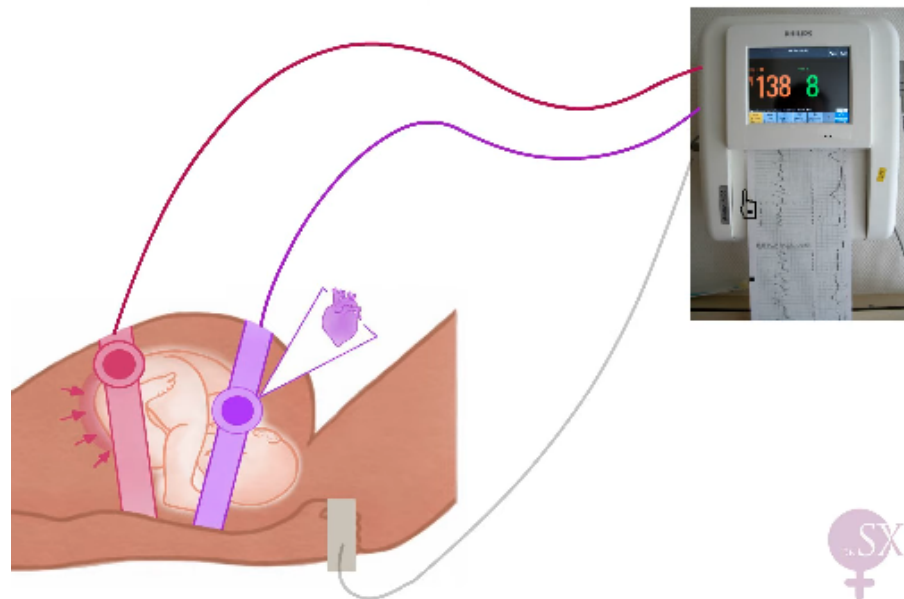
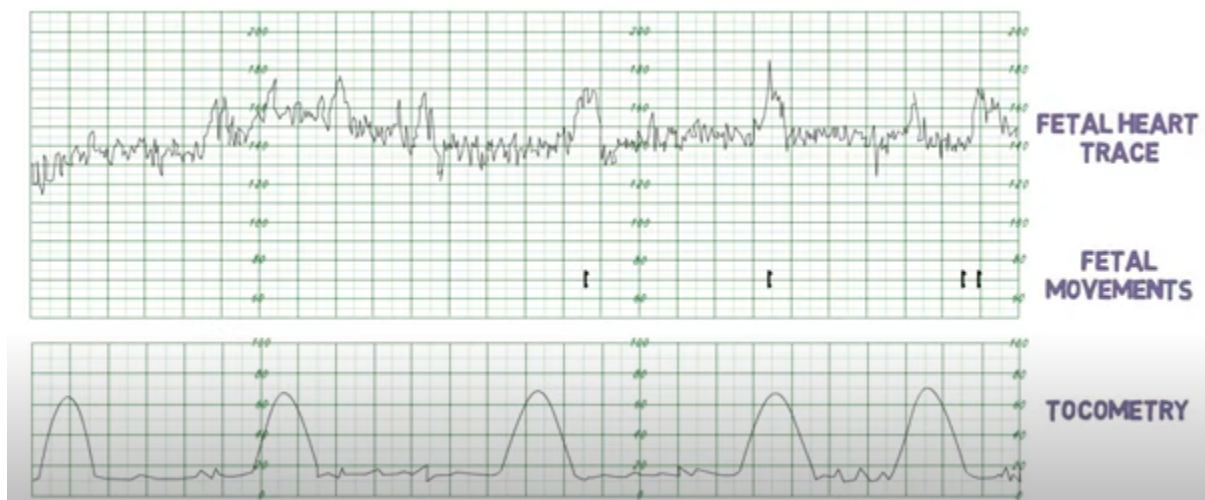


Objective: Deep dive into the medical components (Google Scholar, ChatGBT, Youtube)

- What does a clinician look for when reading results?
- What important features are we missing?
- Is there a feature that we can generate ourselves, using a combination of two other features
- Explain movement, oxygen importance, etc
- What does decelerations mean physically, what could it indicate is happening
- If it's always 10 mins, estimate density or stats of certain behaviors or features



- The purple monitors the heart rate of the fetus
- The pink monitors contractions by measuring the tension of the abdomen wall (this gives indication of intrauterine pressure)



- Divided into 10 minute boxes: each box represents 1 minute

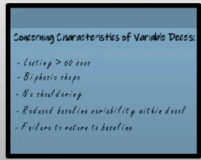
Interpretation (<https://www.youtube.com/watch?v=I5Dj9vKhIMQ>)

- Medical professionals use DR C BRAVADO
 - DR: Defined risk (assesses risk factors of pregnancy)
 - C: Contractions
 - Frequency (number of contractions in 10 mins) and the duration of contractions

- In the screenshot, you can see about 2 contractions per minute
- Coordinates with **Uterine Contractions** column of dataset:
 - Number of uterine contractions per second (Range: 0 to 0.01)
- BRA: Baseline Rate
 - Average heart rate of the fetus
 - Normal range is from 110 to 160 BPM
 - In the screenshot, you can see it's pretty steady
 - Significance:
 - Baseline is higher in preterm fetuses (born before 37 weeks) and lower in post term fetus (born after 42 weeks)
 - Tachycardia: baseline value above 160 bpm lasting more than 10 mins
 - could be sign of fetal infections
 - Bradycardia: baseline value below 110 bpm lasting more than 10 mins
 - could be sign of fetal distress
 - Coordinates with **Baseline Value** column of dataset:
 - Beats per Minute (Range: 106 to 160)
- V: Variability
 - Beat to beat variability: the variation in FHR from one beat to the next
 - Normal is from 5 to 25 bpm
 - Coordinates with:
 - **Abnormal Short Term Variability**: percentage of time with abnormal short term variability (Range: 12 to 87)
 - Refers to the reduction or absence of fluctuations in the fetal heart rate over a defined period
 - **Mean Value of Short Term Variability**: Range is 0.2 to 7
 - Percentage of time with abnormal long term variability: Range: 0 to 91
- A: Accelerations
 - Increase in FHR by more than 15 bpm for more than 15 seconds
 - Sign of a healthy fetus (movements are portrayed as accelerations)
 - Coordinates with **Accelerations** column of dataset:
 - Number of accelerations per second (Range: 0 to 0.02)
- D: Decelerations:
 - Decrease in FHR by more than 15 bpm for more than 15 seconds
 - Not a good sign: if not moving, then it is too conserve energy which leads to low blood oxygen
 - Split into: Early, Variable and Late
 - Early: Start then the uterine contractions begin until the contractions drop
 - Shallow, short lasting, coincident with contractions
 - Variable: Vary in shape, form and timing in relation to contractions
 - Identified by: rapid drop, good variability within deceleration, rapid recovery to baseline (Constitute majority of decelerations during labor)
 - Caused by umbilical cord compression
 - Concerning if: decelerations lasts more than 60 seconds, looks like a W (biphasic shape), no shouldering, fails to return to baseline variability
 - Late: Insufficient blood flow to uterus and placenta
 - Decelerations with gradual onset or a gradual return to baseline
 - Coordinates with **3 columns** in the dataset:

- Light Decelerations: Number of LDs per second (Range: 0 to 0.01)
- Severe Decelerations: Number of SDs per second (Range: 0 to 0.01)
- Prolonged Decelerations: Number of PDs per second (Range: 0 to 0.01)

○ O: Overall Impression

	REASSURING	NON-REASSURING	ABNORMAL
Baseline rate (bpm)	110 - 160	100 - 109 OR 161 - 180	< 100 OR > 180
Baseline Variability (bpm)	5 - 25	< 5 for 30 - 50 mins OR > 25 for 15 - 25 mins	< 5 for > 50 mins OR > 25 for > 25 mins OR Sinusoidal pattern
Decelerations 	None or early variable decelerations with no concerning characteristics for < 90 mins	variable decelerations with no concerning characteristics for >= 90 mins OR variable decelerations with any concerning characteristics in up to 50% of contractions for >= 30 mins OR variable decelerations with any concerning characteristics in > 50% of contractions for < 30 mins OR Late decelerations in > 50% of contractions for < 30 mins	variable decelerations with any concerning characteristics in > 50% of contractions for 30 mins OR Late decelerations for 30 mins OR Acute bradycardia OR Single prolonged deceleration lasting >= 3 mins



1 Non-Reassuring feature
AND
2 Reassuring features



SUSPICIOUS



Conservative measures to correct any
underlying causes:

- Umbilical cord compression → Change position
- Maternal hypotension → IV fluids
- Uterine hyperstimulation → Stop Syntocinon

1 Abnormal feature
AND
2 Non-Reassuring features



PATHOLOGICAL



Conservative measures
Consider fetal scalp stimulation
Consider Fetal Blood Sampling (FBS)
Consider expediting delivery

Note: The **Fetal Movement** column of dataset is not considered in this method

CTG For Fetal Assessment

<https://pubmed.ncbi.nlm.nih.gov/26363287/>

- Consideration should be given to the uterine contractions and their relationship to the FHR pattern

Consensus Guidelines on CTG

- Introduction:
 - Intrapartum monitoring refers to the observation or recording of fetal heart rate (FHR) and uterine contractions: goal is to detect any signs of fetal distress or complications early on
 - Unexpected complications may occur during labor so even in patients without prior evidence of risk, it is important for an expedite delivery (especially emergency c section)
 - External Monitoring -> CTG: uses Doppler ultrasound device (records FHR) and a pressure transducer (measures uterine contractions) placed on belly
- **Maternal position** for CTG acquisition:
 - Supine position (lying flat on back) can lead to aortocaval compression (when the weight of the uterus and baby press down on the inferior vena cava / aorta)
 - Aorta is the main artery that carries oxygen rich blood from the heart to the rest of the body
 - Compression of the aorta can lead to decreased blood flow to mothers organs and placenta, which affects oxygen supply to baby
 - Inferior vena cava is large vein that carries deoxygenated blood from lower half of body back to the heart
 - This compression can decrease blood flow returning to the heart and may reduce placental perfusion, which compromises fetal oxygenation
 - Better to lay on the side (lateral recumbent position) or sitting half up
 - CTG acquisition can be performed by portable sensors that transmit signals wireless to a remote fetal monitor
 - Allows mother to move freely during signal acquisition
- **Paper scales** for CTG registration and viewing
 - Paper speed refers to how fast the CTG tracing moves across the paper or screen (measures in centimeters per minute) - 1, 2, 3 cm/min
 - Many countries use 1 cm/min:
 - Slower paper speed so each minute of real time is represented by 1cm of paper / screen space
 - Provides sufficient detail for analysis while reducing the length of the tracing (making it more compact)
 - North America / Japan uses 3 cm / min:
 - Faster paper speed so tracing moves quickly across the pape / screen
 - Allows for better evaluation of small details in CTG tracings (longer tracings)
 - The vertical scale used for registration and viewing refers to how the FHR is represented on the y axis of the tracing
 - 20 or 30 bpm/cm: each centimeter on the y axis represents a range of 20 hearts per minute of the fetal heart rate

Clinical management	No intervention necessary to improve fetal oxygenation state	Action to correct reversible causes if identified, close monitoring or additional methods to evaluate fetal oxygenation [49]	Immediate action to correct reversible causes, additional methods to evaluate fetal oxygenation [49], or if this is not possible expedite delivery. In acute situations (cord prolapse, uterine rupture, or placental abruption) immediate delivery should be accomplished.
---------------------	--	--	---

	Normal	Suspicious	Pathological
Baseline	110–160 bpm	Lacking at least one characteristic of normality, but with no pathological features	< 100 bpm
Variability	5–25 bpm	Lacking at least one characteristic of normality, but with no pathological features	Reduced variability, increased variability, or sinusoidal pattern
Decelerations	No repetitive ^b decelerations	Lacking at least one characteristic of normality, but with no pathological features	Repetitive ^b late or prolonged decelerations during > 30 min or 20 min if reduced variability, or one prolonged deceleration with > 5 min
Interpretation	Fetus with no hypoxia/acidosis	Fetus with a low probability of having hypoxia/acidosis	Fetus with a high probability of having hypoxia/acidosis

Looking back at the dataset:

- We make the assumption that Each row corresponds to an individual CTG recording during an observation period
 - Each column is broken down per second
 - Comes from: <https://pubmed.ncbi.nlm.nih.gov/11132590/>
 - Assume its an average across an entire CTG exam
- **Maternal position** for CTG acquisition:
 - Supine position (lying flat on back) can lead to aortocaval compression (when the weight of the uterus and baby press down on the inferior vena cava / aorta)
 - Aorta is the main artery that carries oxygen rich blood from the heart to the rest of the body
 - Compression of the aorta can lead to decreased blood flow to mothers organs and placenta, which affects oxygen supply to baby
 - Inferior vena cava is large vein that carries deoxygenated blood from lower half of body back to the heart
 - This compression can decrease blood flow returning to the heart and may reduce placental perfusion, which compromises fetal oxygenation
 - Better to lay on the side (lateral recumbent position) or sitting half up
 - CTG acquisition can be performed by portable sensors that transmit signals wireless to a remote fetal monitor
 - Allows mother to move freely during signal acquisition