

AWHONN MN Section Webinar – Decoding the Fetal Monitor Tracing

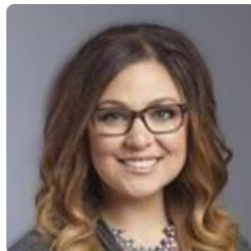
A Guide to Strip Interpretation

Rhianna Britton, MS, RNC-OB, C-EFM, NPD-BC

Nanette Vogel, MS, RNC-OB, C-EFM, NPD-BC



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Left: **Rhianna Britton**, MSN, RNC-OB, C-EFM, NPD-BC
Professional Development Specialist- Nursing, Perinatal Services, M Health Fairview

Right: **Nanette Vogel**, MS, RNC-OB, C-EFM, NPD-BC, FAWHONN
Professional Development Specialist- Nursing, Perinatal Services, M Health Fairview



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Disclosures

- No relevant financial relationship was identified with ineligible companies for anyone with the ability to control content of this activity.
- 1.75 contact hours will be provided with participation in this activity and completion of the evaluation.



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Learning Objectives

As a result of this course, the learner will be able to:

- Analyze complex fetal heart rate patterns using standardized terminology, understand the pathophysiology, and implement corrective measures.
- Explain fetal acid-base balance, the oxygen pathway and its impact on the fetal heart rate tracing.
- Discuss effective communication and escalation of concerns regarding the fetal monitor tracing.



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Purpose

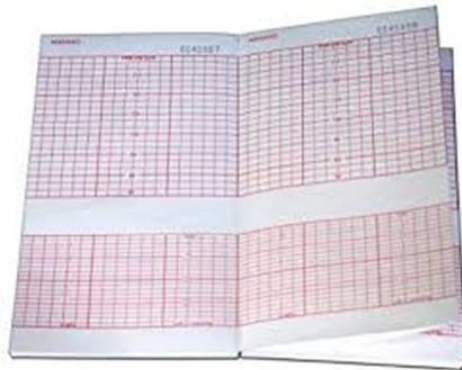
The purpose of this class is to equip healthcare professionals with the knowledge and skills necessary to accurately interpret fetal heart monitoring (FHM) strips using NICHD terminology. Participants will learn how to assess fetal acid-base status through FHM tracings, recognize signs of fetal intolerance, and implement effective communication and timely escalation of concerns to ensure optimal patient outcomes in labor and delivery.



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NICHD Review



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Standardizing EFM for clinicians

- ✓ • **What do I call it?**
Standardized terminology: NICHD definitions and the 3 NICHD categories
- ✓ • **What does it mean?**
Standardized interpretation using the O2 pathway and differentials
- ✓ • **What should we do about it?**
Standardized management using a simple series of questions and evaluating the risk of developing fetal metabolic acidemia versus safely obtaining a vaginal delivery



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Category Definitions

Category 1 (Normal)

Includes *all* the following:

- Baseline rate 110-160 bpm
- Accelerations present or absent
- Moderate variability
- No late decelerations
- No variable decelerations
- No prolonged decelerations
- Early decelerations may be present

**Predicts normal acid-base status

Category III (Abnormal)

Includes *at least* one of the following:

- Absent variability with:
 - recurrent late decelerations
 - recurrent variable decelerations
 - bradycardia for at least 10 minutes
- Sinusoidal pattern for at least 20 minutes

**Predicts abnormal acid-base status

***Only 4 possible tracings are Category III



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Three-Tier Fetal Heart Rate Interpretation System Obstet Gynecol 2008;112:665

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Category II (indeterminate)

- Includes ALL tracings not categorized as Category I or Category III
- Category II tracings are indeterminate:
 - Not predictive of abnormal fetal acid-base status
 - Not enough evidence to classify as I or III
- Warrant evaluation, surveillance and reevaluations
 - This does not mean “no action”



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Let's do some Level Setting (True/False)

- If the FHR tracing has moderate variability, I can rule out the presence fetal metabolic acidemia (FMA) at the time of observation.
- If accelerations are present, I can rule out the presence of Fetal Metabolic Acidemia at the time of observation.
- I must have both moderate variability and accelerations to rule out FMA.
- Category I FHR tracings are predictive of normal fetal acid-base status.
- Category III FHRs confirm the presence of FMA.



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Baseline

Use the time without any accels or decels to establish a baseline



- Normal baseline is 110-160 bpm
- It is documented as a single number and is the mean fetal heart rate rounded to increments of 5 bpm in a 10-minute segment
- Need at least 2 minutes (not necessarily contiguous) or the baseline for that period is considered indeterminate.
- **May occur and be interpreted during a contraction.**
- Excludes accelerations, decelerations and periods of marked variability.

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Variability

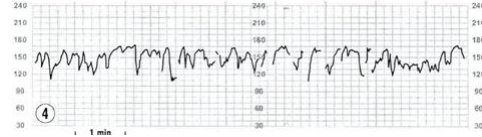
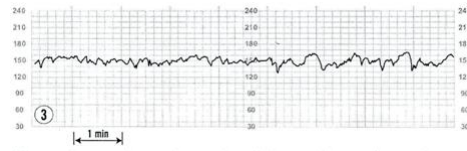
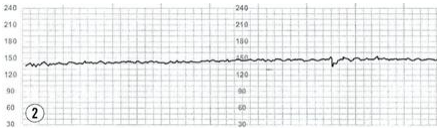
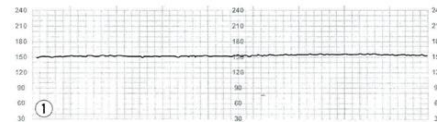
- Defined as fluctuations in the baseline that are irregular in amplitude and frequency
- Interplay of the sympathetic and parasympathetic nervous system
- Variability CAN be assessed with an external monitor
- **The presence of moderate FHR variability reliably predicts the absence of fetal metabolic acidemia at the time it is observed**

Macones et al. (2008)

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Variability examples

- Absent: undetectable
- Minimal: detectable but less than or equal to 5 bpm
- Moderate: range from 6-25 bpm
- Marked > 25 beats/min



Macones et al. (2008)



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Alterations in Fetal Variability

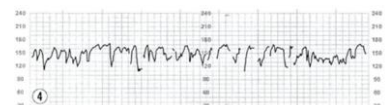
Minimal

- **Sleep** - Fetal sleep cycle
- **Sedation** - Nonhypoxic central nervous system depression
 - Maternal medication (Magnesium sulfate, opioids)
 - Substance use, SSIs
- **Sick** - Hypoxia/hypoxemia
- Prematurity



Marked

- Etiology unclear
 - Acute hypoxemia or hypoxia
 - Prolonged pregnancy
 - Ephedrine
 - Decreased uteroplacental perfusion
 - Umbilical cord compression



Macones et al. (2008) 14

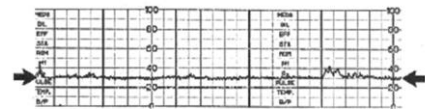
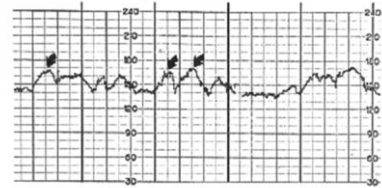


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Accelerations

- Visually apparent abrupt increase from FHR baseline
- Term (32 weeks or more):
 - Onset to peak < 30 seconds; acme \geq 15 bpm
 - Duration \geq 15 seconds < 2 minutes
- Preterm:
 - Onset to peak < 30 seconds; acme \geq 10 bpm
 - Duration \geq 10 seconds
- Prolonged acceleration duration \geq 2 minutes < 10 minutes
- Accelerations indicate the absence of fetal metabolic acidemia at the time of observation



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Macones et al. (2008) 15

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Early Decelerations

Visually apparent gradual decrease and return to FHR baseline associated with uterine contraction

Onset to nadir \geq 30 seconds

Nadir occurs at peak of contraction

Macones et al. (2008)

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Why is this Deceleration Happening?

Early Deceleration

Cord Compression

Head Compression

Placenta/Uterus
(or above the uterus)

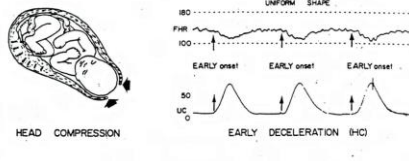


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Early decelerations



- Does not indicate an interruption in the oxygen pathway
- Represent a fetal autonomic response to changes in intracranial pressure &/or cerebral blood flow caused by intrapartum compression of the fetal head during uterine contractions



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Macones et al. (2008)

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Variable Decelerations

Lyndon & Wisner (2021)

Visually apparent abrupt decrease from FHR baseline; may occur with or without contractions

Onset to beginning of nadir < 30 seconds

Decrease \geq 15 bpm. Duration \geq 15 seconds and < 2 minutes from onset to return to baseline FHR

Why is this Deceleration Happening?

Variable Deceleration

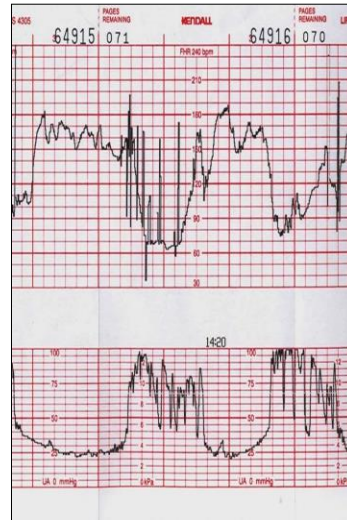
Cord Compression

Head Compression

Placenta/Uterus
(or above the uterus)

Variable Decelerations

Compression of the umbilical cord can result in a variable deceleration and interrupt the transport of oxygen to the fetus



Miller et al. (2021)

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Corrective Measures for Variable Decelerations

- Position change/Upright position
- Vaginal exam to rule out cord prolapse
- Elevation of presenting part
- Amnioinfusion

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Late Decelerations

Visually apparent gradual decrease and return to baseline FHR associated with contractions

Onset to nadir \geq 30 seconds

Onset, nadir and recovery occur after onset, peak and recovery of contraction

Lyndon & Wisner (2021)

Why is this Deceleration Happening?

Late Deceleration

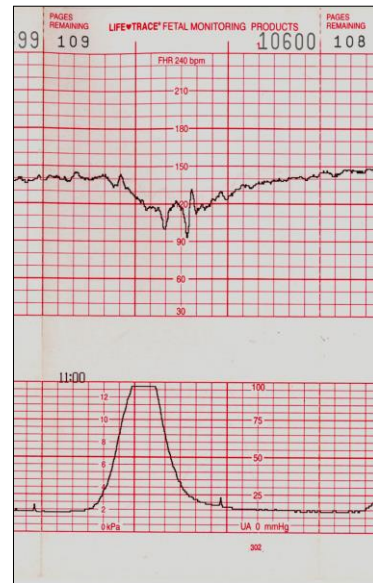
Cord Compression

Head Compression

Placenta/Uterus
(or above the uterus)

Late Decelerations

A late deceleration can result from an interruption in oxygen to the uterus or placenta (or above)



Miller et al. (2021)

Corrective Measures for Late Decelerations

- That depends..... What's the underlying cause?

Corrective Measures to Improve Uterine & Placenta Blood Flow

Late Deceleration Cause	Corrective Measures
Hypotension	Position change Correct hypovolemia - Hydration/IV fluids Pharmacologic therapy (Phenylephrine, Ephedrine)
Hypertension	Anti-hypertensives
Promote oxygenation	Position change Hydration/IV fluids Guide breathing, Reduce pain/anxiety through labor support Push with every other contraction, every third contraction
Decreased O2 saturation/ Maternal disease	Oxygen administration (10 L, non-rebreather, tight face mask) if low maternal O2 Correct/treat underlying disease
Excessive Uterine Activity	Verify toco/IUPC readings Review uterine activity and palpation of tone Decrease/discontinue Pitocin Removal of Cervidil/withhold misoprostol IV fluid bolus of at least 500 mL of Lactated Ringers solution Lateral positioning (either left or right) In no response, terbutaline 0.25 mg subcutaneously may be considered



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Miller et al. (2021) 27

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Prolonged Decelerations

Visually apparent decrease in FHR below baseline

Decrease \geq 15 bpm

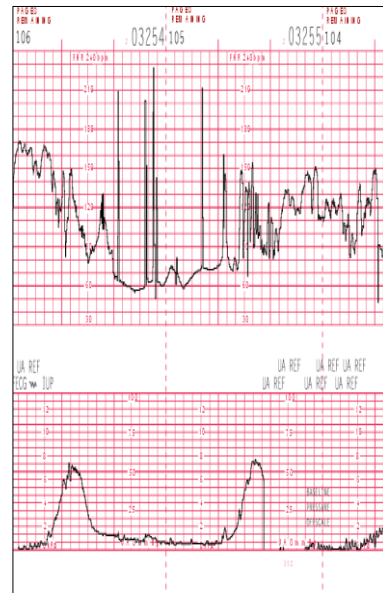
Duration \geq 2 minutes and $<$ 10 minutes from onset to return to baseline

Lyndon & Wisner (2021)

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Prolonged Deceleration

Interruption of oxygen at any point (heart, lungs, vasculature, uterus, placenta, cord) can result in a prolonged deceleration



Miller et al. (2021)



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What about Oxygen Administration?

- Raghuraman, et al. (2020) reviewed 114 randomized FHR tracings
 - No difference in resolution of recurrent decelerations with oxygen
 - No difference in resolution of Category II FHR tracings with oxygen
- Raghuraman, et al. (2021) reviewed 16 RCTs
 - Oxygen administration showed no significant difference in newborn acid/base values
 - No decrease in NICU admissions
 - Umbilical pH values remained similar in the oxygen group when compared to the no oxygen group



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Raghuraman, et al. 2020 & 2021 30

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Let's Review Decelerations/Accelerations

Type	Origin	Definition
Variable	Cord	<i>Abrupt onset:</i> < 30 sec. from onset to beginning of nadir, lasting ≥ 15 sec but < 2 min; depth ≥ 15 bpm
Early	Head	<i>Gradual onset:</i> ≥ 30 sec. from onset to nadir; nadir simultaneous with peak of contraction
Accelerations	OK/Oxygen	<i>Abrupt increase</i> (onset to peak < 30 sec.) in FHR above baseline. Increase is ≥ 15 bpm and ≥ 15 sec., and arises from and returns to baseline
Late	Placenta/Uterus	<i>Gradual onset:</i> ≥ 30 sec. from onset to nadir, delayed in timing with nadir after peak of contraction
Prolonged	Cord/Placenta/Uterus	Decrease of ≥ 15 bpm lasting ≥ 2 min but less than 10 min (≥ 10 min = baseline change)



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Macones et al. (2008) 31

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Have you heard these terms? Shoulders/Overshoots

Reactive

Reassuring

Happy Baby

**Variables with a
Late Component**

Subtle Lates

**Good Variability
During a Decel**

**Good Recovery
After a Decel**



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Miller et al. (2021)

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Are the decelerations?

Recurrent

Intermittent

Periodic

Episodic

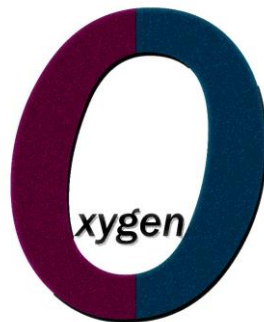


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Macones et al. (2008)

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Fetal/Acid Base Status



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Fetal Heart Rate Classifications

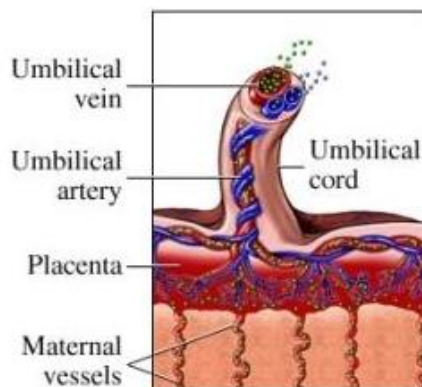
Category 1	Category 2	Category 3
Baseline 110-160 bpm	Tracings that are not category 1 or category 3	Absent baseline variability
Moderate Baseline Variability		• Recurrent Late Decelerations
Accelerations present/not present		• Recurrent Variable Decelerations
Decelerations - Early Decelerations present/not present - No other decelerations		• Bradycardia
		Sinusoidal pattern



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Parer, J. T., Ikeda, T., & King, T. L. (2009)

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- Spiral arteries in the placenta must traverse the full thickness of the myometrium to reach the intervillous space (the 1-2 cell layer thick where mom meets baby)
 - Uterine contractions STOP placental blood flow

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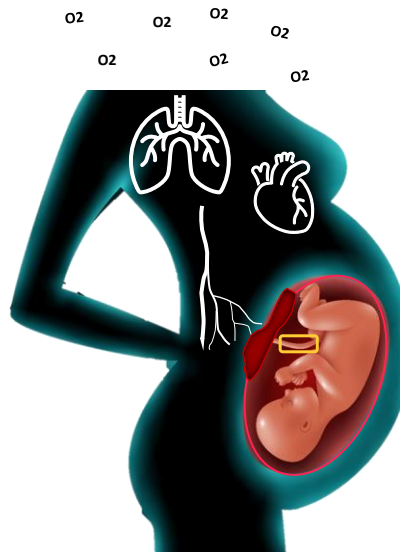
Fetal Physiology

- pO₂ of the umbilical vein is only about 35
- How does the fetus compensate to thrive and survive?
 - Fetal hemoglobin concentration is higher
 - Fetal cardiac output per body weight is higher



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Clinically Significant Decelerations:

- Late Decelerations
- Variable Decelerations
- Prolonged Decelerations

Interruption to the Oxygen Pathway

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What is the Fetal Monitor telling us?

- FHM provide insight into the oxygenation and potential acid/base status of the fetus
- External fetal monitoring is capable of strongly predicting normal acid-base status at the time of observation.
- Can NOT confirm the presence of abnormal fetal acid-base status.

EFM is NOT DIAGNOSTIC

HEALTH FAIRVIEW
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Physiological Pathway to Harm

Hypoxemia

Hypoxia

Acidosis

Acidemia

Potential for Injury

The diagram illustrates a physiological pathway to harm. It starts with Hypoxemia, which leads to Hypoxia. Hypoxia leads to Acidosis, which leads to Acidemia. Acidemia leads to Potential for Injury. The pathway is represented by a large red arrow pointing downwards and to the right.

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“When either moderate variability OR accelerations of the Fetal Heart Rate are present, damaging degrees of hypoxia-induced metabolic acidemia can be reliably excluded”

- Neonatal Encephalopathy and Neurologic Outcome

Report of the American College of Obstetricians and Gynecologists' Task Force on Neonatal Encephalopathy

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Conversely “Category III tracings are predictive of *abnormal* fetal acid-base status at the time of observation and require prompt evaluation.”

- Macones et al. (2006). The 2008 NICHD workshop report on EFM: Update on definitions, interpretation and research guidelines. *Obstetrics & Gynecology*, 112(3).

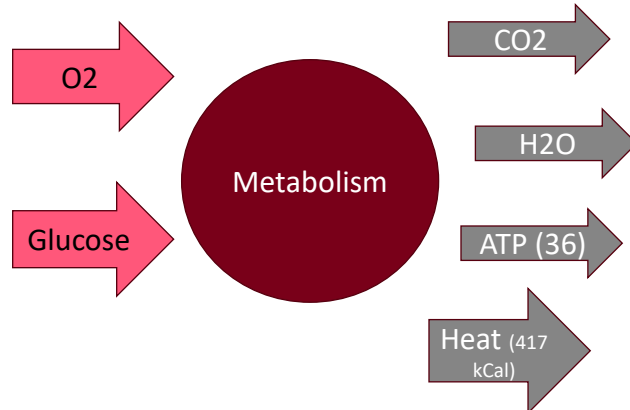
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Understanding Acid-Base

- In a healthy and well oxygenated fetus, the primary mode of energy is via *aerobic* metabolism

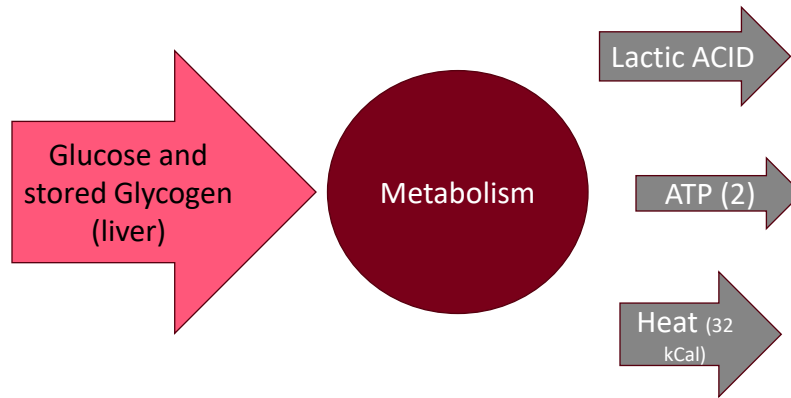
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Aerobic Metabolism



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Anaerobic Metabolism



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Why is this important?

Fetal umbilical artery pH less than 7.0

or a base excess less than -12mmol/L

or both increases the probability of hypoxic ischemic encephalopathy (HIE)

Parer, J. T., Ikeda, T., & King, T. L. (2009)

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Metabolic Acidemia

- Anaerobic metabolism results in lactic acid which must be buffered
- When the amount of lactic acid exceeds the amount of base, this is when metabolic acidemia occurs
- The base excess is reflective of the severity of the metabolic acidosis
- The more “negative” the base excess number, the more base had to be used to counteract the acid



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Physiology of Late Decelerations

Transient Hypoxemia

Chemoreceptor stimulation

Sympathetic outflow

Peripheral vasoconstriction

BP Rise

Baroreceptor stimulation

Vagal Nerve Outflow

Deceleration

Recurrent or sustained disruption of oxygenation

Tissue hypoxia

Anaerobic Metabolism

Lactic Acidosis

Metabolic Acidemia

Direct Myocardial Depression

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Definitions

Hypoxemia	Lactic acid in the blood
Hypoxia	Low oxygen in the tissues
Acidosis	Lactic acid in the tissue
Acidemia	Low oxygen in the blood



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Respiratory vs. Metabolic Acidemia

- Respiratory Acidemia=Aerobic Metabolism
 - During normal aerobic metabolism, the end products are CO₂ and Water
 - If blood flows slow, these byproducts are not cleared and will accumulate and turn into hydrogen and bicarbonate
 - The accumulation of these free hydrogen ions in the blood cause the drop in pH
 - This “acidemia” is due to an inability to clear the stored CO₂- the first breaths correct this

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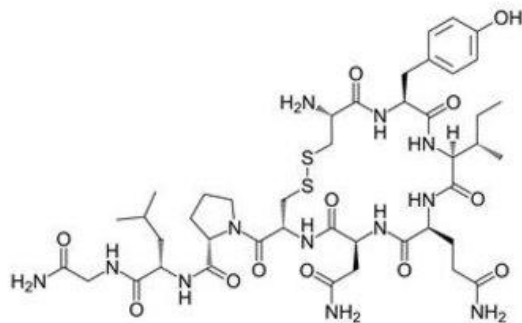
Respiratory vs. Metabolic Acidemia

- Metabolic Acidemia= Anaerobic Metabolism
 - If the decrease in blood flow becomes significant OR there is a problem with getting sufficient oxygen to the placenta, then the peripheral tissue will shift into anaerobic metabolism

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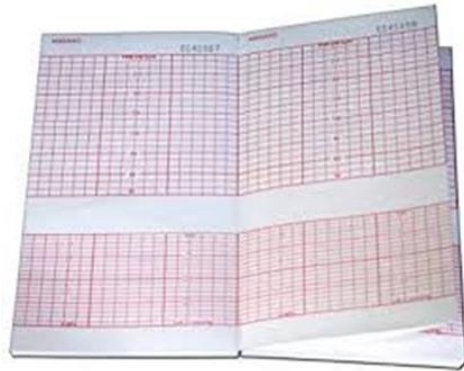
Uterine Activity and Acid/Base status

- Emerging evidence around the correlation of uterine contractions/oxytocin administration/acid base status
- Consideration should be taken when looking at length of labor and long-term use of oxytocin



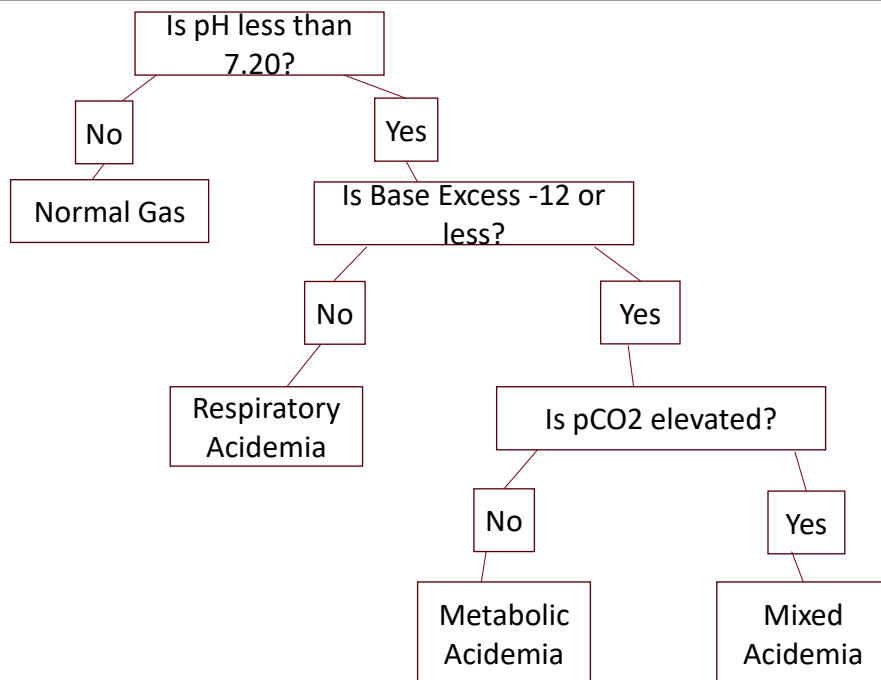
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Case Study and Algorithm Practice



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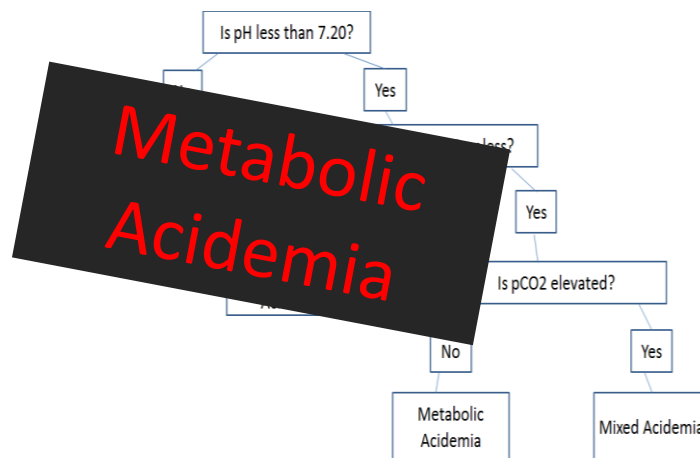
Normal Cord Blood Values

	Vein (blood to baby)	Artery (blood away from baby)
pH	7.30-7.40	7.20-7.30
pO ₂	25-35 mmHg	15-25 mmHg
pCO ₂	35-45 mmHg	45-55 mmHg
HCO ₃	18-22	20-24
Base Excess	-4 +/- 2 mEq/Liter	- 4 +/- 2 mEq/Liter

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This arterial cord gas is obtained

- pH 7.01
- pO₂ 9
- pCO₂ 46
- HCO₃ 10
- BE -17



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Care Implications

- Hypoxic Ischemic Encephalopathy

- Developmental delays
- Problems with growth
- Hearing or vision loss
- Issues with cognitive function
- Difficulty paying attention
- Epilepsy
- Cerebral palsy
- Infections
- Death

Therapeutic Hypothermia

- Target temp: 33.5 C
- Decreased temperature slows baby's metabolic rate
- Reduced metabolism = reduced acid production
- Brain cells are able to recover



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Communication (Documentation) and Escalation of Concerns



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Risk Management



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How do I minimize risk?

- Know and follow hospital policies/procedures/guidelines
- Follow national standards of care and practice
- Attend fetal monitoring in-services
- Become a life-long learner of the literature
- Join professional organization – AWHONN, ACNM
- Specialty certification e.g., EFM, Inpatient OB-RN

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I was told nurses don't get sued...

Depending on the circumstances, nurses can be sued for medical malpractice or negligence based on their actions or inaction.

Roughly 18% of closed medical lawsuits from 2018 to 2021 included registered nurses (RNs), licensed practical nurses (LPNs), nursing assistants, and nursing students.

Common allegations against nurses include lack of patient monitoring, medication errors, and failure to escalate concern (even if the presence of a provider order)

Remember- the goal is to provide safe patient care and prevent harm



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Liability / Malpractice

Malpractice

- Failure to act in a manner that a reasonable and prudent clinician would do in the same circumstance
- An unintentional act performed by a professional acting in a professional capacity that causes harm to an individual

Negligence

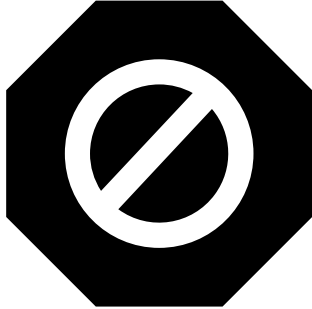
- Failure to act in a required manner, causing harm to an individual



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STOP Normalizing the Abnormal



- Belief that the rules are stupid and inefficient
- Belief that work goals are best met by breaking rules
- Imperfect knowledge of standards
- Fear of speaking up

Banja, 2010. The normalization of deviance in healthcare delivery.



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Common Malpractice Claims (Miller p. 251)

Failure to recognize and manage Category II or III FHR tracings

Failure to maintain an adequate FHR & UA

Failure to recognize signal ambiguity

Failure to complete ongoing EFM education

Failure to adhere to organization's guidelines

Failure to communicate because of lack of knowledge or fear of conflict

Failure to maintain an organizational culture

Failure to use the chain of command and escalation of concerns

Failure to maintain situational awareness

Failure to provide adequate documentation in the EHR



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Escalating Concerns About Fetal Heart Rate Tracings



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Speaking Up

- Look out for one another to catch each other's mistakes while building a greater sense of accountability for our actions
- Be willing to give feedback to others... and be willing to have others give feedback to you!
 - "Thanks for the crosscheck"
- Provide feedback based on observations
- Assume the best intent – use the lightest touch possible
- Manage power differential

<https://www.pressganey.com/consulting/safety-high-reliability-consulting/>

Remember – without saying a word:
"What you permit, you promote."

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Speaking Up

Speaking up in an organized and professional way gives the receiver of the message three chances to listen and address the issue before using the chain of command

- Ask a question
- Request a change
- Voice a Concern **"I have a Safety Concern..."**
- Chain of command

Repeating your concern twice, maybe even three times gives the receiver the time they may need to hear your concern



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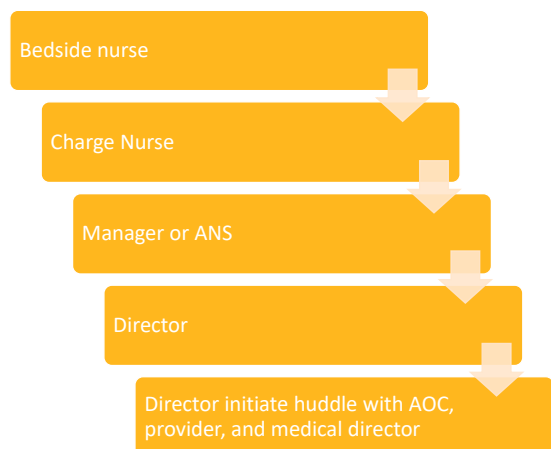
<https://www.pressganey.com/consulting/safety-high-reliability-consulting/>

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Chain of Command

- OB Chain of Command



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Documentation



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Effective Documentation & Communication

- Reflective of nursing process and critical thinking
- Applies standardized EFM terminology and approved abbreviations
- Avoidance of nonspecific terms such as reassuring, non-reassuring, reactive, hyperstimulation, hypertonus



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Miller et al. (2022, p. 243-356)

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Make sure your charting is "CLEAR"

Contemporaneous: "Timely"- document in real-time or as close to real time as possible.

- Late entries are acceptable but not too late.

Logical: Plain and clear charting- do not be ambiguous

- SOAP notes
- Standardized note templates

Explicit: Do not use vague terms (large amount, reassuring, etc.)

- Describe what is seen/happening
- It is important to be objective in your documentation at all times

Accurate: Document accurately- provide a truthful and objective picture of what is happening

- Provide correct times of events (ensure they match the provider note– this requires a huddle with the provider)
- Use correct terms in your documentation
 - If you gave a medication "subQ" do not document that you gave it "IM"
- Provide a truthful representation of what happened

Readable: When documenting in the EHR, use the correct terms, do not abbreviate, spell incorrectly, and verify the note makes sense.



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Other times to document...

Corrective measures to improve uterine blood flow, umbilical circulation and fetal oxygenation, normalization of uterine activity as well as maternal and fetal response to interventions

Medications and procedures

Provider notification and response as well as communication to other team members and patient/family (e.g., huddles) in flowsheets and notes

Labor support, labor progress and interventions

Lapses in continuous electronic monitoring (e.g., up to use bathroom, epidural placement)

Any escalation of concern/use of the chain of command



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Provider communication notes to include:

Fetal heart rate/tone interpretation

- clinical context of the pattern (e.g. medications, oxytocin, cervical ripening agents, maternal vital signs/temperature, labor progress, cervical status, ruptured membranes status, TOLAC, etc.
- Corrective measures undertaken and maternal-fetal response
- fetal heart rate/tone status timeframe (e.g., how long has fetal heart rate status persisted?)
- If fetal status is concerning for decreased fetal oxygenation

Level of urgency for provider in person evaluation (e.g., STAT, within 30 minutes)

Provider name notified and response (ongoing plan)



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Phrases to avoid

- **“No new orders received”**: This is not encouraged documentation. We have witnessed this in nurse’s depositions where this backfired. Tell the story when documenting. For example, document “requested an order for ABG’s”.
- **“Provider aware of patient condition- no orders received”**: document objectively the information shared with the provider and then document the requested order for ABG’s
- **“RN discussed fetal condition and provider not coming to bedside”**: Again, document objectively what was shared with the provider. Document “Requested provider come to bedside to see patient.” Document any escalation of the concern via the Chain of Command.



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More Issues with Documentation

- Use of the medical record as a weapon
 - “I initiated the chain of command”
 - “The provider did not return my page.”
 - “This is a constant issue with this provider”
- Copy forward without modifying changes in patient condition

Miller et al. (2022, p. 243-356)

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Notes



When do I need to write a note?



Flowsheets are DATA



Notes are a STORY



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Stigmatized Language in Documentation

- Negative descriptors
 - o Difficult, challenging, resistant, insisted, demanded, complains of, non compliant
- Judgement or Blame
 - o Failed, cannot tolerate, poor effort, insufficient
- Labeled as a "disease"
 - o "She's an uncontrolled obese diabetic"
 - o Train wreck/Frequent flyer
- Projecting Doubt: "Claims she's been contracting for three days"



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Case Study – where is the biased language?

- C.G. is a G3P1 diabetic patient- uncontrolled- who presents to triage with complaints of abdominal pain at 31 weeks gestation. RN attempted to place FHM- patient refusing as laying down is "uncomfortable". States she started feeling pain after eating dinner. Asked what she had to eat; patient admitted to eating fast food for dinner. Patient non-compliant with ordered diet at this time. Patient history reviewed- patient presents often to triage without cause.



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Case Study – where is the biased language?

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Thank You

Nanette Vogel
nanette.vogel@fairview.org

Rhianna Britton
rhianna.britton@fairview.org

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