StillSafe

empowering safe pregnancies for every family

The Devastating Reality of Stillbirth

"Stillbirth is the loss of a baby at or after 20 weeks of pregnancy." (CDC)

- **Global Impact**: 2 million stillbirths annually (1 every 16 seconds) (CDC)
- **US Impact**: Over 21,000 stillbirths annually (1 every 175 births) (CDC)
- **Emotional Cost**: Increased risk of depression, anxiety, and PTSD (Westby et al., 2021)
- **Financial Burden**: $7,000-$9,000 per stillbirth (Veettil et al., 2023)

A Preventable ~~Tragedy~~

- Most stillbirths occur in pregnancies that appear healthy (NHS)
- Early detection of risk factors could prevent many stillbirths (You et al., 2020)
- If trends persist, 20 million additional stillbirths are projected in the next decade (You et al. 2020)

“Many stillbirths could be prevented with early detection, timely interventions, and access to high-quality healthcare.” (You et al., 2020)

8 out of 10

Meet Our Team

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Our Solution

Empowering families through data-driven insights to predict and prevent stillbirth.

Mission: Provide early, personalized risk assessments using machine learning

Vision: Make healthcare equitable, reduce stillbirth rates, and improve maternal-fetal outcomes

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empowering safe pregnancies for every family

Target User Overview

Early-On/Soon-To-Be Pregnant Patients

Patients With Limited Access To Healthcare Services

Market Research

Missed Opportunity: Maternal health market projected to grow to **$22.6 billion** by 2025

Tommy App	AI-powered tool focused on early assessment and monitoring for pregnant people
Hera MED	Smart home fetal monitor for remote maternity car
Nuvo MED	Remote monitoring system for fetal non-stress tests

None of these address the need for comprehensive, risk-based stillbirth prevention

MVP

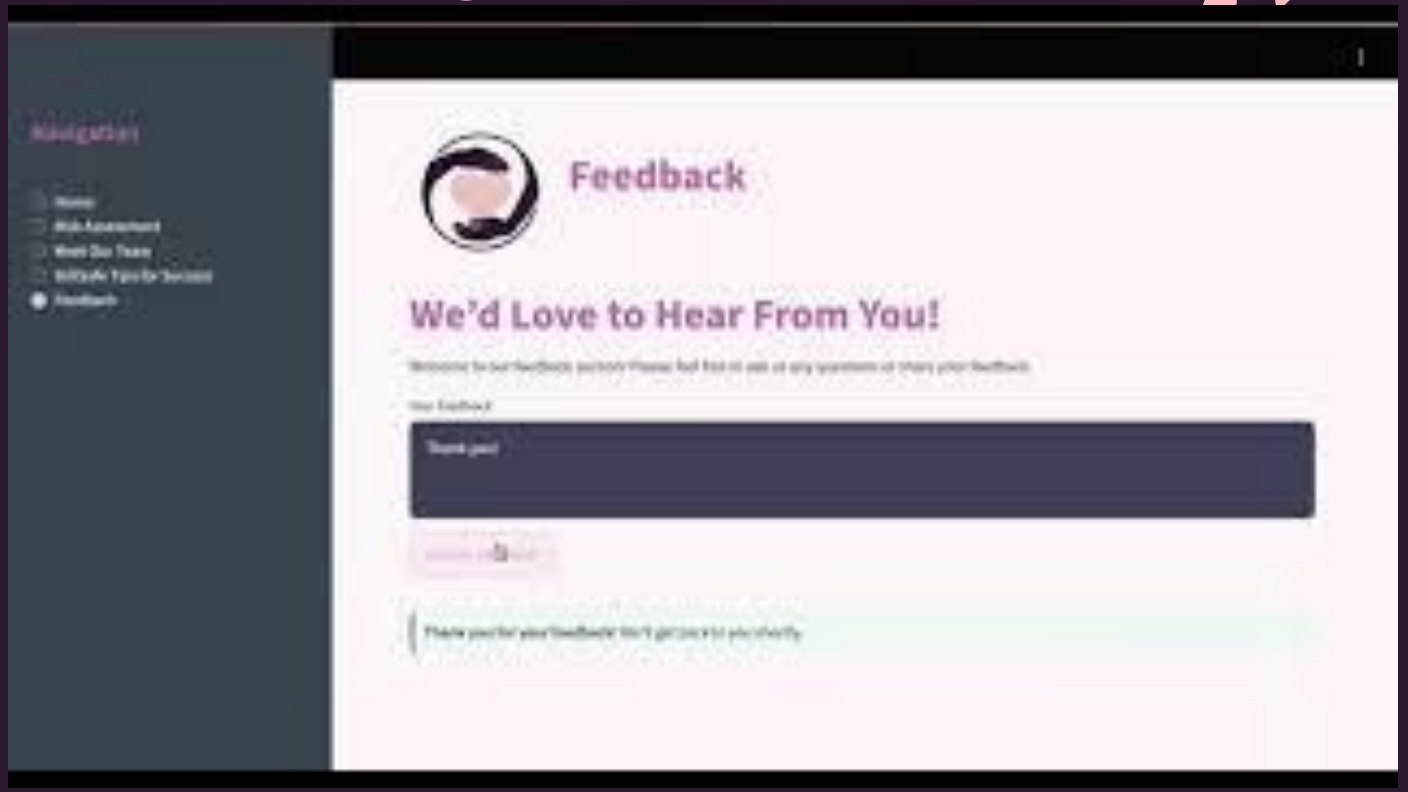
Demo: Home Page

Demo: Risk Assessment Tool

Demo: Meet Our Team Page

Demo: StillSafe Tips for Success Page

Demo: Feedback Page

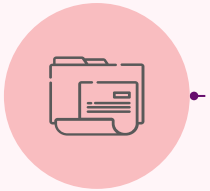


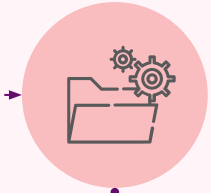
Technical Overview

Pipeline

Data Wrangling

Pull, clean and explore the data



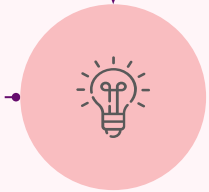


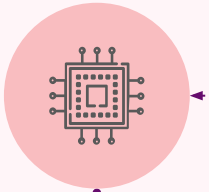
S3

Data is stored in Amazon S3 bucket

SageMaker Model Training

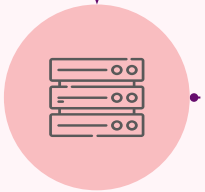
Train and deploy ML models





SageMaker Inference

Create a SageMaker Serverless Inference Endpoint



Streamlit Web App

Streamlit Web App allows users to interact

AWS Lambda

Acts as a bridge to connect the Streamlit web app with the inference endpoint

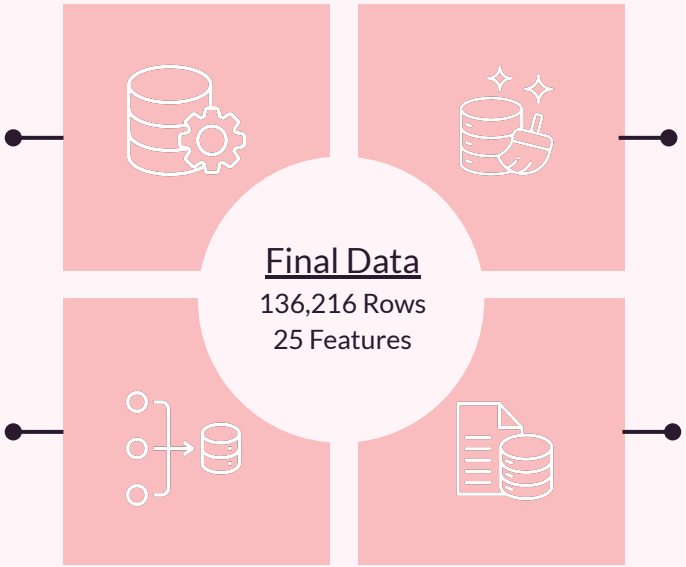
Summary of Data

01 Source

- Pull data from CDC website
- Merged "Fetal Death" and "Live Birth" data from 2014 to 2022
- Over 1 million rows and 100+ features

02 Assumptions

- **Target Variable**: Created using "Obstetric Estimation Tabulation Flag"
- **Definition**: Any death occurring at or after 20 week of pregnancy



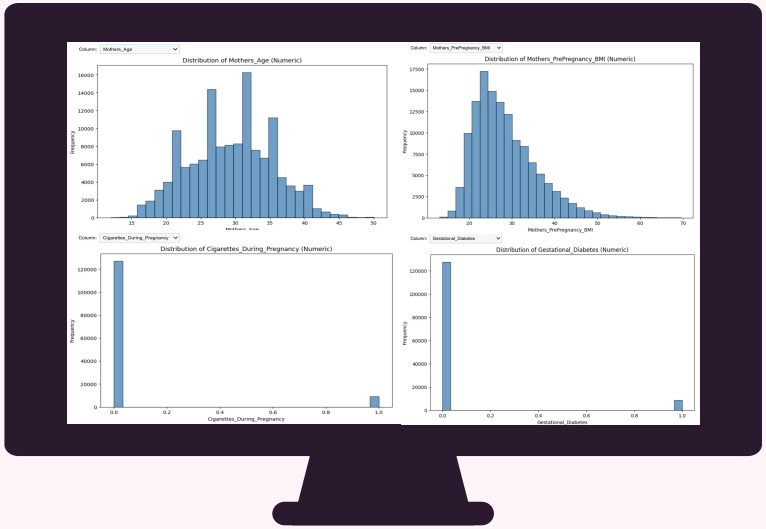
03 Features

- Guided by experts to retain key stillbirth-related features
- Removed unnecessary/redundant features and feature engineered new ones

04 Clean

- Converted "Unknowns" to null values
- Removed rows with excessive nulls
- Balanced live births and fetal deaths by year

Exploratory Data Analysis



Missing Data

- **Mean/Mode**
- Multiple Imputation
- Inverse Probability Weighting

Bias

- Feature distribution visualization
- Normal and non-normal distributions
- Balanced live births and fetal deaths by year

Evaluation Metrics Selection and Initial Approach

Accuracy | Precision | Recall | F1 Score

01 **ACCURACY**

Labels in the data are approximately balanced, so they serve as a good indicator of our models' performance

02 **RECALL**

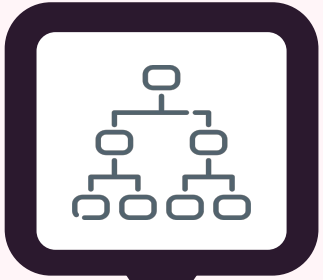
One of the most important metrics in healthcare because it is crucial to minimize misdiagnosing a stillbirth

Baseline Models	Accuracy	Recall
Logistic Regression	0.6274	0.6806
Bernoulli Naive Bayes	0.6077	0.6899
KNN	0.6206	0.7379

Modelling Approach

Traditional Machine Learning

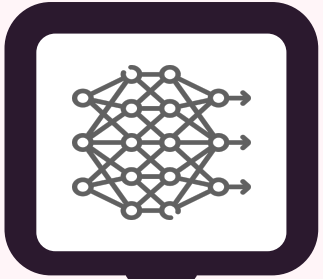
- Logistic Regression
- Bernoulli Naive Bayes
- KNN
- Random Forest
- Decision Trees



Gradient Boosting

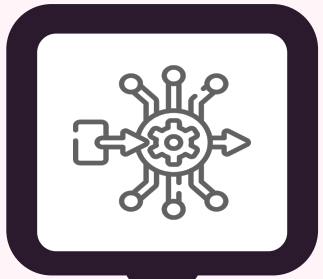
- LightGBM
- XGBoost
- CatBoost

Grid Search + Random Search



Neural Networds

- Convolutional Neural Networks



Ensemble Methods

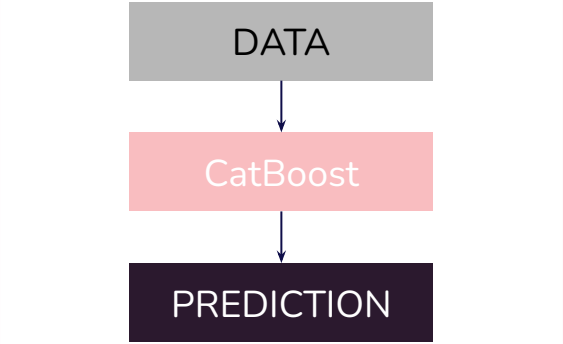
- LightGBM + XGBoost + CatBoost w/ Meta Learner

Accuracy: 0.7728
Recall: 0.7647

Best Performing Models

~~Accuracy: 0.7728~~
~~Recall: 0.7647~~

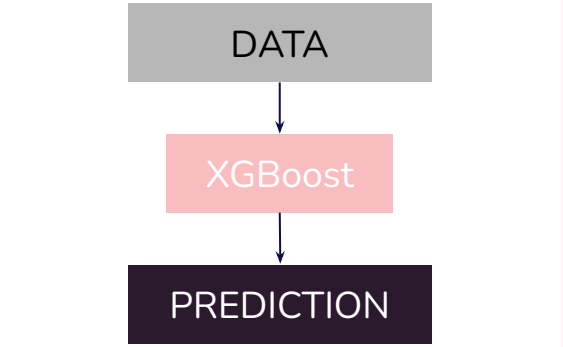
CatBoost



Accuracy: 0.7717

Recall: 0.8133

Fine-Tuned XG Boost



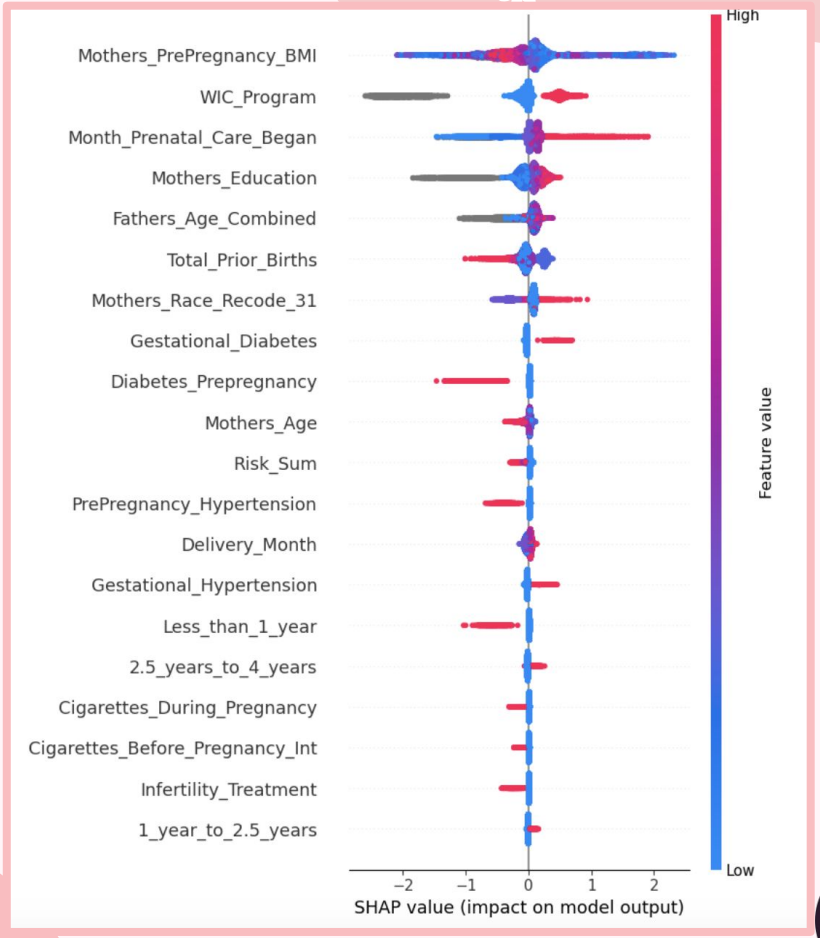
Accuracy: 0.7970

Recall: 0.8586

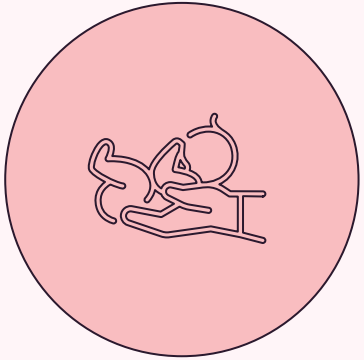
Feature Importance

- Top Predictors
  - *Mothers_PrePregnancy_BMI*
  - *WIC_Program*
  - *Month_Prenatal_Care_Began.*
- Feature Impact
  - High BMI
  - Early prenatal care
- Global Importance

*BMI: body mass index
*WIC: federal program that assists Women, Infants, and Children
*Prenatal Care: medical care during pregnancy to monitor and support the health of the mother and baby

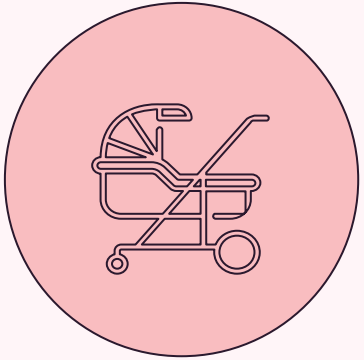


Technical Challenges



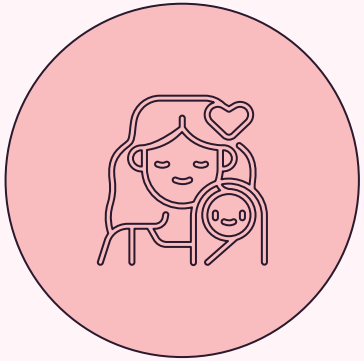
Data Collection

- Lack of available data (mainly features of interest)
- Pulling and parsing data from the CDC



Dealing with Health Data

- Health data is sparse
- Several missing data
- Understanding the features with no medical background



Feedback Loop

- Cannot add new data from users to further train our model

Ethical Considerations

Lack of Standardization in Data Collection

> Oftentimes the ones getting the least care have the most missing variables
>
> **Monica Wojcik**
> Director of the Neonatal Genomics Program at Boston Children's Hospital

> Fetal Death data is challenging to collect due to lack of resources and difficulty asking mothers questions after their stillbirth.
>
> **Elizabeth Gregory**
> Health scientist at the CDC's National Center for Health Statistics

> There is a disparity by states of how well data is collected. This could be because some states don't give mothers the worksheet to fill out the self-reported data.
>
> **Elizabeth Gregory**
> Health scientist at the CDC's National Center for Health Statistics

Future Work

- Interview and run demo with pregnant women
- Implement chatbot to replace “Tips” section
- Broaden target user to include doctors

Design 2.0

Accessing data that contains more features that are believed to the related to stillbirth risk

Access More Data

Ensuring that the data entered in the website is completely secure and not accessible by others

Data Security

Final Remarks

“Our mission is to empower pregnant individuals and their families with a groundbreaking, data-driven tool that predicts the risk of stillbirth early, offering hope, action, and equity when it matters most.”

Acknowledgements

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- **Dr. Glenn Grossman (OBGYN)**
- **Monica Wojcik** and **Micaela Mateo Smith** (Stillbirth Working Group of Council)
- **Megan Aucutt** (Healthy Birth Day / Count the Kicks)
- **Natasha Williams** (NICHD Subject Matter Expert)
- **Elizabeth Gregory** (CDC National Center for Health Statistics)
- **Sarah Lopez**, **Susannah Leisher**, and **Nathan Blue** (University of Utah Health, Stillbirth Center of Excellence)

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Thank you!