

# Early Detection of Pathological Prenatal Diagnoses Using Machine Learning

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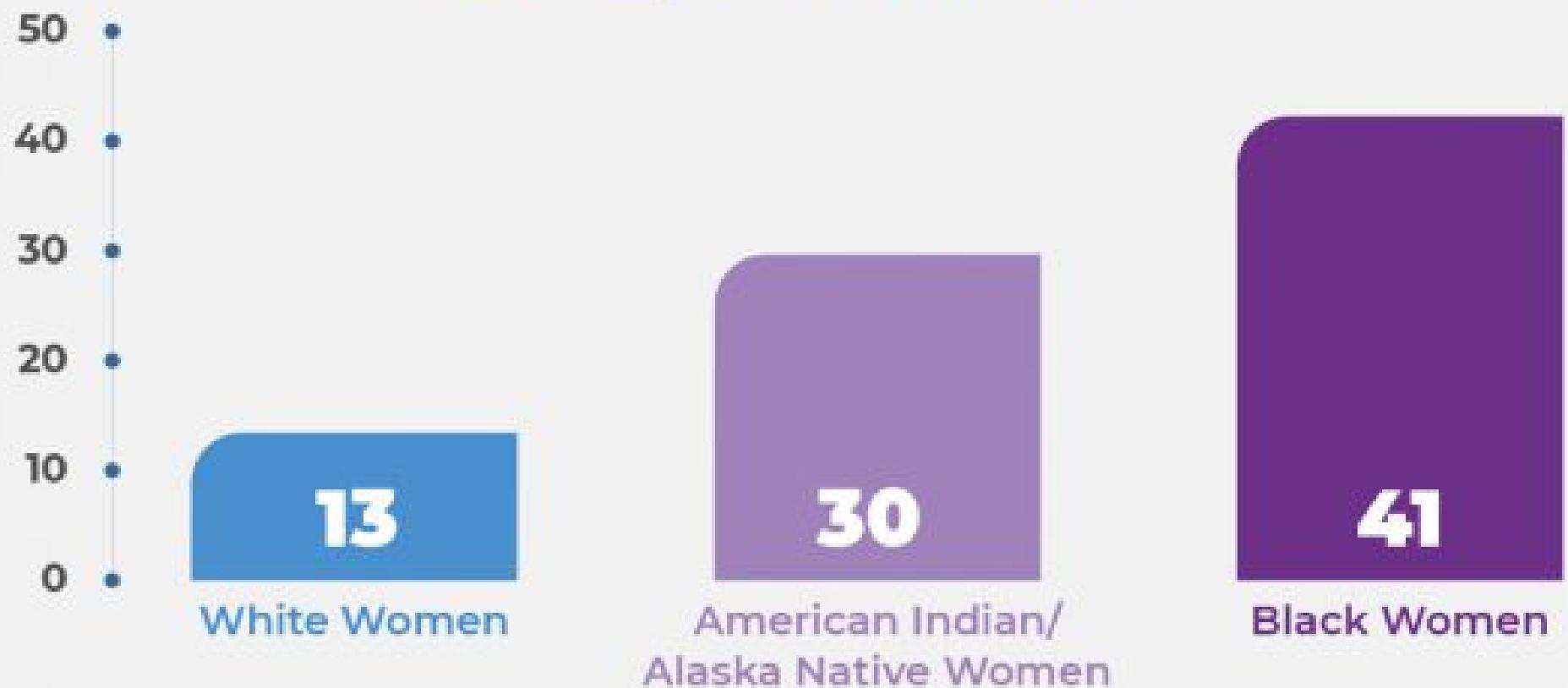
July 7th, 2022



Photo by Stephen Andrews via Upslash

## PREGNANCY-RELATED DEATHS

PER 100,000 LIVE BIRTHS



Full report: [bit.ly/maternaldeath\\_](http://bit.ly/maternaldeath_)

**PROBLEM:**  
**The United States  
is already not an  
equitable place to  
give birth**

## Abortion Bans Increase Maternal Mortality Rates

"With a total abortion ban...estimated pregnancy-related deaths would increase from 675 to 724 (49 additional deaths, representing a 7% increase), and in subsequent years to 815 (140 additional deaths, for a 21% increase)... -Duke University.

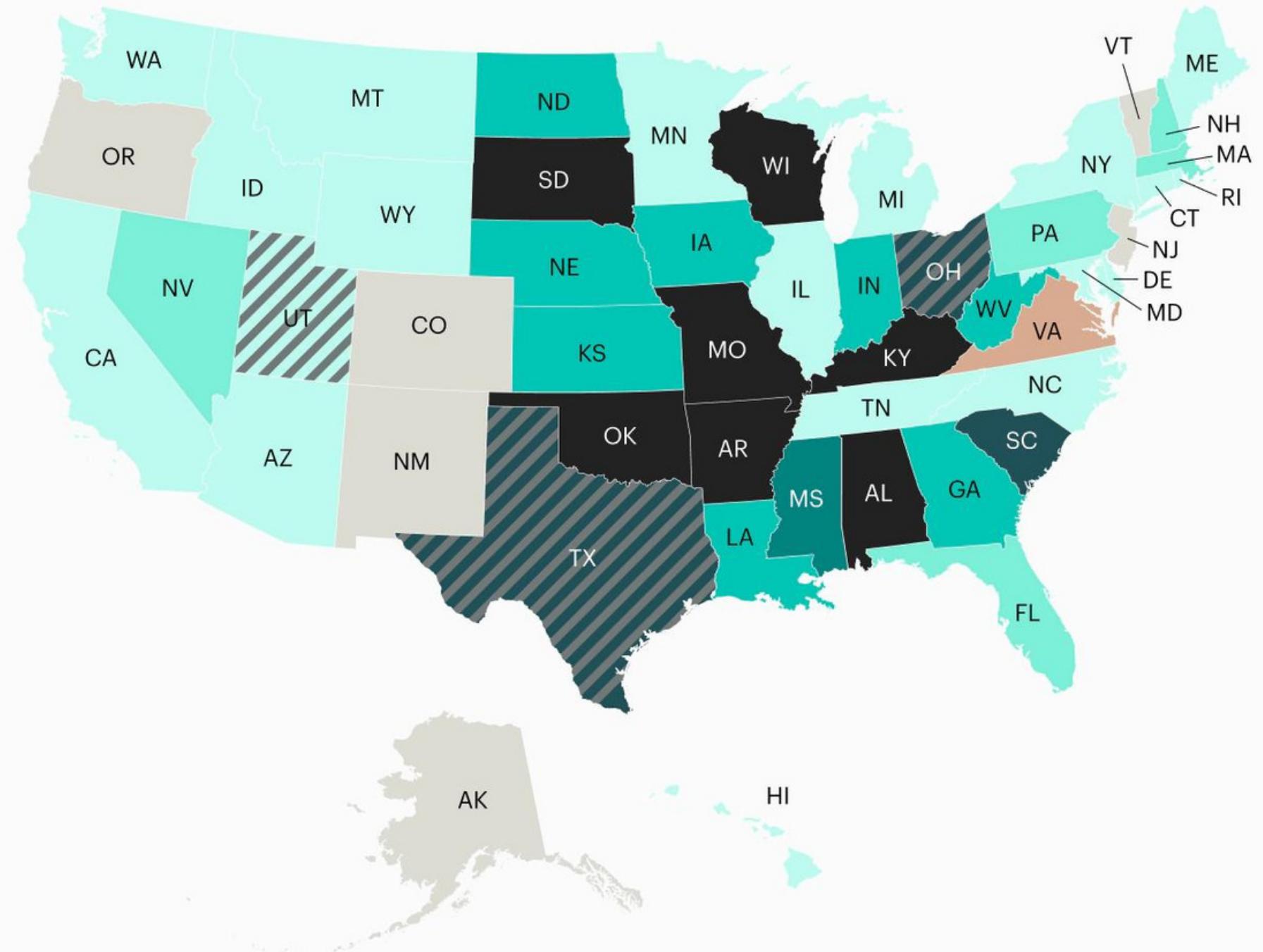
## Stakeholder 1: Stacey

- Has preexisting conditions
- Lives in a very restricted state
- Wants early detection of lethal prenatal diagnoses so she can avoid carrying to term

## State-by-state restrictions on abortion

Last updated June 28, 2022

- Abortion Ban in Effect
- Abortion Ban Temporarily Blocked
- 6-week abortion ban
- 20 weeks or later
- 22 weeks or later
- 24 weeks or later
- At fetal viability\* or later
- Third trimester
- No limits



\*Note: Fetal viability is a precedent set by Roe v Wade. It usually is interpreted as the time at or around 24 to 28 weeks of pregnancy.

Credit: Guttmacher Institute



## **Stakeholder 2: Alex**

- Strong religious beliefs
- Wants to carry to term
- Wants early detection of lethal prenatal diagnoses so she can make funeral arrangements

[Photo by Dan Meyers via Upsplash](#)

# Proposed Solution: An Early Detection Machine Learning Diagnostic Tool for Pathological Cases



[Photo of CTG by Sharon McCutcheon on Unsplash](#)

# **With early detection of potentially lethal prenatal diagnoses, NYU Langone can:**

- provide the best possible outcomes, regardless of how the birth-parent decides to proceed**
- save resources and better schedule clinicians**

# Data Source:

- 2126 rows with no missing values
- 21 continuous features

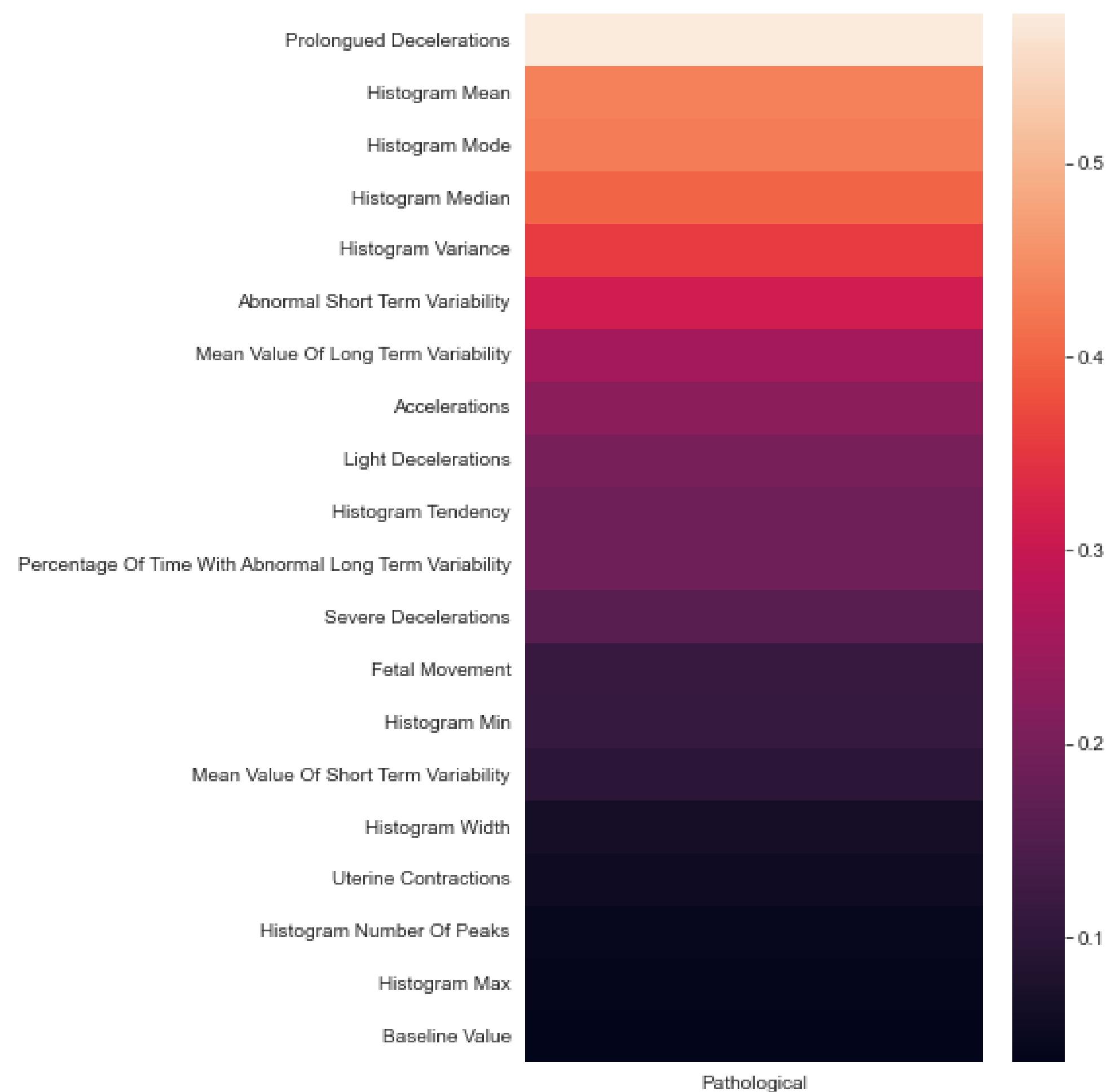
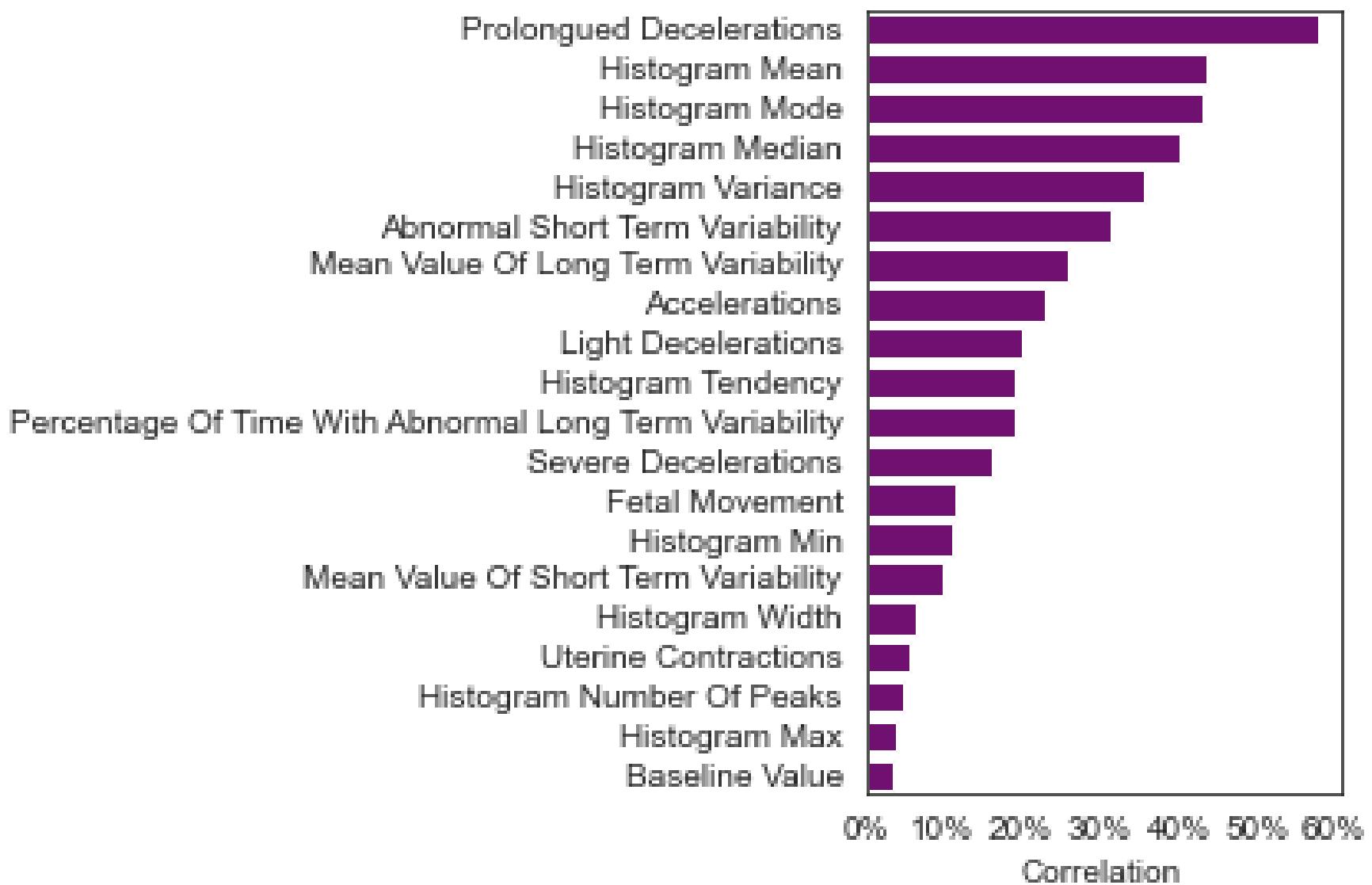
Measurements extracted from cardiotocograms and classified by expert obstetricians. Published in 2000 by:

Ayres de Campos et al. (2000) SisPorto 2.0 A Program for  
Automated Analysis of Cardiotocograms. J Matern Fetal Med  
5:311-318

# Limitations of the Data:

- Lethal Prenatal Diagnoses is only a small subset of Pathological class.
- I'll use this data as a stand in, as a proof of concept for future work.

# Correlation of Features with the Pathological Diagnoses:



Correlation

Pathological

# Methods:

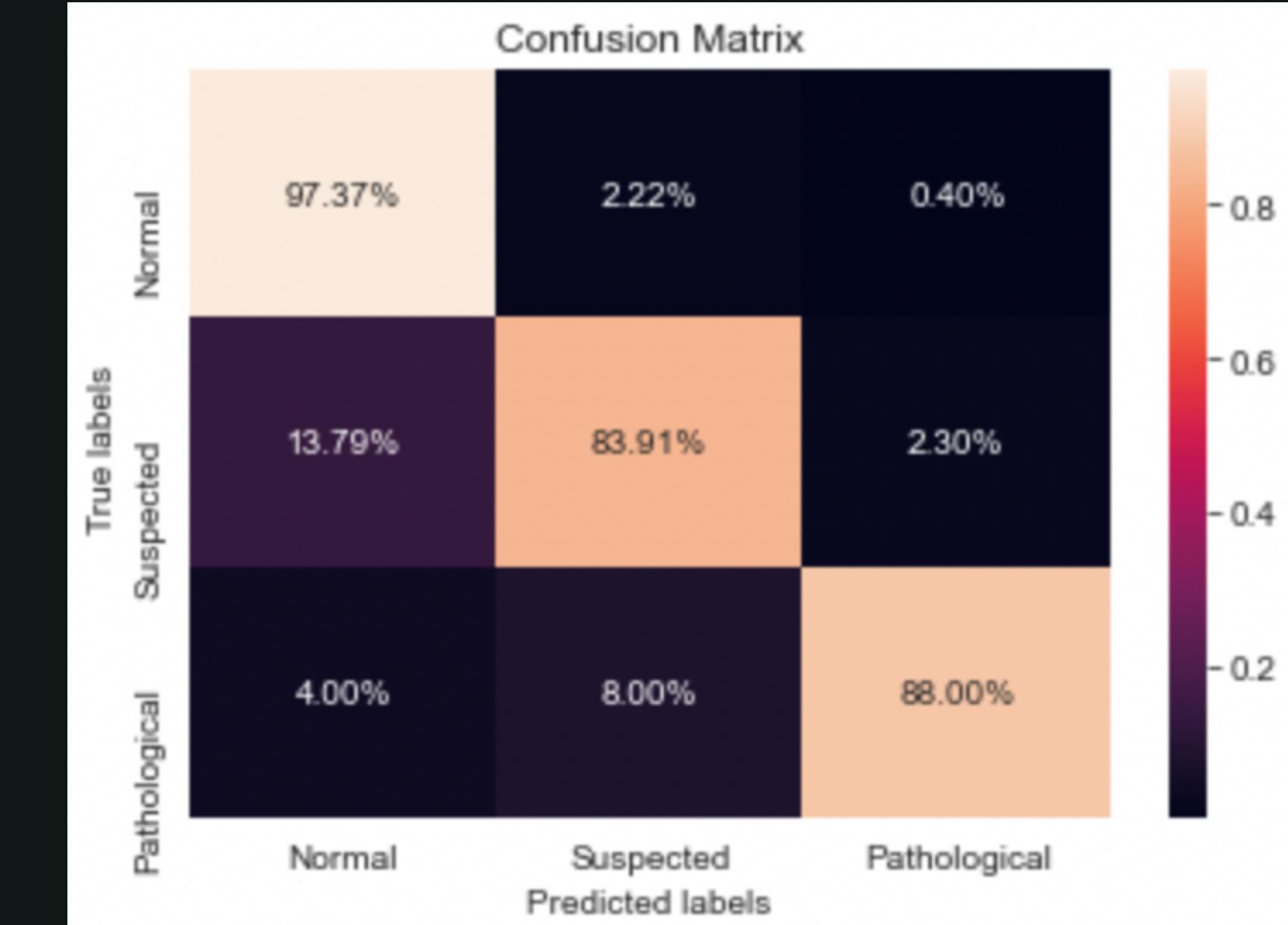
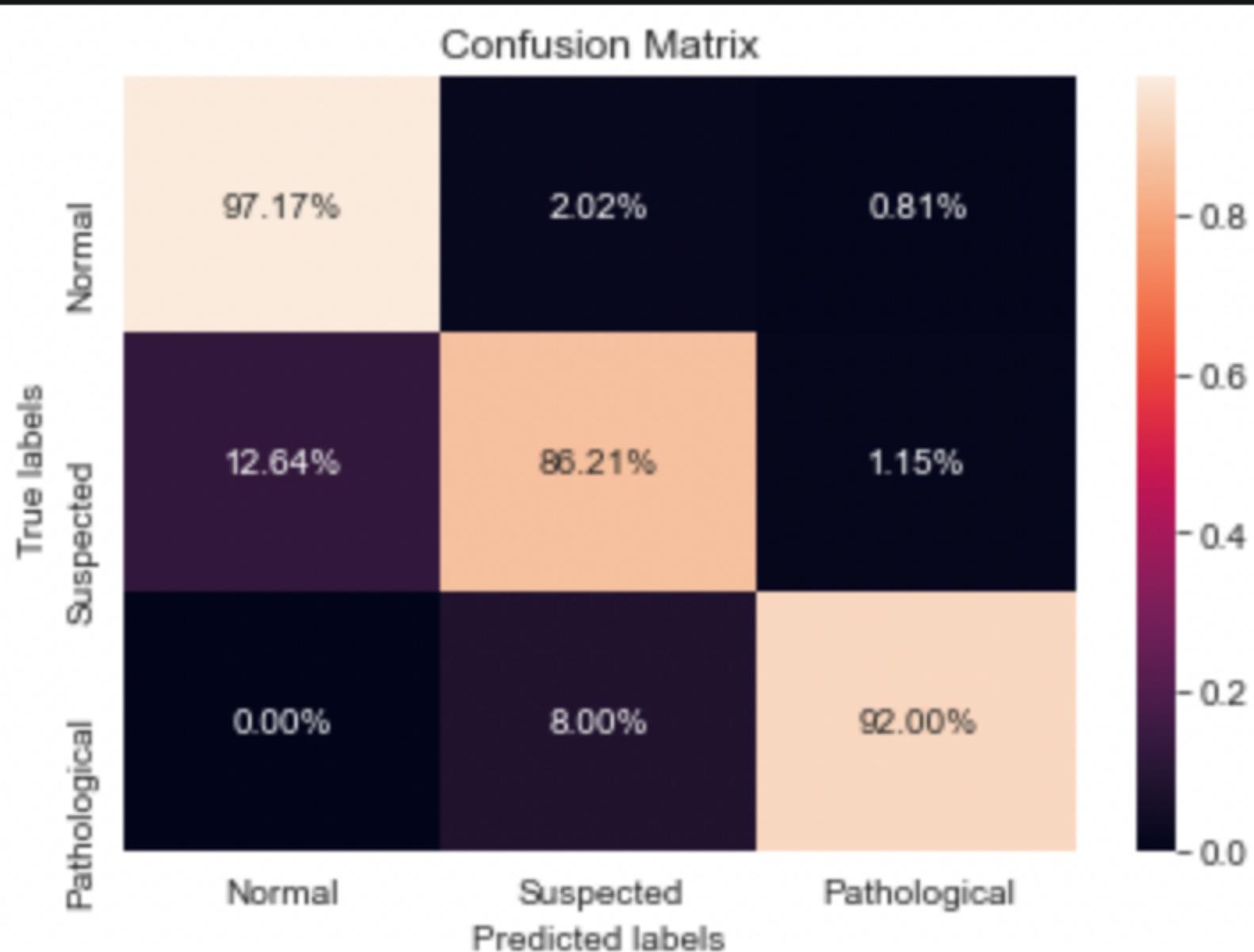
- Tried four different kinds of predictive algorithms
- Prioritized *Recall* on the Pathological Class
- Boosted performance in by running algorithm modularly, predicting *Pathological class* vs *Normal and Suspected classes*

# Results:

Model A:

Pathological Diagnoses:

- 90% Trustworthy
- Flagged 92% of all Pathological Cases
- Used all features



Model B:

Pathological Diagnoses:

- 91% Trustworthy
- Flagged 88% of all Pathological Cases
- Reduced Dimensionality

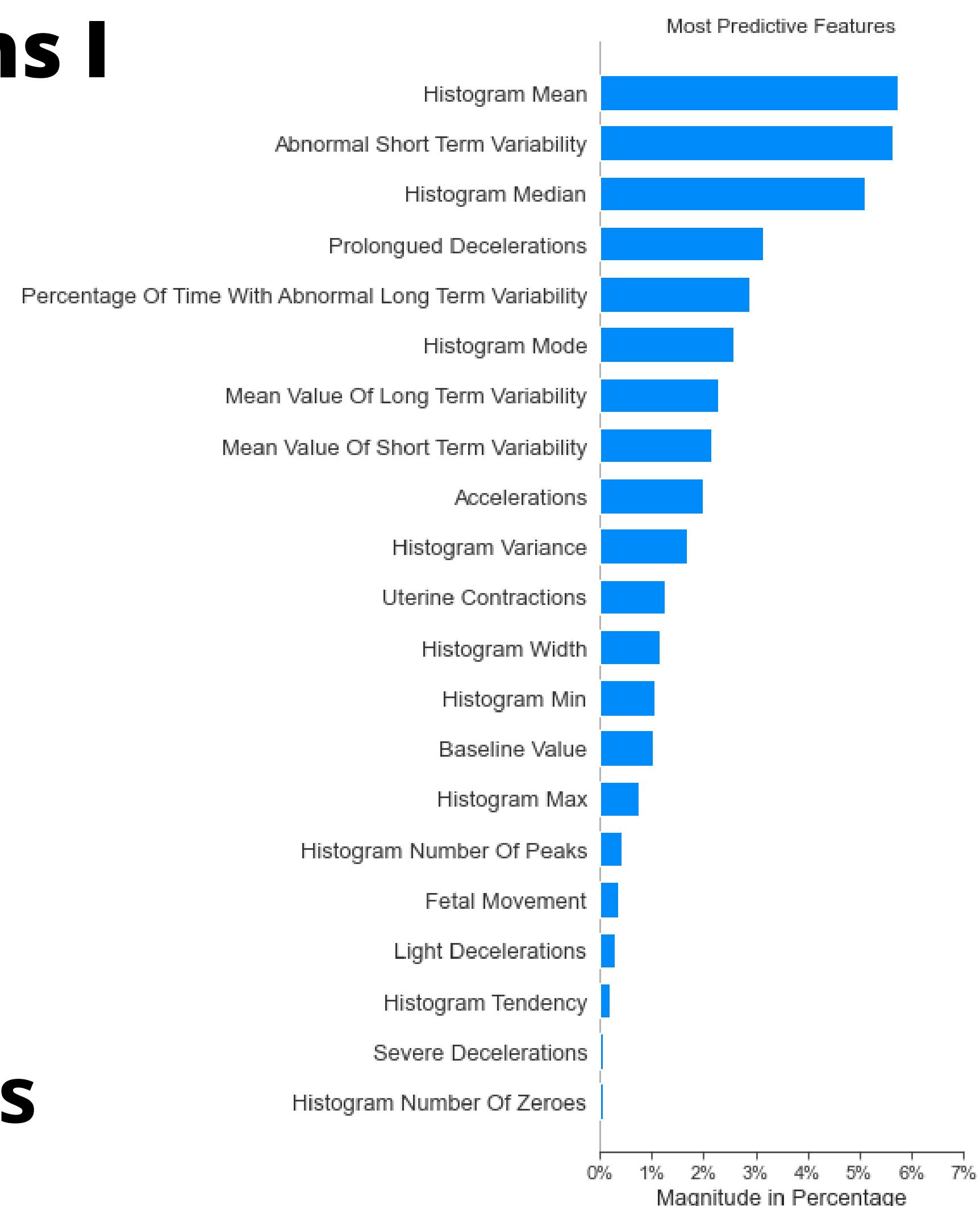
# Conclusion: Recommendations I

Birthing Centers, Hospitals and Clinics to watch for:

1) *Low histogram median*

2) *Low abnormal short term variability*

3) *High prolonged decelerations*



# Conclusion: Recommendations II

For **Stacey**: to avoid carrying a lethal prenatal diagnosis to term:

- 1) How far along are you in your pregnancy?
- 2) Get CTG test and talk to your healthcare team documenting your preexisting condition
- 3) Prescreening for Pathological Prenatal Diagnosis

# Conclusion: Recommendations III

For Alex:

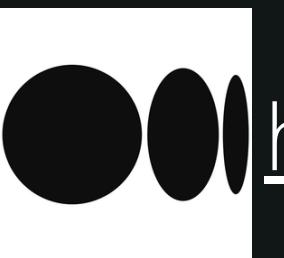
- 1) Continuity of care between your natal care team and post-natal care team
- 2) Get CTG Test and Prescreen for Pathological Prenatal Diagnoses
- 3) Planning for Infant Mortality

# Conclusion: Future Work

- 1) Roll Out Model A and Model B for A/B testing
- 2) Collect more precise data regarding lethal prenatal diagnoses
- 3) Retune Models for Best Performance
- 4) Make secondary early detection model for Suspected diagnoses

# Thank You!

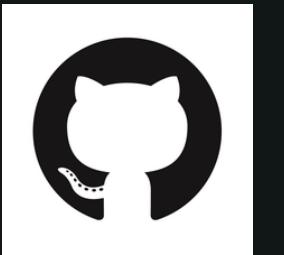
## Question and Answer



<https://medium.com/@ls.casanavet>



<https://www.linkedin.com/in/louis-casanave-78057aa0/t>



[https://github.com/casanave/fetal\\_health](https://github.com/casanave/fetal_health)



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