

Keeping Labor Safe LLC  
The Fetal Reserve Index (FRI) Fall 2022  
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### **The Need:**

Childbirth should be a time of great joy, but it can also be perilous. Electronic fetal monitoring (EFM) has been used for >50 years to predict and prevent compromised babies who can have neurodevelopmental delays including cerebral palsy. Unfortunately, EFM has performed poorly – missing as much as 50% of problematic cases. As a result, medical liability costs around labor have reached \$40 Billion per year in the USA. Outcomes have been substantially worse in minority populations. We have developed a very disruptive technology called the Fetal Reserve Index (FRI) to provide improved and earlier assessment of clinical risk to prevent damage rather than react to it. We need to move the FRI into a deployable platform for clinical introduction, refinement, and world-wide implementation. We need help to create the app for clinical implementation.

### **Company Background:**

Keeping Labor Safe, LLC (KLS), is a start-up medical technology company, developing technology and software that will make labor and delivery (L&D) and immediate postpartum care (L&D/PC) safer for mother and newborn infant. Our team is primarily comprised of medical professionals who have spent our careers working in maternity hospitals in Detroit, Chicago, Augusta, Dayton, Philadelphia and New York City where we have seen firsthand the need to make childbirth safer for all parties involved. We have developed the Fetal Reserve Index (FRI) a contextualized, quantitative metric to identify distressed fetuses earlier in the course of developing compromise. Earlier identification potentiates earlier intervention to help produce better medical outcomes for mother, fetus, and baby. We have multiple papers and patents and have developed the computer algorithm to “read” the tracing and produce a quantitative score.

### **The Project:**

To add additional features and capabilities (these additional features are listed in the next section “Application Requirements”) to the web app created by the CS Mines summer 2022 field session. This will turn the Fetal Reserve Index algorithm into an Intelligent Cloud Platform and Bedside Web Application. Currently the application has 3 user types (Administration, Clinical, and Decision Support) and will work on the current releases of the major web browsers. With this project we are ultimately looking for electronic download of fetal monitoring data and risk factor data collected from current models of Electronic Health Record platforms (EPIC, Cerner), these data are input through your custom-built API into the FRI Algorithm. Once data are input, the diagnostic output will be returned to the user’s device and displayed in an easy-to-read visual format. To this point, 300 test cases have been used to calibrate the Algorithm/Application.

### **Application Requirements:**

- Refactoring the code to make it easy to internationalize the product.
- Front End Improvements
  - Improve the design
  - Improve the Intuitiveness
  - Add reports
- Reset/Forgot Password capabilities
- Data input through intuitive UI
  - Live/Manual/Automated Input of EFM Data
  - Live/Manual/Automated Input of EHR/Risk Factor Data
  - Live/Manual/Automated Input of Notable Events
- Drop Down Menu for Maternal, Obstetrical and Fetal Risk Factors
- UI automatically prompts for inputs at predetermined and variable intervals
- Dynamically update on-screen reporting as data is input
- Multiple Concurrent viewing capabilities: Real Time Sharing of Data
- Remote Administrative access for diagnostic support

- HIPAA compliant
- Built to allow expansion

**Technologies and Desired Skills:**

- Python (Python Flask, Micro framework)
- General Front End Development: React
- WebSocket
- REST API
- SQL Database
- JavaScript, TypeScript
- HTML/CSS
- Others as appropriate
- C++
- Cloud Architecture

**Sample Data:**

Each row represents 1 minute of case data for a particular patient and a particular metric. The two main metrics included are UA (Uterine Activity) and FHR (Fetal Heart Rate).

We would like to see the following data being input:

- EFM/UA Data
- Nursing Data Entry

With the following diagnostic report:

- Risk Factor Scoring

Column	Data Type	Size	Required	Notes
Prop_0	DateTime		Y	Timestamp for the beginning of the minute that the record represents
Prop_1	String	128	Y	Metric (UA, HR, HR2, etc)
Prop_2	String		Y	Metric Source (external, TOCO, IUP)
Prop_3	Numeric	11,6	Y	Metric value for the first quarter second of the minute
Prop_4	Numeric	11,6	Y	Metric value for the second quarter second of the minute
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Prop_242	Numeric	11,6	Y	Metric value for the final quarter second of the minute

**EFM/UA Data Sheet**

Each row represents a measurement of HR and UA values at a specific point in time. Based on existing sample data, we would expect this to be every quarter second.

Column	Data Type	Size	Required	Notes
PATIENT_ID	String	128	Y	Unique ID representing a patient (mother)
HR	INT	128	Y	HR Value (BPM)
UA	INT		Y	UA Value (mmHg)
DATE_TIME	DateTime		Y	Timestamp when these values were recorded

## Nursing Entry Data Sheet

Each row represents a measurement recorded by a nurse (coming from Epic or other EMR) that will be ingested and could have an impact on FRI calculation.

Column	Data Type	Size	Required	Notes
<b>PATIENT_ID</b>	String	128	Y	Unique ID representing a patient (mother)
<b>MEASUREMENT_TYPE</b>	String	256	Y	Type of measurement recorded (ex: cervical dilation, Pitocin, FHR variability, etc)
<b>DATA</b>	String	500	Y	Measurement Value (generic string)
<b>DATE_TIME</b>	DateTime		Y	Timestamp when these values were recorded

**Preferred Team Size:** 4-5 Students

**Preferred Work Location:** Remote

- Meeting regularly via Zoom

**Intellectual Property:** All intellectual property developed as part of this project will be owned by Keeping Labor Safe, LLC.

**NDA:** Signed NDA will be required