-mediated response to increased arterial pressure, as occurs with umbilical cord compression. They are seldom associated with an important degree of fetal hypoxaemia/acidaemia, unless they evolve to exhibit a U-shaped component, reduced variability within the deceleration (see late decelerations below), and/or their individual duration exceeds 3 minutes (see prolonged decelerations below).

Late decelerations (U-shaped and/or with reduced variability): late decelerations have a gradual onset and/or a gradual return to the baseline and may also have reduced variability within the deceleration. Gradual onset and return occurs when more than 30 seconds elapses between the beginning/end of a deceleration and its nadir. When contractions are adequately monitored, late decelerations start more than 20 seconds after the onset of a contraction, a nadir after the acme,

and a return to the baseline after the end of the contraction. These decelerations are indicative of a chemoreceptor-mediated response to fetal hypoxemia. In the presence of a tracing with no accelerations and reduced variability, the definition of late decelerations also includes those with an amplitude of 10-15 bpm.

Prolonged decelerations: decelerations lasting more than 3 minutes.

These are likely to include a chemoreceptor-mediated component and thus to indicate hypoxemia. Decelerations exceeding 5 minutes, with FHR maintained <80 bpm and reduced variability within the deceleration are frequently associated with acute fetal hypoxaemia/acidaemia and require emergent intervention.

Sinusoidal pattern: a regular, smooth, undulating signal, resembling a sine wave, with an amplitude of 5-15 bpm, and a frequency of 3-5 cycles per minute. This pattern lasts more than 30 minutes, and coincides with absent accelerations. The pathophysiological basis of the sinusoidal pattern is incompletely understood, but it occurs in association with severe fetal anaemia, as is found in anti-D allo-immunisation, fetal-maternal haemorrhage, twin-to-twin transfusion syndrome and ruptured vasa praevia. It has also been described in cases of acute fetal hypoxaemia and infection, cardiac malformations, hydrocephalus and gastrochisis.

The pathophysiological basis of the sinusoidal pattern is incompletely understood, but it occurs in association with severe fetal anaemia, as is found in Rhesus or Kell allo-immunisation, fetal-maternal haemorrhage, twin-to-twin transfusion syndrome and ruptured vasa praevia.

Pseudo-sinusoidal pattern: a pattern resembling the sinusoidal pattern, but with a more jagged “saw-tooth” appearance, rather than the smooth sine-wave form. Its duration seldom exceeds 30 minutes and it is characterised by normal patterns before and after. It is sometimes difficult to distinguish the pseudosinusoidal pattern from the true sinusoidal pattern, leaving the short duration of the former as the most important variable to discriminate between the two.

Contractions: these are bell-shaped gradual increases in the uterine activity signal followed by roughly symmetric decreases, with 45-120 seconds in total duration. Contractions are essential for the progression of labour, but they compress the vessels running inside the myometrium and may transiently decrease placental perfusion and/or cause umbilical cord compression.

Tachysystole: represents an excessive frequency of contractions and is defined as the occurrence of more than 7 contractions in 15 minutes in a nulliparous patient (or more than 5 contractions in 15 minutes in a multiparous patient).

Coincidence pattern or doubling: this represents a signal artefact of the fetal heart rate during decelerations shown above the baseline.

6.2 CTG Classification

Tracing classification requires a previous evaluation of basic CTG features (see above). Tracings should be classified into one of three classes: normal, suspicious or pathological, according to the criteria presented in the below table. Due to the changing nature of CTG signals during labour, re-evaluation of the tracing should be carried out at least every hour in the first stage of labour, and every 15 minutes in the second stage of labour.

6.3 Examples of CTG Tracing

For examples of CTG tracing, see examples provided by the FIGO Consensus Guidelines on Intrapartum Fetal Heart Rate Monitoring, 2015. This Guideline recommends traces to be set at 1cm.

	Normal ✓	Suspicious ?	Pathological !
Baseline	110-160 bpm	Lacking at least one characteristic of normality, but with no pathological features	<100 bpm >10 mins
Variability	5-25 bpm		<ul style="list-style-type: none"> • Reduced variability < 5bpm for >50 minutes. • Increased variability >25bpm for >50 minutes. • Sinusoidal pattern for >30minutes.
Decelerations	No repetitive* decelerations		Repetitive* late or prolonged (>3minutes) decelerations for >30minutes (or >20minutes if reduced variability). Isolated deceleration >5minutes
Interpretation	No hypoxia/acidosis	Low probability of hypoxia/acidosis	High probability of hypoxia/acidosis
Clinical Management	No intervention necessary to improve fetal oxygenation state	Action to correct reversible causes if identified, close monitoring or adjunctive methods	Immediate action to correct reversible causes, adjunctive methods, or if this is not possible expedite delivery. In acute situations immediate delivery should be accomplished.

Table 1: Adapted from FIGO, 2015: CTG classification criteria, interpretation and recommended management

*Decelerations are repetitive when associated with >50% contractions.

Absence of accelerations in labour is of uncertain significance.

Please note: As the FIGO guideline does not outline a timeframe where variable decelerations become suspicious, we note that variable decelerations need to be present for 90 minutes or more before being considered 'suspicious'; or alternatively, if they are present for up to 50% of contractions for 30 minutes, or for more than 50% of contractions for less than 30 minutes.

7 Intrapartum Clinical Response and Management Plan

To avoid an adverse neonatal outcome, action is required when a CTG trace is 'suspicious' or 'pathological' and fetal hypoxaemia/acidaemia is suspected or anticipated. This action does not necessarily require performing an immediate Caesarean section. Often, the reason for such a trace can be identified and the situation may be reversed with successive recovery of adequate fetal oxygenation and the return to a normal tracing.

The following lists reversible factors and their associated corrective actions:

Uterine tachysystole	Requiring reduction or discontinuation of uterotonics
Aortocaval compression	Requiring maternal repositioning
Maternal hypotension	Potentially requiring intravenous hydration or ephedrine if triggered by epidural analgesia.

7.1 Treatment of Uterine Tachysystole (uterine hyperactivity)

The most common cause of fetal hypoxaemia/acidaemia is excessive uterine activity. Uterine contractility is considered to be excessive ('uterine tachysystole') when the number of contractions exceeds 7 in 15 minutes, or alternatively for hospitals that count contraction frequency over 15 minute intervals, excessive contractions are defined as more than 7 in 15 minutes in a nulliparous patient or more than 5 in 15 minutes in a multiparous patient. Excessive activity can usually be reversed by:

This can be identified by documenting tachysystole in the CTG trace and/or palpation of the uterine fundus.

- 4) Reducing or discontinuing oxytocin infusion
- 5) Removing administered prostaglandins (if possible)
- 6) Administering a tocolytic agent at the following doses:
 - d) Salbutamol – 100 micrograms intravenously
 - e) Terbutaline – 250 micrograms intravenously or subcutaneously
 - f) Nitroglycerine (NTG) spray - 400 micrograms sublingually

Given that oxytocin is less commonly required in multiparous patients, and given the potential for harm in this population, it is considered good practice to be more cautious in the infusion rate of oxytocin in multiparous patients. An upper limit of 5 contractions in every 15 minutes in multiparous patients is advised, adjusting the oxytocin infusion rate accordingly.

Positioning:

If the woman is supine, aortocaval compression may occur and lead to reduced placental perfusion. Repositioning the woman from supine position to her side is often followed by a normal CTG trace.

Uterine weight may cause sacral plexus stimulation. Similarly, transient cord compression may cause variable decelerations and may also be reversed through changing the maternal position.

Hypotension:

Maternal hypotension may sometimes occur after administration of epidural or spinal analgesia and is usually reversible by rapid fluid administration and/or intravenous ephedrine.

8 Limitations of Cardiotocography

Whilst it is essential to be aware of the limitations of CTG, one must also appreciate that the purpose of intrapartum fetal monitoring is to identify situations that precede hypoxaemia/acidaemia, avoiding fetal injury.

Intra- and inter-observer disagreement	Identifying and classifying decelerations, evaluating variability, classifying traces as suspicious and pathological are aspects of CTG interpretation most susceptible to disagreement between clinicians.
Sensitive indicators with low specificity and low positive predictive values	Whilst hypoxaemia/acidaemia has not been documented following a normal CTG trace; suspicious and pathological tracings have limited ability to predict metabolic acidosis and low Apgar scores.
Variable evidence	It is difficult to establish how the results of RCTs conducted in the 1970s, 1980s and early 1990s compare with clinical practice today as these studies used different CTG interpretation criteria.
Underpowered studies	No study to date has demonstrated an effect of CTG monitoring on perinatal mortality or on serious perinatal morbidity with long term consequences, but no study is likely ever to be powered to do so. This is due to the scale of a study that would be required to investigate such uncommon birth outcomes and that would require with-holding of CTG monitoring from a large cohort of labouring women when it has become an integral component of intrapartum fetal monitoring over the past 3 decades, notwithstanding that uncertainty remains with respect to the magnitude of its role in improving birth outcomes.
Lack of knowledge	A perceived association between continuous monitoring and increased obstetric interventions in labour may be attributed to a practitioner's limited knowledge of pathophysiology of fetal oxygenation and inappropriate clinical response to CTG changes.

9 Adjunctive Testing

9.1 Fetal Scalp Stimulation

Acceleration of the fetal heart rate following fetal scalp stimulation indicates that the likelihood of a low scalp pH is 2% (Skupski, 2002). Nonetheless, randomised trials to support the utility of digital fetal scalp stimulation (DFSS) as an adjunctive test, or indeed as an alternative to CTG testing, are lacking.

Digital Fetal Scalp Stimulation Method:

With the woman lying in the left lateral position, to avoid aortocaval compression, the fetal scalp is stimulated digitally with the index finger over a period of 30 seconds. The CTG will be observed over a 5 to 10 minute interval after the FSS. The test is considered normal/ reassuring if a fetal heart rate acceleration (>15 bpm for 15 seconds) and/or an episode of good fetal heart rate variability (5-15 bpm) is observed.

! Digital scalp stimulation is best avoided during a deceleration, as the deceleration reflects a vagal response that prevents any sympathetic nerve response during scalp stimulation.

9.2 Fetal Scalp Blood Sampling

Continuous CTG monitoring with recourse to adjunctive testing in the event of non-reassuring fetal status:

There is no evidence that fetal blood sampling as an adjunct to CTG monitoring reduces the incidence of emergency Caesarean delivery, or influences the reduction in neonatal seizures associated with continuous CTG monitoring (Alfirevic *et al.* 2017). There is no evidence that the intrapartum caesarean delivery rate is greater in units where fetal blood sampling is unavailable (Alfirevic *et al.* 2017). There is no evidence for a role for fetal pulse oximetry, nor fetal ECG ST-segment analysis (STAN) in reducing neither perinatal morbidity nor operative deliveries (Bloom *et al.* 2017).

In units where the practice of fetal blood sampling is established, such testing may have a role in facilitating triage or prioritisation in cases of suspected fetal compromise. This benefit has not been proven in a clinical trial, but practitioners may wish to incorporate FBS results into the decision-making process surrounding timing/ mode of delivery. However, in recognition of the absence of evidence for a benefit to FBS in reducing perinatal morbidity or avoiding unnecessary Caesarean delivery, the availability of fetal blood sampling facilities in all units should not be considered a requirement for safe provision of intrapartum care. One area where FBS is undoubtedly useful is when in retrospect a normal pH has been obtained is when there has been a poor outcome following labour.

10 Documentation

CTGs should be labelled with the woman's name, hospital number, date and time of commencement. The maternal heart rate should be recorded and noted on CTG. Following birth, the midwife caring for the woman should sign and note the date, time and mode of delivery on the CTG. The CTG should be stored securely with the woman's notes. Tracer systems should be available for all CTGs if stored separately from the woman's notes.

Consider how this fetus is not just the CTG			
Determine Risk	Low Why?	High	Amniotic Fluid Maternal Pulse
Contractions	/10 Adequate resting tone	Oxytocin YES No Yes NO	Cycling present Yes NO Is the baseline appropriate for gestational age yes NO
	Normal	Suspicious	Pathological
Baseline RA	110-160bpm _____bpm	Lacking at least one characteristic of normality, but with no pathological features	< 100bpm Is the baseline rising YES no
Variability	5-25bpm		Reduced variability Increased variability Sinusoidal pattern
Accelerations	Present		Absence of accelerations in labour is of uncertain significance
Decelerations	No repetitive* decelerations		Repetitive* late or prolonged decelerations for > 30 min (or > 20 min if reduced variability). Deceleration > 5 min
Overall Interpretation	No hypoxia/acidosis	Low probability of hypoxia/acidosis	High probability of hypoxia/acidosis
*Decelerations are repetitive when associated with > 50% contractions.			
Management plan			
Signature _____ Print _____ Designation _____ Date _____ Time _____			

Table 2: DR C BRAVADO mnemonic

With thanks to Dr Kim Hinshaw, Consultant Obstetrician Gynaecologist at City Hospitals Sunderland, for the creation of the DR C BRAVADO mnemonic used in the above table.

Note: we appreciate hospitals/units using the MN-CMS cannot use stickers.

Example of stickers to support FHRM and vaginal examination.

Fresh Eyes Review the complete CTG How is this Fetus?				Date: _____ Time: _____
Are there any new risk factors?				Signature
Baseline ____ bpm	Variability ____ bpm	Accelerations	Decelerations	Print
Is cycling present?		Yes	No	Management plan
Is the baseline appropriate for gestational age?		Yes	No	
Is the baseline rising?		Yes	No	
Is the variability between 5-25 (normal)?		Yes	No	
Adequate resting tone		Yes	No	
More time spent during decelerations than at baseline		Yes	No	

Table 3: Fresh Eyes sticker for maternity hospitals and units without MN-CMS.

Vaginal Examination:	No.:	Time:	Date:
Indication:		Consent: <input type="checkbox"/>	
Abdominal Examination: Presentation: _____ Position: _____ 5 th Palpable: _____ FH: _____		Membranes: Intact <input type="checkbox"/> Ruptured <input type="checkbox"/> ARM <input type="checkbox"/>	
Cervix: Consistency _____ Length (cm) _____ Dilatation _____ Application _____ FH Post VE _____	Presentation: Cephalic <input type="checkbox"/> Breech <input type="checkbox"/> Position _____ Station _____ Caput _____ Moulding _____	Liquor: None <input type="checkbox"/> Clear <input type="checkbox"/> Blood stained <input type="checkbox"/> Light meconium <input type="checkbox"/> Thick meconium <input type="checkbox"/>	
Comments/plan:			
Name:	Printed Name:	Designation:	

Figure 2: Vaginal Examination Sticker, for maternity hospitals and units without MN-CMS

10.1 Review of adverse neonatal outcomes due to labour

The Reports listed on page 5 of this Guideline have highlighted that adverse outcomes of labour are frequently due to one or more of the following factors:

- 1) Non-recognition of an intrauterine growth restricted fetus
- 2) Overuse/misuse of oxytocin
- 3) Misinterpretation of an abnormal CTG trace
- 4) Failure to recognise equipment (i.e. monitor) malfunction
- 5) Failure to escalate concerns about abnormal tracings in a timely manner
- 6) Underestimating the impact of maternal pyrexia on adverse outcomes
- 7) Attempting instrumental delivery when inappropriate
- 8) Failure to monitor the fetus in early labour; due to either resource issues or a failure to diagnose labour
- 9) Lack of progress in labour
- 10) Failure to consider obstetric history

Sentinel events:

- 1) Cord prolapse
- 2) Shoulder dystocia
- 3) Uterine rupture
- 4) Placental abruption, e.g., haemorrhage, placental insufficiency, vasa praevia

The above themes that are commonly considered to contribute to an adverse perinatal outcome should be considered and explored in any risk-reduction strategy intended to minimise the incidence of birth injury.

11 Staff Education

All obstetrical and midwifery staff involved in labour ward care are required to undertake recent documented training, every two years that demonstrates a thorough understanding of these Guidelines and machine usage.

An addendum on staff education requirements will be issued following appropriate interaction with educational bodies. This will focus on the following:

- Intermittent Auscultation with Pinard and/or hand held Doppler
- Fetal Heart Rate Monitor Machine Usage
- Interpreting cardiotocography

12 References

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Appendices

- 1 Schedule of Intrapartum Fetal Monitoring Guideline Revision Group meetings

Schedule of Intrapartum Fetal Monitoring Guideline Revision Group meetings

	1	2	3	4	5	6	7	8	9
Meeting date	05/06/18	03/07/18	28/08/18	09/10/18	06/11/18	18/12/18	15/01/19	28/02/19	11/04/19
Dr Peter McKenna (Chair)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ms Angela Dunne	✓	✗	✓	✗	✓	✓	✓	✓	☎
Mr Kilian McGrane	✓	✓	✗	✗	✓	✓	✓	✗	✓
Mr James McGrath	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Gerry Burke	✓	✓	✓	✗	✓	☎	✓	✓	✓
Prof Fionnuala Breathnach	✓	✓	✓	✓	✓	✗	✓	✓	✓
Prof Declan Devane PhD	✗	✗	✓	☎	✗	✗	✗	☎	☎
Ms Brigid Doherty	Joined on 09/10/18			✓	✓	✓	✓	✓	✗
Ms Geraldine Gannon	✗	✓	✗	✗	✓	✓	✓	✗	✓
Ms Roisin Molloy	Joined on 06/11/18				✓	✓	✓	✗	✓
Ms Deirdre Naughton	✓	✓	✓	✓	✓	✓	✓	✗	✗
Ms Maureen Reviles	✓	✓	✗	✓	✗	✓	✓	✓	☎
Prof Valerie Smith PhD	✓	✓	✗	✗	☎	✗	✗	✗	☎
Dr Michael Turner	✗	✓	✓	✓	✗	✗	✗	✗	✗

The above table displays the attendees to each meeting held between June 2018 and April 2019.

Note: 1. Listed are the original members of the Intrapartum Fetal Monitoring Guideline Revision Group.



Dublin, 2019