Objective: Deep dive into research to grasp clinical aspect

- Investigate the clinical data and explore the features
- Questions:
    - What are the risk factors?
    - Are there missing features from the dataset that hold important information to the diagnosis?
- Present the clinical problem with connection to available data

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- Clinical problem: fetal distress during pregnancy can lead to adverse neonatal outcomes
    - CTG is tool to monitor fetal well being during labor and in high risk pregnancies
    - Correct interpretation of CTG patterns is vital for timely intervention (emergency delivery procedures)

- Accurately classify fetal health status based on signals obtained from the CTG exams:
    - Identify delta distress accurately and efficiently
    - Reducing the need for unnecessary interventions
    - Classify health of a fetus as normal, suspect, pathological

- Kaggle dataset has 2126 records of features extracted from CTG exams, which were classified by 3 export obstetricians into 3 classes

CTG (cardiotocogram) Exams

- CTG is a form of Doppler that uses only sound (doesn't produce an image)
    - Simple, painless, non invasive procedure that is non stress
    - Performed before birth and during labor to monitor the baby for any signs of distress
    - Strap two electronic sensors to the belly:
        - One monitor the heartbeat and movement
        - The other records any contractions in your uterus
    - Each sensor is attached to a wire, which is connected to the machine and elastic belts hold the sensors in place
- Uses sound waves (ultrasound) to detect baby's heart rate
- Monitors heartbeat while baby is moving then resting to see if the heart rate of the baby goes up while they are moving or kicking
    - Normally, a heart rate is anywhere between 120 and 160 beats per minute and increases when the baby moves
    - Checking that the baby's heart rate responds to his movements is an indirect way of knowing if he gets enough oxygen from the placenta
- Doctor checks if the test result is:
    - Reactive test results indicates that your baby's heart rate increases by the expected amount after each of their movements
    - Non reactive test result means the baby's heart rate does not increase after his movements

        - Could indicate something is wrong or that the test didn;t provide enough information (baby is asleep)

Dataset: 22 columns

- Baseline Value: baseline fetal heart rate (FHR)
    - Range: 106 to 160
    - Description: Average heart rate of the fetus during a specified period of time
        - FHR baseline (beats per minute)
    - Interpretation:
        - Normal range is between 110 and 160 BPM (beats per minute)
        - Below normal range is less than 110 BPM: could be sign of fetal distress
        - Above normal range is greater than 160 BPM: could be sign of fetal infections
- Accelerations: Number of accelerations per second
    - Range: 0 to 0.02
    - Description: short term rises in the fetal heart rate
- Fetal Movement: Number of fetal movements per second
    - Range: 0 to 0.48
- Uterine Contractions: Number of uterine contractions per second
    - Range: 0 to 0.01
- Decelerations: represent a temporary drop in FHR
    - 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
- Abnormal Short Term Variability: Percentage of time with abnormal short term variability
    - Range: 12 to 87 - units?
    - Refers to the reduction or absence of fluctuations in the fetal heart rate over a defined period
    - Variability indicates fluctuations in FHR
    - Interpretation:
        - High percentage of time with abnormal STV can be concerning
        - Decreased or absent STV is indicative of lack of oxygen
    - What is defined as abnormal STV?
- Mean Value of Short Term Variability
    - Range: 0.2 to 7
- Percentage of time with abnormal long term variability
    - Range: 0 to 91
- Mean value of long term variability
    - Range: 0 to 50.7
- Histogram width: Width of the histogram made using all values from a record
    - Range: 3 to 180

- Histogram min: histogram min value
    - Range: 50 to 159
- Histogram max: histogram max value
    - Range: 122 to 238
- Histogram number of peaks: number of peaks in the exam histogram
    - Range: 0 to 18
- Histogram number of zeros: number of zeros in the exam histogram
    - Range: 0 to 10
- Histogram mode:
    - Range: 60 to 187
- Histogram mean:
    - Range: 73 to 182
- Histogram median:
    - Range: 77 to 186
- Histogram variance:
    - Range: 0 to 269
- Histogram trend:
    - Range: -1, 0, 1
- Fetal health:
    - 1 for normal, 2 for suspect, 3 for pathological

What are the risk factors?

- Abnormalities and deviations from the normal ranges in the CTG parameters
    - Baseline FHR: below 110 BPM or above 160 BPM
    - Accelerations: a decreased number of accelerations, which are reassuring signs
    - Fetal movement: decreased movements
    - Uterine contractions: abnormal pattern or high frequency of contractions could impact fetal oxygenation
    - Decelerations: increased number of decelerations might be indicative of issues

Are there missing features from the dataset that hold important information to the diagnosis?

- The dataset is comprehensive in terms of capturing the essential features of a CTG
- Duration of decelerations: Dataset captures types of decelerations (light, severe, prolonged) but does not provide the duration of each individual deceleration
- Baseline variability: needed to differentiate short term vs long term variability
- Contextual information: maternal health, medication, gestational age or pre existing condition
- Recovery time: time it takes for fetal heart rate to return to its baseline
- External factor: did the mom eat something before hand, drink something sugary
- Overall duration of monitoring
- Previous CTG results
- Other obstetric measures: fetal blood vessels, amniotic fluid index