Queensland Clinical Guidelines

Translating evidence into best clinical practice

Maternity and Neonatal **Clinical Guideline**

Intrapartum fetal surveillance (IFS)

Queensland Government

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Cultural acknowledgement

We acknowledge the Traditional Custodians of the land on which we work and pay our respect to the Aboriginal and Torres Strait Islander elders past, present and emerging.

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Flow Chart: Mode of fetal heart rate monitoring

Risk Factors

Antenatal

Fetal

- Abnormal antenatal CTG
- Abnormal doppler studies and/or bio-physical profile
- Suspected/confirmed FGR
- Multiple pregnancy
- Breech presentation
- Known fetal abnormality requiring monitoring
- Reduced fetal movements within week preceding labour

Maternal

- Oligohydramnios/polyhydramnios
- APH
- PROM ≥ 24 hours
- Gestation ≥ 42 weeks
- Previous caesarean section or uterine surgery
- Essential hypertension or preeclampsia
- Diabetes on medication or poorly controlled or fetal macrosomia
- Current/previous obstetric or medical conditions
- Morbid obesity (BMI ≥ 40 kg/m^2)
- Age ≥ 42 years
- Abnormal PaPP-A (<0.4 MoM)
- Vasa praevia

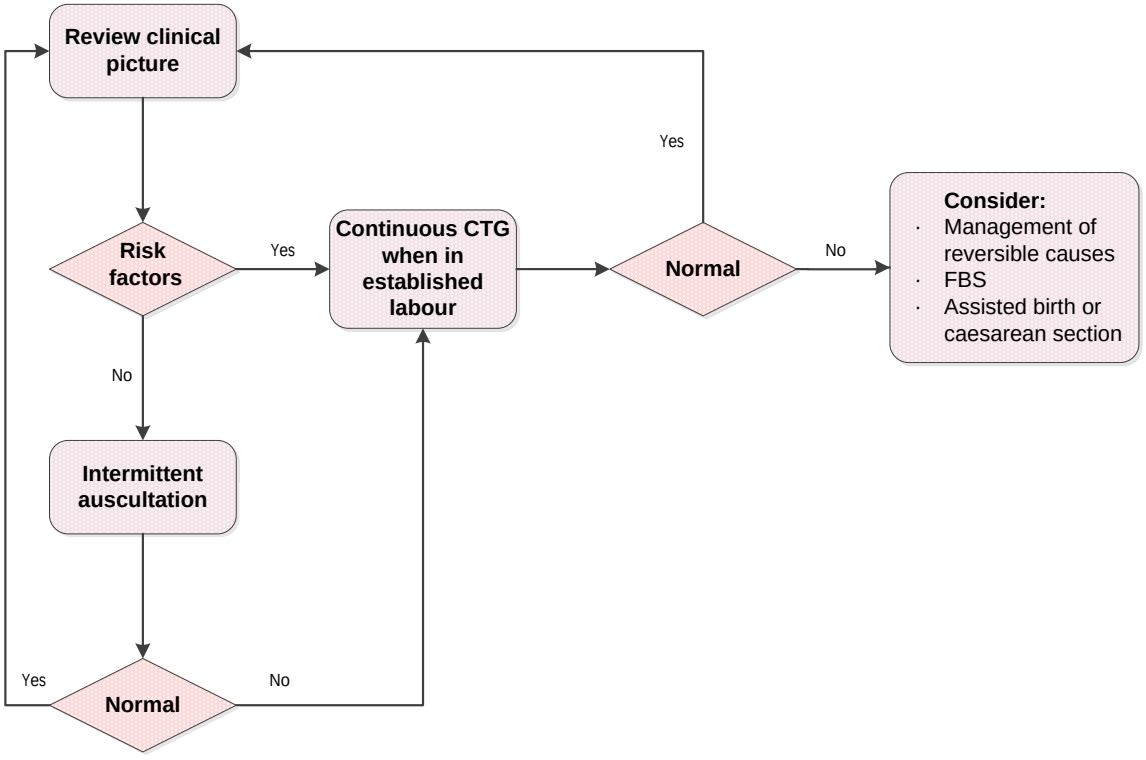
Intrapartum

- IOL with prostaglandin
- Abnormal auscultation or CTG
- Oxytocin induction/augmentation
- Post PV prostaglandins at onset of contractions
- Regional analgesia/paracervical block (obtain baseline trace prior to insertion)
- Abnormal PV bleeding
- Pyrexia T ≥ 38^{o}C
- Meconium or blood stained liquor
- Absent liquor following amniotomy
- Prolonged first stage of labour
- Prolonged 2nd stage where birth not imminent
- PTL < 37/40
- Uterine hyperstimulation/tachysystole

Other

Multiple (≥ 2 conditions)

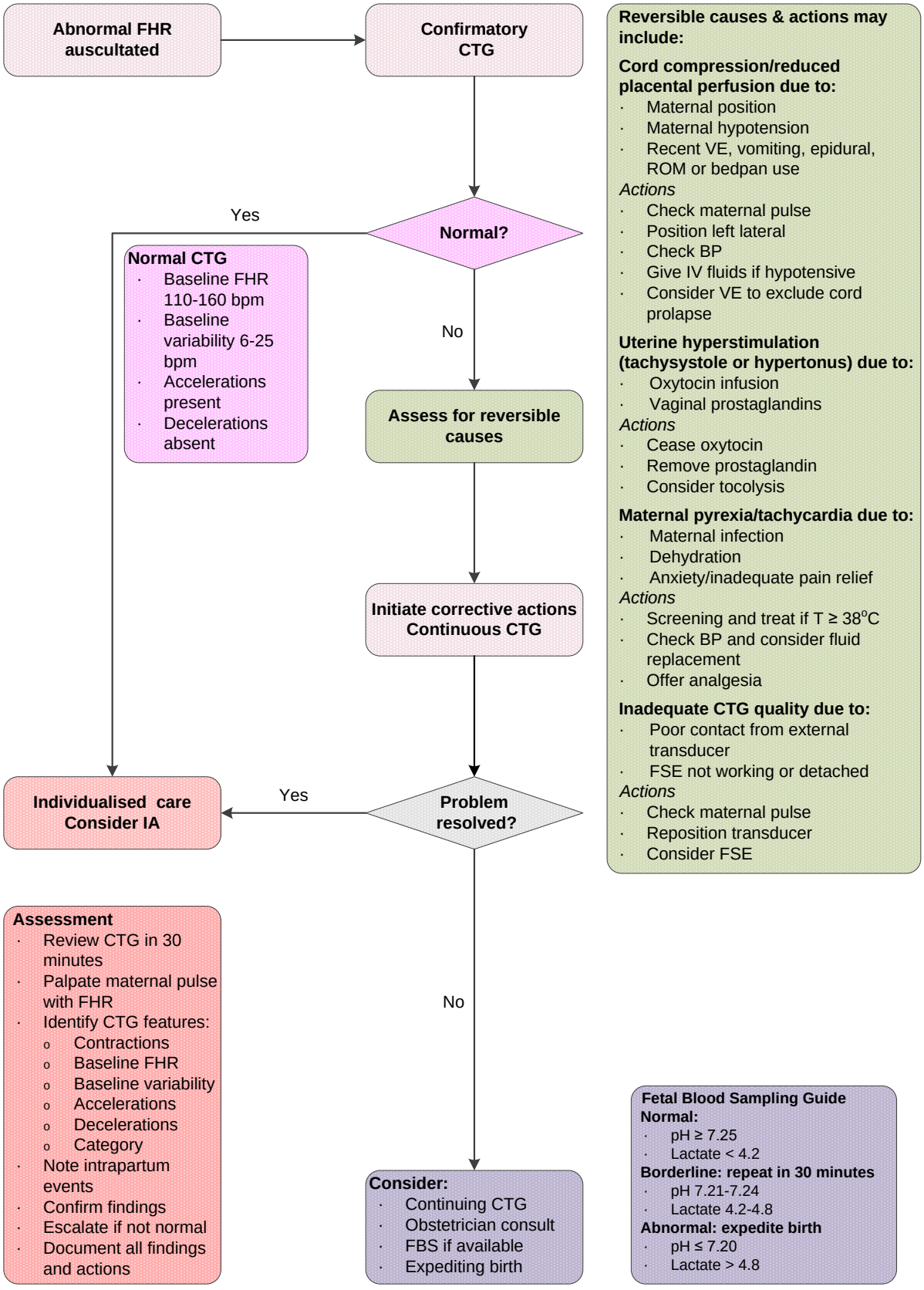
- Gestation 41+0 to 41+6 weeks
- Gestational hypertension
- GDM without complicating factors
- Obesity (BMI 30-40 kg/m^2)
- Age ≥ 40 and < 42 years
- Pyrexia T = 37.8 ^{o}C or 37.9 ^{o}C



APH antepartum haemorrhage, **BMI** body mass index, **CTG** cardiotocograph, **FBS** fetal blood sample, **FGR** fetal growth restriction, **GDM** gestational diabetes mellitus, **IOL** induction of labour, **MoM** multiples of median, **PaPP-A** pregnancy associated plasma protein-A, **PROM** premature rupture of membranes, **PTL** preterm labour, **PV** per vaginal, **T** temperature, **≥** greater than or equal to, **<** less than, **=** equal to; **ºC** degrees celsius

Flowchart: F19.15-1-V6-R24

Flow Chart: Abnormal fetal heart



IA intermittent auscultation, **BP** blood pressure, **bpm** beats per minute, **CTG** cardiotocograph, **FHR** fetal heart rate, **FSE** fetal scalp electrode, **FBS** fetal blood sampling, **IV** intravenous, **ROM** rupture of membranes, **T** temperature, **VE** vaginal examination, **≥** greater than or equal to, **≤** less than or equal to, **>** greater than, **<** less than, **ºC** degrees celsius

Flowchart: F19.15-2-V6-R24

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Abbreviations

BMI	Body mass index
bpm	Beats per minute
CEFM	Continuous electronic fetal monitoring
CS	Caesarean section
CTG	Cardiotocograph
FBS	Fetal blood sample/sampling
FGR	Fetal growth restriction
FHR	Fetal heart rate
FSE	Fetal scalp electrode
GTN	Glyceryl trinitrate
Hb	Haemoglobin
IA	Intermittent auscultation
IFS	Intrapartum fetal surveillance
IV	Intravenous
MoM	Multiples of Median
PaPP–A	Pregnancy associated plasma protein–A
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
UA	Umbilical artery
US	Ultrasound
USS	Ultrasound scan
UV	Umbilical vein
VE	Vaginal examination

Definitions

Early labour (latent first stage)	Irregular painful contractions which may be associated with a show, intact membranes or some cervical changes (not full effacement), and or less than 4–6 cm dilatation.[1,2]
Established labour (active first stage)	Regular painful contractions (which may be associated with a show, ruptured membranes or cervical changes (full effacement, 4–6 cm or more dilatation).[1,2]
Hypertonus (uterine)	Contractions longer than two minutes or contractions within 60 seconds of each other, without fetal heart rate abnormalities.[2]
Uterine tachysystole	More than five active labour contractions in 10 minutes without fetal heart rate abnormalities.[2]
Uterine hyperstimulation	Tachysystole or uterine hypertonus with fetal heart rate abnormalities.[2]

1 Introduction

The principal aim of intrapartum fetal surveillance is to prevent adverse perinatal outcomes arising from fetal metabolic acidosis related to labour.[2] As the fetal brain modulates the fetal heart rate (FHR) through an interplay of sympathetic and parasympathetic forces, fetal heart rate monitoring can be used as an indicator of whether or not a fetus is well oxygenated.[3]

In the absence of risk factors FHR surveillance by continuous electronic fetal monitoring (CEFM) does not provide proven benefit and may increase the intervention rate in a normal spontaneous labour lasting less than 12 hours in the active phase.[2,4,5] This guideline is congruent with and builds on the Intrapartum Fetal Surveillance Clinical Guideline published by the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG).[2]

1.1 Definition

The primary purpose of fetal surveillance is to attempt to prevent adverse fetal outcomes.[2] Fetal surveillance includes intermittent auscultation (IA) of fetal heart rate, cardiotocography (CTG) which measures fetal heart rate and uterine contractions and fetal blood sampling (FBS) for indications of metabolic acidosis (pH and or lactate).

1.2 Clinical practice standards

Refer to Queensland Clinical Guideline: *Standard care* for routine aspects of clinical care.[6]

Table 1. Clinical care

Aspect	Comment/consideration/recommendation/good practice point
Antenatal care	· Offer women information about intrapartum fetal surveillance (IFS) during the antenatal period[2] · Discuss the advantages and disadvantages of IFS as they pertain to the individual woman[2] · Encourage the woman to make decisions about the mode of FHR monitoring with her health care provider[2]
Intrapartum care	· The wellbeing and wishes of the woman are respected with regard to monitoring[7] · All women in active labour including when continuous electronic fetal monitoring (CEFM) is used receive one–to–one midwifery care[2,8,9] · Assess the maternal pulse with a contraction and simultaneously with FHR by IA or CEFM in order to differentiate between maternal and fetal heart rates[10] · If there is suspected fetal bradycardia or any other FHR anomaly in the second stage of labour, palpate the maternal pulse to differentiate between the two heart rates[10] · If fetal death is suspected despite the presence of an apparently recordable FHR, then fetal viability is confirmed with real–time ultrasound scan (USS) with colour flow doppler assessment where available o During CEFM: Review, interpret and escalate findings and document plan of action as per clinical circumstances including stage of labour [refer to Appendix A Interpretation of CTG] · Short infrequent interruptions are acceptable for personal care if the preceding monitoring is normal and there have not been any interventions that can be expected to alter the fetal heart (e.g. amniotomy, epidural insertion or top-up)[10] · Minimise disturbances to the woman (e.g. keep monitor volume low and do not restrict mobility and position or the use of water for pain relief[10]) · Continue FHR monitoring by IA during unavoidable interruptions (including transfer to operating room) when there is potential fetal vulnerability and recommence CEFM when feasible[10]

1.3 Service standards

Table 2. Facility responsibilities

Aspect	Good practice point
Clinician education	- Incorporate recognised intrapartum fetal surveillance training programs[2] so that clinicians: o Have an understanding of the relevant maternal and fetal pathophysiology and the available fetal surveillance options[2] o Are able to demonstrate competence in the interpretation of fetal surveillance options[2,8,9,11]
Systems	· Implement communication pathways for the escalation of concerns regarding fetal wellbeing · Ensure CTG interpretation is included in bedside handovers[12] o Refer to Table 8. Cardiotocography · Use tools (e.g. stamps or stickers) to assist with CTG interpretation and prompt escalation of abnormal traces[12] · Refer to Appendix A Interpretation of CTG o Using a *traffic light* system can assist effective interpretation of a CTG[13] · Undertake regular audit and action plans to respond to poor audit results[12]

2 Risk factors

Risk factors that increase the risk of fetal compromise require intrapartum CTG.

Table 3. Risk factors

Period	Conditions
Antenatal[2]	· Abnormal antenatal CTG · Abnormal doppler ultrasound (US) umbilical artery velocimetry · Suspected or confirmed fetal growth restriction (FGR) · Oligohydramnios or polyhydramnios · Prolonged pregnancy greater than or equal to 42 weeks · Multiple pregnancy · Breech presentation · Antepartum haemorrhage · Pre-labour rupture of membranes (PROM)—greater than or equal to 24 hours · Known fetal abnormality which requires monitoring · Uterine scar (e.g. previous caesarean section (CS)) · Essential hypertension or preeclampsia · Diabetes where medication (insulin or metformin) is indicated; or poorly controlled; or with fetal macrosomia) · Current or previous obstetric or medical conditions which may pose a risk of fetal compromise (e.g. cholestasis, isoimmunisation, substance abuse) · Fetal movements reduced within the week preceding labour · Morbid obesity—body mass index (BMI) greater than or equal to 40 kg/m^2 · Maternal age greater than or equal to 42 years · Abnormalities of maternal serum screening (i.e. low Pregnancy associated Plasma Protein–A (PaPP–A) less than 0.4 MoM) associated with an increased risk of poor perinatal outcomes (e.g. stillbirth, infant death, FGR, preterm birth and preeclampsia in a chromosomally normal fetus[14] · Vasa praevia
Intrapartum[2]	· Induction of labour with prostaglandin · Abnormal auscultation or CTG · Oxytocin induction/augmentation · Regional analgesia (epidural or spinal) and paracervical block · Abnormal vaginal bleeding in labour · Maternal pyrexia (greater than or equal to 38 ^{o}C) · Meconium or blood stained liquor · Absent liquor following amniotomy · Prolonged first or second stage of labour o Refer to Queensland Clinical Guideline: *Normal birth*[1] · Preterm labour greater than 28$^+$0 weeks and less than 37$^+$0 weeks[15] o Less than 24 weeks not recommended o 24–28 weeks clinical utility uncertain · Uterine hyperstimulation · Tachysystole

2.1 Other indications

Where two or more of the following antenatal or intrapartum indications are present in labour, CEFM is recommended[2] because of the synergistic effect on the woman:

- 41 to 41+6 weeks gestation
- Gestational hypertension
- Gestational diabetes mellitus (GDM) without complicating factors
- Obesity (BMI 30–40 kg/m2)
- Maternal age greater than or equal to 40 and less than 42 years
- Maternal pyrexia (temperature 37.8 ^{o}C or 37.9 ^{o}C)
- Prior to epidural block to establish baseline features[2]

3 Fetal heart rate monitoring

3.1 Indication

- Recommend to all women in labour that FHR monitoring occurs whether by CEFM or IA. The technique used must accurately measure the FHR in the individual woman[2]
- Routine admission CTG[16,17]:
  - Insufficient evidence to support the routine use for low risk women
  - Decided according to individual circumstances
  - May increase the CS rate
  - May identify a small number of previously unidentified at risk fetuses where CTG monitoring would not normally be indicated[2]

3.2 Mode of fetal heart rate monitoring

Table 4. Mode of monitoring in labour

Aspect		Consideration
Intermittent	**Auscultation**	· Use in women who, at the onset of labour are identified as having a low risk of developing fetal compromise[2]
	CTG	· May be used for women who have a low risk of developing fetal compromise where IA is difficult[2]
Continuous	**External CTG**	· Recommended for women where either risk factors or fetal compromise have been: o Identified antenatally o Detected at the onset of labour o Develop during labour[2] · Uses external Doppler US to monitor FHR and pressure transducers strapped to the abdomen to monitor uterine contractions[18] · Requires physical attachment to CTG machine if telemetry not available · Associated with high false positive results and inconsistent FHR tracing interpretations[5]
	Internal CTG– fetal scalp electrode (FSE)	· Recommended when: o Concerns with baseline variability o Difficulty: § Auscultating the fetal heart § Obtaining an adequate fetal heart rate tracing at any time in labour[2] § May be used on presenting twin if cephalic and membranes ruptured

3.3 Intermittent auscultation

Table 5. Principles of intermittent auscultation

Aspect	Good practice point
Indication	· Use in healthy women at low risk of complications
Context	· Doppler may be more reliable than a Pinard stethoscope[10,19] o Confirm fetal movement with mother[20]
Method	· Use either: o Doppler ultrasound (with speaker mode turned on)[2,12] o Pinard stethoscope (fetoscope)[20]
Auscultate and record fetal heart	· Evidence for frequency and duration of auscultation from randomised and non-randomised clinical trials not available · Consensus suggests: o Towards the end of a contraction and continue for least 30–60 seconds after the contraction has finished[2] o Every 15–30 minutes in the active phase of the first stage of labour [refer to Queensland Clinical Guideline: *Normal Birth*][2,21] o Towards the end of and after each contraction or at least every 5 minutes in the active second stage of labour[2] o If a fetal heart rate abnormality is suspected palpate the maternal pulse simultaneously to differentiate between the two[22]
Good practice points	· Differentiate between maternal pulse and FHR by[22] o Palpating maternal pulse simultaneously each time with FHR auscultation in labour during a contraction[8] o Document findings including when accelerations and decelerations are heard
Transition to continuous monitoring	· Need for labour augmentation with oxytocin · Development of intrapartum complications including[2,17]: o Meconium stained liquor o Abnormal bleeding during labour o Signs of infection: § Maternal pyrexia (greater than or equal to 38 °C on one occasion or 37.8°C or 37.9°C in the presence of other risk factors)[2] and/or § Maternal tachycardia–pulse greater than 120 bpm o Hypertension:[8] § Systolic greater than or equal to 160 mmHg or diastolic greater than or equal to 110 mmHg between contractions **or** § Systolic greater than or equal to 140 mmHg or diastolic greater than or equal to 90 mmHg on two consecutives readings taken 30 minutes apart between contractions o Hypertonus or tachysystole[8] o Confirmed delay in first or second stage of labour[8] o Refer to 2.1 Other indications · Abnormal FHR detected by IA including: o Baseline less than 110 bpm o Baseline greater than160 bpm o Any decelerations after a contraction · Refer also to Appendix B: Description of fetal heart rate patterns

3.4 Management during intermittent auscultation

Table 6. Management of abnormal fetal heart rate by intermittent auscultation

Aspect	Recommendations
Good practice points	· Re-assess FHR after implementing recommendations · Confirm FHR by CTG · If no abnormal features on CTG after 20 minutes consider return to IA
Tachycardia[8]	· Reposition to increase utero-placental perfusion or alleviate cord compression · Exclude fever, dehydration, drug effect or prematurity · Correct hypovolaemia
Bradycardia[8]	· Reposition woman to increase utero-placental perfusion or alleviate cord compression · Perform vaginal examination (VE) to: o Assess for cord prolapse/relieve cord compression o Assess stage and progress of labour · Correct hypovolaemia
Decelerations[8]	· Reposition · Assess for passage of meconium if membranes ruptured · Correct hypotension
Additional measures[8]	· Consider: o Transition to CEFM o Expediting birth[8]

3.5 Mode of continuous monitoring

Table 7. Modes of Cardiotocography

Aspect	Recommendations
External	· Uses external doppler US to monitor fetal heart rate and pressure transducers strapped to the abdomen to monitor uterine contractions[18] · Requires physical attachment to CTG machine · Associated with high false positive results and inconsistent FHR tracing interpretations[5]
Telemetry	· When available[23]: o Improves mobility o Aides analgesic positioning o May be used in water · May have increased artefact (e.g. maternal pulse/FHR confusion)
Internal fetal scalp electrode (FSE)	· May be used when external monitoring is unable to be used or when the signal quality is poor · Requires rupture of membranes, cervical dilation 2–3 cm and cephalic presentation · Requires relative certainty of fetal head position to avoid placement in fontanelles, eyes, sutures or other structures[24] · Contraindications–same as for FBS [refer to Table 14. Intrapartum fetal blood sampling] · Risks–same as for FBS [refer to Table 14. Intrapartum fetal blood sampling]

3.6 Management during cardiotocography

Table 8. Cardiotocography

Aspect	Good practice points
Good practice point	· Review CTG trace every 15–30 minutes depending on stage of labour o Refer to Queensland Clinical Guideline: *Normal birth*[1] · Use systematic method for interpretation and intervention including: o Contractions o Baseline, baseline variability, accelerations, decelerations o Other findings and relevant information o Category of trace o Plan of action · Differentiate between maternal pulse and FHR by: o Assessing maternal pulse simultaneously with FHR when CEFM applied and every 30 minutes in labour during a contraction[8]
Machine settings	· Ensure: o Paper speed of 1 cm per minute o Validated date and time settings · Note: Machines from different manufacturers use different vertical axis scales and this can change the perception of FHR variability[2]
CTG labelling and documentation[2,12]	· Include: o Woman's name o Hospital record number o Date and time of commencement o Maternal observations including heart rate o Contemporaneous noting of any intrapartum events that may affect the FHR (e.g. VE, obtaining FBS, insertion/top-up of an epidural anaesthetic) o Interpretation of trace o Date, time and signatures
Communication	· Keep woman informed of CTG findings · Include CTG interpretation in bedside handover between clinicians[12]
CTG storage of thermal paper images (when electronic storage not available)	· Keep the original in a labelled envelope with the medical record · Include a photocopy when: o There has been significant morbidity for the baby related to labour o Neonatal death or intrapartum stillbirth o Apgar score less than or equal to 5 after 5 minutes o Vaginal birth requiring active resuscitation of neonate, including intermittent positive pressure ventilation by bag and mask or intubation and or cardiac massage (i.e. more than suction) o Category 1 CS

3.6.1 Special considerations

Table 9. Multiple pregnancy and preterm labour

Aspect	Consideration
Multiple pregnancy	· Use twin/triplet CTG machine (where available) or separate machines for each fetus · Identify and confirm each FHR by assessing and documenting each fetal position[25] and ensuring cables for each fetus are correctly identified · Confirm each fetus is being recorded separately according to local protocols · Monitor presenting fetus by external doppler US or FSE if membranes ruptured and second by external doppler ultrasound · Confirm maternal heart simultaneously with both fetal hearts during a contraction[8]
Preterm labour	· Preterm fetus: o Physiological control of FHR and resultant CTG trace interpretation differs compared with the term baby, especially at gestations less than 28 weeks[26] o Has lower reserves o Has reduced ability to withstand persistent intrapartum insults o Requires early identification and management of hypoxia[26] · CEFM[26]: o Not recommended at less than 24 weeks gestation o May have more accelerations and decelerations and higher baseline variability[27] o Clinical utility uncertain between 24 weeks and 28 weeks gestation o Absence of high variability or accelerations not abnormal[28] o Has poor positive predictive value[26] o Variation to interpretation can lead to unnecessary intervention[26] o Recommended in labour after 28 weeks · Interpretation: o Refer to Table 11. Description of normal FHR o Requires expert clinician input o Refer to Queensland Clinical Guideline: *Preterm labour and birth*[15] and Queensland Clinical Guideline: *Perinatal care at the threshold of viability*[29]

4 Cardiotocograph

4.1 Features in labour

Table 10. Features of CTG

Aspect	Consideration
Physiology[30]	· FHR pattern, level of activity, and degree of muscular tone are all sensitive to hypoxemia and acidemia · FHR is normally controlled by the central nervous system and mediated by sympathetic or parasympathetic nerve impulses originating in the fetal brainstem · Presence of intermittent FHR accelerations associated with fetal movement is believed to be an indicator of adequate oxygenation sufficient to maintain normal fetal autonomic nervous system function · Factors including prematurity, fetal sleep-wake cycle, maternal medications, and fetal central nervous system abnormalities can also impact biophysical parameters
Characteristics of maternal heart rate	· Baseline maternal heart rate significantly lower than baseline FHR · Maternal 'accelerations': o Uniform and rounded off o Increase in rate occur at beginning of contraction or pushing effort · Fetal accelerations: o Differ in duration o Have irregular shape o Are asymmetric o Occur at variable intervals

4.2 Normal CTG

Table 11. Description of normal FHR

Aspect		Consideration
Baseline FHR[2]		· Resting heart rate not a sleeping rate · Assessed in the absence of fetal movement, accelerations, uterine activity and decelerations · Determined over a time period of 5 or 10 minutes and expressed as beats per minute (bpm) · More likely to be at the upper limits of normal in a very premature fetus and at the lower limits in a mature or post mature fetus
Baseline variability[2]		· Minor fluctuations in FHR · Normal baseline variability shows cyclical fluctuations of 6–25 bpm · Assessed by estimating the difference in bpm between the highest peak and the lowest trough of fluctuation in one minute segments of the CTG trace · Represents an adequately oxygenated fetal central nervous system
Accelerations[2]		· Transient increases in the FHR of 15 bpm or more above the baseline rate, lasting 15 seconds or more, at the baseline · Are a fetal response to stimulation · Commonly occur as a result of fetal movement · May be of lesser amplitude and shorter duration in a premature fetus than a mature fetus · Significance of no accelerations on an otherwise normal intrapartum CTG is unclear and may be related to the fetus moving less
Normal intrapartum	**Term[1]**	· Baseline FHR of 110–160 bpm · Normal baseline variability present · Accelerations may or may not be present · No decelerations
	Preterm[26]	· Baseline fetal heart at 20–24 weeks averages 155 bpm decreasing with advancing gestational age · Baseline rate will be around the upper limits of normal o Tachycardia reduces with gestational age · Baseline variability may be reduced due to tachycardia in preterm fetus · Accelerations frequency and amplitude reduced before 30 weeks gestation and increase with advancing gestation · Decelerations (variable) occur more commonly than in term fetus

4.3 Fetal compromise

Table 12. Compromised fetus

Aspect	Consideration
Abnormal FHR patterns[2]	· Refer Appendix B: Description of fetal heart rate patterns · Fetus may be under-perfused · May be due to reversible causes o Refer to Table 13. Reversible causes of abnormal CTG · Signs of fetal compromise may include: o Reduction in fetal movements o Passage of meconium into the amniotic fluid especially in the presence of FHR abnormalities[31,32]
Identification[2]	· Review clinical picture[2]: o Understand the total clinical picture including the indication for monitoring o Consider progress of labour with regard to parity o Review the clinical history including previous births and investigations · Consider any medications including: o Intravenous infusions o Prescription drugs o Over the counter o Complementary therapies o Illicit drugs · Review the trace prior to (including antenatal period) and following the abnormality as this is informative in terms of fetal well being
Interventions	· Identify and review and where required escalate findings of CTG trace[2,9]with reference to Appendix A Interpretation of CTG · Document as per Table 8. Cardiotocography · Identify reversible causes and initiate potential corrective actions based on the possible contributing factors to the abnormal CTG [refer to Table 13.] o Identification and management of reversible FHR abnormalities may prevent unnecessary interventions[2,9] · Consider further fetal evaluation when CTG features suggestive of: o Likely fetal compromise o Fetal compromise and abnormality persisting after correcting reversible causes · Fetal blood sampling (FBS) if in first stage or early second stage (i.e. vaginal birth not imminent[2]) o Refer to Table 14. Intrapartum fetal blood sampling · Expedite birth[2] by instrument or CS where: o FBS unavailable[2] o CTG indicates: § Further assessment required and FBS contraindicated § Clinically inappropriate (e.g. prolonged bradycardia less than 100 bpm for greater than 5 minutes)

4.4 Management of reversible causes of abnormal CTG

Table 13. Reversible causes of abnormal CTG

Possible cause of abnormal CTG	Potential contributing factors	Possible corrective actions
Cord compression or reduced placental perfusion	· Maternal position · Maternal hypotension · Vaginal examination · Bedpan use · Vomiting or vasovagal episode · Epidural siting or top up · Rupture of membranes	· Advise maternal position change (encourage adoption of left lateral position)[3] · If hypotensive: give crystalloid 500 mL IV (maximum 1000 mL)[3,8] · Consider VE to exclude cord prolapse or presentation[3]
Uterine hyperstimulation (tachysystole or hypertonus)	· Oxytocin infusion · Recent vaginal prostaglandins insertion	· Stop oxytocin infusion[3] while reassessing labour and fetal state · Remove prostaglandins (PGE_2) o Refer to Queensland Clinical Guideline: *Induction of labour*[33] · Terbutaline 250 micrograms subcutaneously or intravenously (IV)[2,3] · Sublingual glyceryl trinitrate* (GTN) spray 400 micrograms[2] · Salbutamol 100 micrograms IV[2]
Maternal tachycardia/ pyrexia	· Maternal infection · Dehydration · Anxiety/pain may cause tachycardia without pyrexia	· If temperature greater than 38^{o}C undertake screening and treatment · If dehydrated: give crystalloid 500 mL IV[3]
Inadequate quality of CTG	· Poor contact from external transducer · FSE not working or detached	· Check maternal pulse · Reposition external transducer/FSE · Consider applying FSE[34]

*Not currently listed on the Queensland Health List of Approved Medications (LAM)

5 Intrapartum fetal blood sampling

Table 14. Intrapartum fetal blood sampling

Aspect	Considerations
Context	· Facilities using CEFM are encouraged to have access to FBS facilities[2] to improve definitive diagnosis of fetal compromise · Where available, FBS is undertaken in the presence of a FHR trace which remains abnormal despite appropriate corrective actions · Scalp sampling aims to provide: o Additional physiological information to that implicit in the CTG o Information that will confirm the suspicion of fetal compromise or provide the reassurance necessary to allow labour to continue · FBS may reduce the CS rate
Indications	· Abnormal CTG in first or second stage of labour[2,3]
Contraindications	· Not generally recommended for pregnancies less than 34 weeks[2,8] · CTG suggestive of serious sustained fetal compromise (e.g. prolonged bradycardia greater than 5 minutes)[2] · Fetal bleeding disorders (e.g. suspected fetal thrombocytopenia, haemophilia) · Breech, face or brow presentation · Maternal infection (e.g. HIV, hepatitis B, hepatitis C, herpes simplex virus and intrauterine sepsis)[2,35] o Group B *Streptococcus* carrier does not preclude FBS[2]
Risks	· Eyelid laceration · Neonatal scalp abscess and ulceration · Neonatal subarachnoid penetration
Sample collection	· Cervix must be adequately dilated (greater than 4 cm) and membranes ruptured · Woman positioned: o Left lateral position[36], or lithotomy with a wedge in place to avoid inferior vena cava syndrome or supine hypotension syndrome[2]
Management	· FBS is interpreted taking into account[2]: o Any previous FBS value o Rate of progress in labour o Other clinical circumstances · Repeat in 30 minutes if the FHR trace remains abnormal despite a normal FBS result · If stable FBS after second test (lactate or pH remains unchanged)— o Further testing may be deferred unless additional abnormal features are seen[2]

5.1 Interpretation of fetal blood sampling results

Table 15. Intrapartum fetal blood sampling results

Interpretation[2,35]	pH (units)	Lactate (mmol/L)
Normal	Greater than or equal to 7.25	Less than 4.2
Borderline: Repeat in 30 mins	7.21 to 7.24	4.2 to 4.8
Abnormal: Birth expedited	7.20 to 7.14	Greater than 4.8

5.1.1 Special considerations for fetal scalp lactate measurements

- Use of scalp lactate rather than pH measurement provides an easier and more affordable adjunct to CEFM for some units[2]
- Is as effective as scalp pH in predicting fetal outcomes[37]
- Has a strong negative predictive value for fetal acidemia at birth[38]
- Requires local decision making to set absolute parameters for interpretation of lactate values as results may vary between machines[2,39]
  Requires due diligence with regard to calibration of machine and transcription of results[40]

6 Paired umbilical cord blood gas or lactate analysis

Table 16. Paired umbilical cord sampling

Aspect	Consideration
Context	· Collection and analysis of paired cord blood samples allows the detection of respiratory and metabolic acidosis if present at birth[17,41,42] · Umbilical artery (UA) blood: o Provides most accurate information regarding fetal and newborn acid-base[3] o Is a tool for quality control of obstetric care[43] · Umbilical venous blood reflects maternal acid-base status and placental function · Involves sampling both[41]: o UA—smaller lumen, thicker wall and contains less blood **and** o Umbilical vein (UV)[41] · Deferred sampling with or without cord clamping is possible[2,43] · Studies inconsistent regarding timing of sampling with or without clamping and cord blood gas results[43-47] · Procedure as per local practice within 30 minutes of birth
Indications[2,3,8,41,48]	· Preterm gestation · Multiple pregnancy · Intrapartum fever (temperature greater than or equal to 38 ^{o}C) · Meconium stained liquor · Breech birth · Shoulder dystocia · Fetal scalp sampling performed in labour · Operative birth for suspected fetal compromise · Small for gestational age baby/FGR · Intrapartum haemorrhage · Abnormal CTG · Neonatal resuscitation required or Apgar score: o Less than 4 at one minute o Less than 7 at five minutes · All emergency CS · Severe growth restriction · Other at clinician discretion
Interpretation	· Confirm one venous and one arterial sample · Arterial pH will be less than venous pH (at least 0.022 units) · Arterial pCO_2 will be greater than venous pCO_2 (at least 5.3 mmHg) · Cord blood gas values may vary according to: o Gestation o Type of birth o Time after birth[2,43] o Prior pH and lactate[46] · Delayed cord clamping occurring when pulsations have ceased spontaneously, has significant effect on acid-base parameters in arterial and venous blood in vigorous newborns including[47]: o Umbilical cord blood gases o Bicarbonate (HCO_3) o Base excess (BE) o Lactate · UA and UV lactate levels may be higher from intrapartum scalp lactate levels following vaginal birth because of lactic acid accumulation · Lactate levels are directly associated with gestation and length of second stage of labour · Arterial lactate levels up to 7.5 mmol/L can be normal · Arterial lactate should be 0.6 mmol/L greater than the venous level

6.1 Management and use of cord blood results

- Sampling should not interfere with management of the third stage of labour when undertaken as part of a clinical audit regimen[2]
- Resuscitate the baby as per Queensland Clinical Guideline: *Neonatal Resuscitation*[49]
- Universal umbilical cord blood gas analysis independent of obstetric intervention is associated with a reduction in:
  - Incidence of acidaemia
  - Incidence of lactic acidaemia at birth
  - Neonatal nursery admissions[50,51]

6.1.1 Normal cord blood values

Table 17. Normal cord blood gas and lactate (at birth)

At term[52]	pH	Base Excess (mmol/L)	pO_2 (mmHg)	pCO_2 (mmHg)	Lactate (mmol/L)
UA	7.10 to 7.38	-9.0 to 1.8	4.1 to 31.7	39.1 to 73	Less than 6.1
UV	7.22 to 7.44	-7.7 to 1.9	30.4 to 57.2	14.1 to 43.3	

7 Other methods of fetal monitoring

There is currently insufficient evidence to recommend fetal surveillance during labour by:

- Fetal electrocardiogram including ST analysis[2,8,53-55]
- Fetal pulse oximetry[3,8,54,56,57]
- Near infrared spectroscopy[58]
- Intrauterine pressure catheters (IUPC)[2]
  - May be considered for use on obese women where palpation of contractions is difficult

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Appendix A Interpretation of CTG

<table>
<tr><th colspan="3">Classification</th><th>Baseline</th><th>Variability</th><th>Decelerations</th><th>Accelerations</th><th>Actions</th></tr>
<tr><td rowspan="4">Normal
Abnormal[3,4]</td><td>Low probability
fetal compromise</td><td>GREEN</td><td>110–160 bpm</td><td>6–25 bpm</td><td>Nil</td><td>15 bpm[1]
for
15 seconds</td><td>Nil</td></tr>
<tr><td>Unlikely
fetal compromise</td><td>BLUE</td><td>100–109 bpm</td><td></td><td>Early
or
Variable</td><td>Absent[1]</td><td>Continue CTG</td></tr>
<tr><td>May be
fetal compromise</td><td>YELLOW</td><td>> 160 bpm
or
Rising</td><td>3–5 bpm
for
> 30 minutes</td><td>Complicated variable[2]
or
Late</td><td></td><td>Correct reversible causes</td></tr>
<tr><td rowspan="2">Likely
fetal compromise</td><td rowspan="2">RED</td><td colspan="3">≥ 2 YELLOW features = RED</td><td rowspan="2"></td><td>Persistent YELLOW = RED</td></tr>
<tr><td>< 100 bpm
for
> 5 minutes</td><td>< 3 bpm
for
> 30 minutes
or
Sinusoidal</td><td></td><td>FBS
or
Expedite birth</td></tr>
</table>

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NOTES:

1. Significance of accelerations/no accelerations in an otherwise normal CTG is unclear
2. Complicated variable features[2]:
   - Slow return to baseline FHR after the end of the contraction
   - Large amplitude (> 60 bpm) and/or long duration (> 60 seconds)
   - Presence of post deceleration smooth overshoots
3. All abnormal CTGs require further evaluation and management considering:
   - Full clinical picture
   - Identification of reversible causes
   - Initiation of appropriate action including FBS and expediting birth if abnormality persist
4. Follow local escalation procedures to senior midwifery and obstetric staff when CTG is abnormal

bpm beats per minute; **>** greater than; **≥** greater than or equal to; **<** less than; **CTG** cardiotocograph; **FBS** fetal blood sample; **FHR** fetal heart rate

Flowchart: Flowchart: F20.15-2-V5-R25

Appendix B: Description of fetal heart rate patterns

Terms	Definition and description	Possible causes
Baseline fetal heart rate	· Mean level of the FHR[2] · Determined over a time period of 5 or 10 minutes and expressed as beats per minute (bpm) · Assessed in the absence of fetal movement (accelerations), uterine activity and decelerations · Resting heart rate not sleeping heart rate	· A trend to a progressive rise in the baseline is important as well as the absolute values · Heart rate may rise slightly and baseline variability may be reduced (or occasionally absent) in a sleeping fetus[2]
Normal baseline fetal heart rate	· FHR 110-160 bpm	· Premature fetus–baseline rate will be around the upper limits of this range · Mature or post mature fetus–baseline rate around the lower limits of the normal range · Baseline fetal heart rate within normal range does not imply intrinsically well fetus · Features around a baseline, in particular baseline variability, and also accelerations define fetal wellbeing[2]
Baseline bradycardia	· FHR less than 110 bpm	· Low inherent rate (e.g. mature fetus) · Maternal hypotension · Prolonged cord compression · Drugs (e.g. high dose beta blockers) · Conduction defects or heart block in the fetus · Profound fetal hypoxia due to: · Prolonged cord depression · Maternal hypotension · Hypoxia · Acute utero-placental insufficiency due to placental abruption or uterine hyperstimulation[2]
Baseline tachycardia	· FHR greater than 160 bpm	· Maternal fever/infection · Fetal infection i.e. chorioamnionitis · Medications (e.g. salbutamol or terbutaline) · Maternal medical disorders[59] · Fetal tachyarrhythmia (e.g. supraventricular tachycardia) · Very premature fetus[2]

Terms	Definition and description	Possible causes
Baseline variability	· Minor fluctuations in baseline FHR · Assessed by estimating the difference in bpm between the highest peak and the lowest trough of fluctuation in one minute segments of the CTG trace	· Physiological response · Most important feature of the CTG in terms of fetal wellbeing[2]
Normal baseline variability	· 6–25 bpm between contractions	· Normal physiological response · Low probability of fetal compromise
Reduced baseline variability	· 3–5 bpm* for greater than 30 minutes *Exercise caution when interpreting with an external transducer[2]	· Deep fetal sleep[2] · Drugs/medication · Maternal opioid administration · Other medications (e.g. magnesium sulphate[59]) · May be associated with significant fetal compromise and require further action[2]
Absent baseline variability	· Less than 3 bpm	· Likely to be associated with significant fetal compromise · Require immediate assessment and management · May require urgent birth
Increased baseline variability	· Variability greater than 25 bpm	· May be caused by acute hypoxia or mechanical compression of the umbilical cord · Interpreted with reference to entire clinical picture[60]
Sinusoidal	· Oscillating pattern—smooth and regular resembling sine wave · Smooth undulating persistent pattern · Relatively fixed period of 2–5 cycles per minute and amplitude of 5–15 bpm above and below the baseline · Baseline variability absent · No accelerations[2]	· Severe anaemia–haemoglobin less than 50 gm/L[2] · Reduced fetal movements may be present
Pseudo–sinusoidal	· False sinusoidal pattern · Not as smooth or regular · Has some period of normal baseline variability and accelerations[2]	· Fetal thumb sucking[2]
Accelerations	· Transient increases in FHR of 15 bpm or more above the baseline and lasting 15 seconds · May be of lesser amplitude and shorter duration in the preterm fetus	· Low probability of fetal compromise[2]
No accelerations	· FHR does not rise above the baseline	· Significance in an otherwise normal CTG is unclear[2]

Terms	Definition and description	Possible causes
Decelerations	· Transient episodes of: o Decrease in FHR of more than 15 bpm below the baseline o Lasting 15 seconds or more	· Dependent on the variant[2]
Early decelerations	· Uniform repetitive decrease of FHR · Slow onset early in the contraction · Slow return to baseline by the end of the contraction · Often associated with reduced or absent baseline variability	· Head compression resulting in mild increase in intracranial compression[2] · Typically occur in sleep phase · Reflect a well oxygenated fetus
Variable decelerations	· Repetitive or intermittent decreasing of FHR · Relative to uterine activity vary in: o Depth o Duration o Timing · Typically, rapid descent and rapid recovery	· Cord compression during contraction · Significance depends on: o Overall clinical picture o Specific features of the decelerations themselves o Other features of the CTG[2]
Complicated variable decelerations	· Slow return to baseline FHR after the end of the contraction · Large amplitude (> 60 bpm) and/or long duration (> 60 seconds) · Presence of post deceleration smooth overshoots[2]	· Cord compression resulting in hypoxia with depth reflecting degree of hypoxia · During a contraction · Breadth reflects length of cord compression and not necessarily fetal condition[2]
Late decelerations	· Uniform and repetitive decreasing of FHR · Usually slow onset from mid to end of the contraction · Nadir more than 20 seconds after the peak of the contraction · Ends after the contraction · Includes decelerations less than 15 bpm when non-accelerative trace with baseline variability less than 5 bpm	· Transient or chronic utero-placental insufficiency (acute or chronic hypoxia) including[2] o Uterine contractions o Maternal hypotension from epidural o Uterine tachysystole o Maternal hypoxia · Cord compression[2]
Prolonged decelerations[2]	· Decrease of FHR below the baseline for longer than 90 seconds but less than 5 minutes	· Prolonged contractions · Uterine tachysystole · Supine hypotension · Post-epidural insertion · Vaginal examination · Placental abruption · Ruptured uterus
Prolonged fetal bradycardia	· Decrease of FHR below the baseline for longer than 5 minutes	· Supine hypotension · Hypotension caused by epidural or spinal anaesthesia[2,59]

Term	Definition and description	Possible causes
Pre- and post-deceleration shouldering	· The FHR pushes above, before returning, to the baseline[2,59] · Reflects well oxygenated fetus	· Normal physiological response to acute hypoxia and possibly hypertension and hypotension · Generated by sequential cord compression · Loss of pre and post deceleration shouldering—may reflect a fetus no longer responding appropriately to physiological insults[2]
Smooth post deceleration overshoots	· Temporary smooth rise in the FHR beyond the baseline rate · FHR returns to baseline after the oxygen deficit has been corrected · Associated rising baseline or baseline tachycardia, and reducing baseline variability if uterine activity consistent and fetal oxygen requirements unchanged	· Cord compression resulting in response to reduced oxygenation in the fetus[2]
Fetal arrhythmia	· Uncommon	· Aetiology may be complex, or benign irregularly irregular, making CTG machine interpretation difficult[2]

bpm: beats per minute, **CTG:** cardiotocograph, **FHR:** fetal heart rate, > greater than

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