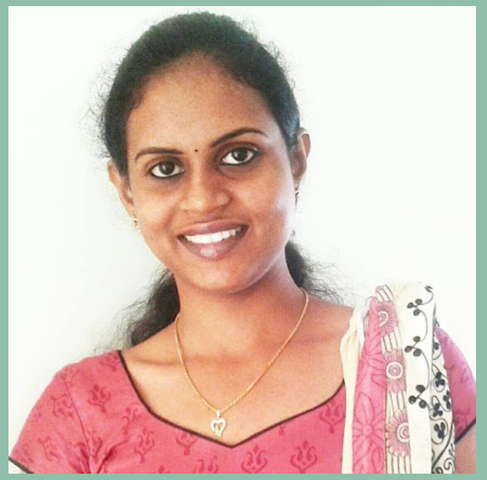
A PRESENTATION BY THANUJA

INFANT MORTALITY AND PREVENTION

ANALYSIS AND PREDICTION

BIO



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EDUCATION: Bachelors in Electrical and Electronics Engineering.

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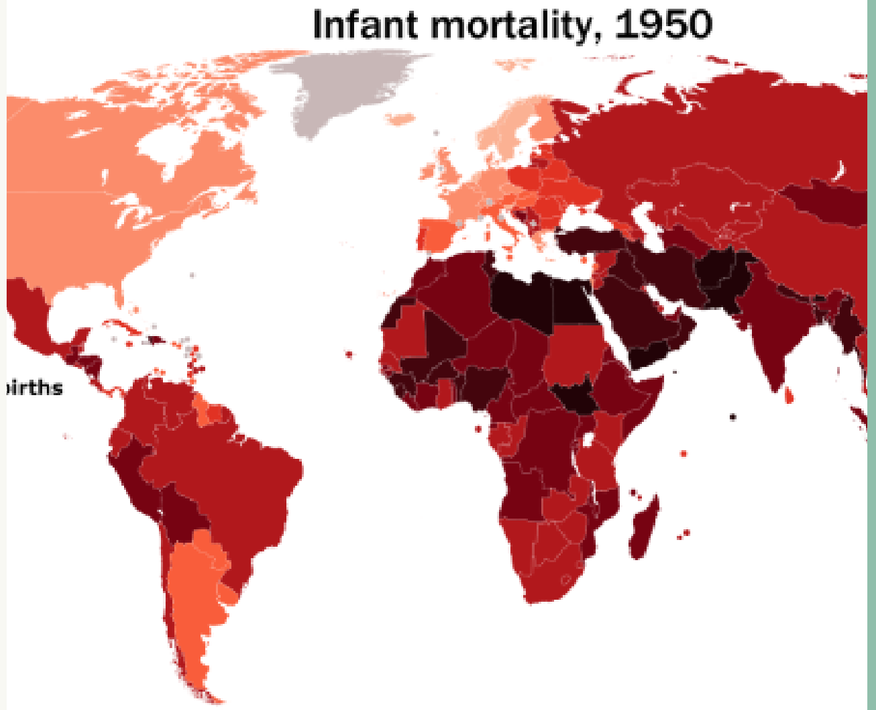
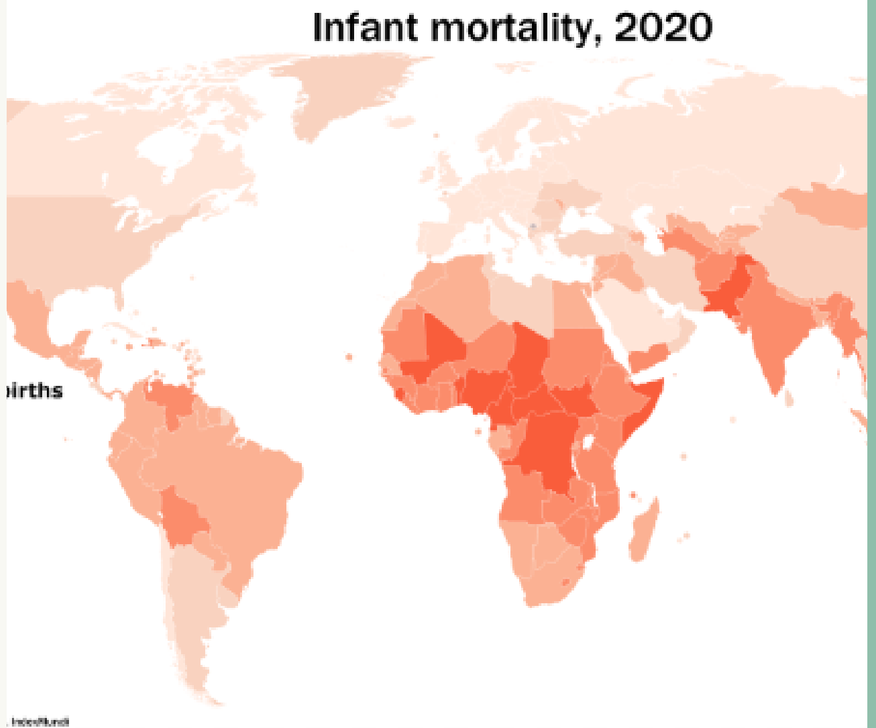
CERTIFICATION: Completing certification in Data Science and Artificial Intelligence in Institute of Data.

Contents

- WHO data Overview on Infant mortality.
- Causes, trends, and geographical variations.
- Preventable deaths.
- Introduction to Cardiotocograms(CTGs).
- Dataset overview of CTG readings.
- Prediction of fetal health based on CTG readings.
- Conclusions

TOPICS FOR DISCUSSION





What is infant mortality?

Infant mortality is a death of an infant during birth or before the age of 5 due to various reasons.

Context:

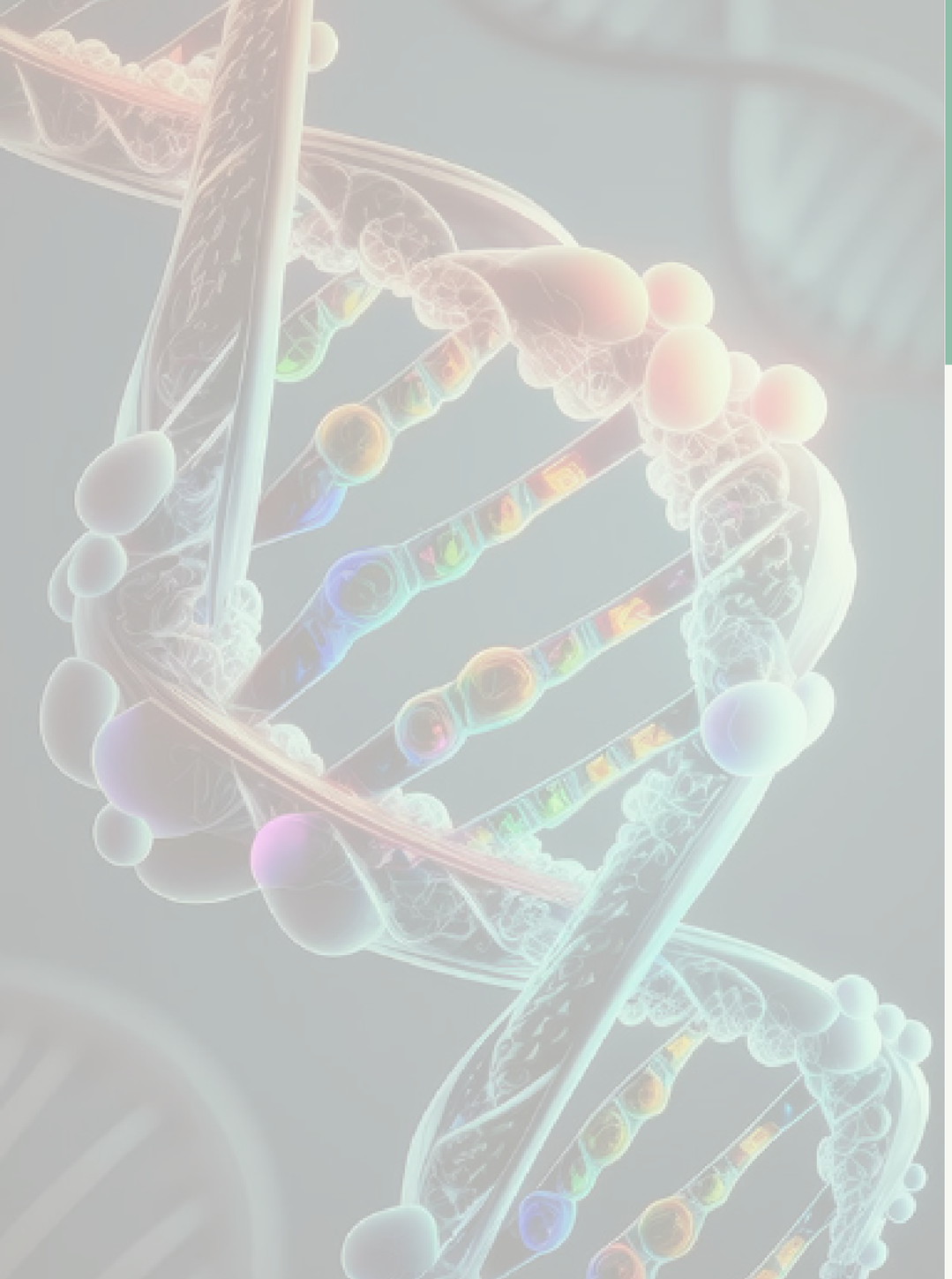
The UN expects that by 2030, countries end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce under-5 mortality to at least as low as 25 per 1,000 live births. Reduction of child mortality is reflected in several of the United Nations' Sustainable Development Goals and is a key indicator of human progress.

Business Objective

- Infant mortality involves the in-depth analysis of data related to the unfortunate deaths of children under the age of five.
- By investigating the causes, trends, and geographical variations in under-five mortality, this analysis aims to derive valuable insights that can inform policies and interventions to reduce child mortality rates and improve child health worldwide.
- Develop a multiclass classification model for CTG features to accurately categorize fetal health into Normal, Suspect, and Pathological states, aiming to aid healthcare professionals in reducing child and maternal mortality.

ABOUT THE DATASET

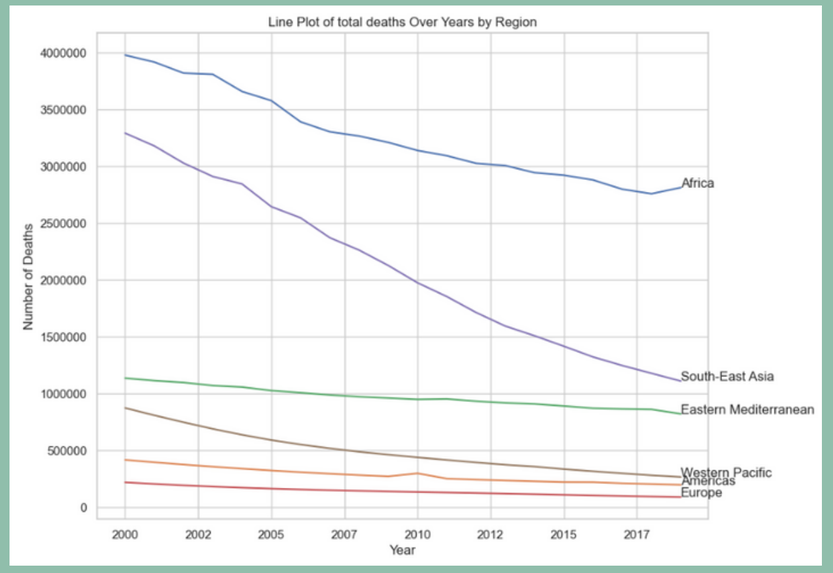
- This dataset is downloaded from WHO website. https://platform.who.int/data/maternal-newborn-child-adolescent-ageing/indicator-explorer-new/mca/number-of-under-five-deaths---by-cause
- It contains number of under-5 deaths for all the countries over a period of 19 years(2000-2019) due to various reasons.
- Dataset has 54,320 which has been used for analysis and insights.
- Dataset has 11 columns with Year, Country, Region, Income group and Number of Deaths as the important features.

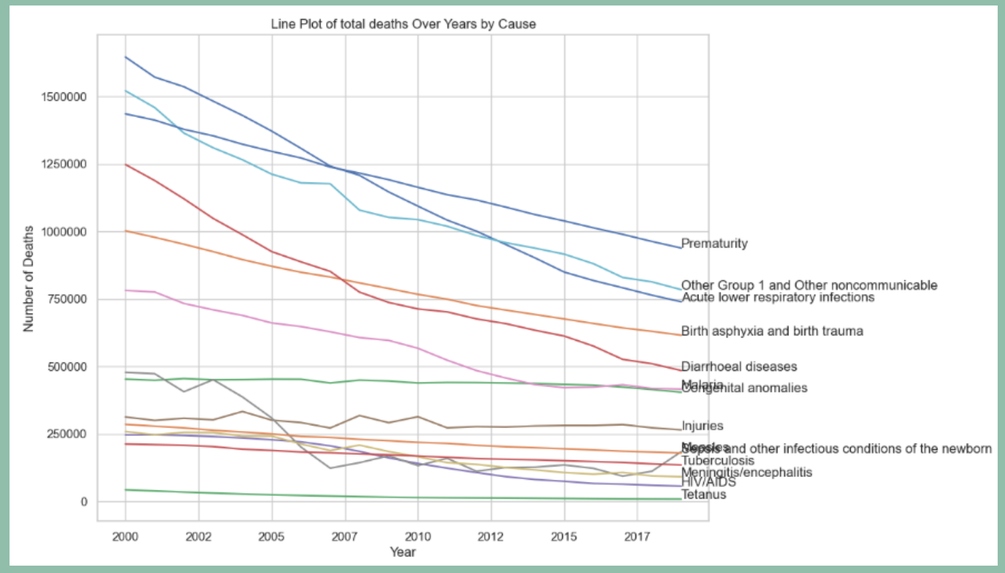


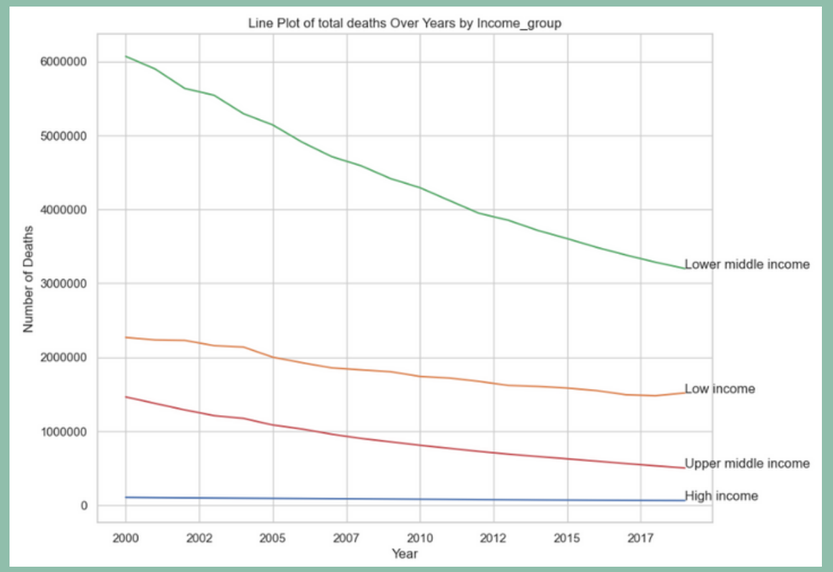
The causes of infant mortality

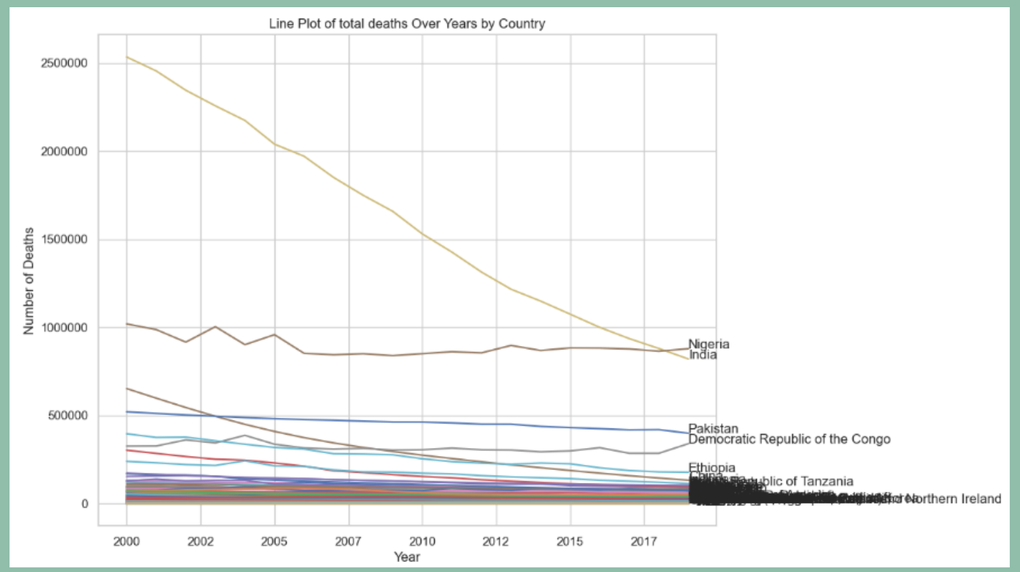
Prematurity
Acute lower respiratory infections
Diarrhoeal diseases
Birth asphyxia and birth trauma
Malaria
Measles
Injuries
Congenital anomalies
Sepsis and other infectious conditions of the newborn
Tuberculosis
Meningitis/encephalitis
HIV/AIDS
Tetanus
Other Group 1 and Other noncommunicable.

Time series Analysis of Infant Mortality









Significant work has been done by African and South-East Asian countries to reduce infant mortality.

COUNTRIES ON FOCUS

Infant mortality rate

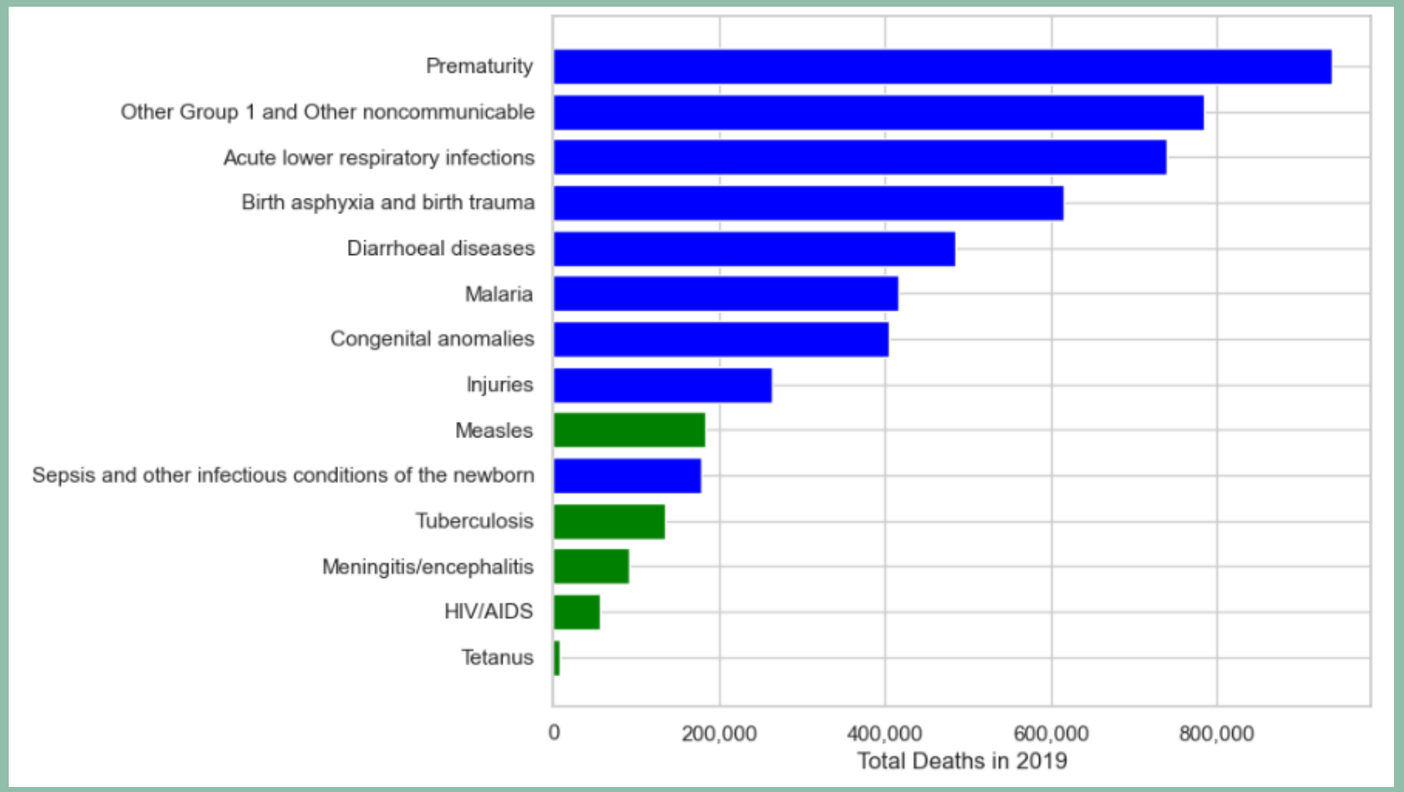
IT IS THE NUMBER OF INFANT DEATHS FOR EVERY 1,000 LIVE BIRTHS. THESE ARE THE TOP COUNTIRES TO FOCUS WITH HIGH INFANT MORTALITY RATES AND NUMBER OF DEATHS

	Cause	Country 1	Country 2	Country 3	Country 4	Country 5	Country 6	Country 7	Country 8	Country 9	Country 10
0	Acute lower respiratory infections	India	Nigeria	Pakistan	Ethiopia	Democratic Republic of the Congo	China	Bangladesh	Angola	United Republic of Tanzania	Afghanistan
1	Birth asphyxia and birth trauma	India	Pakistan	Nigeria	China	Ethiopia	Bangladesh	Democratic Republic of the Congo	Indonesia	United Republic of Tanzania	Afghanistan
2	Congenital anomalies	India	China	Pakistan	Indonesia	Brazil	Nigeria	Egypt	Mexico	Bangladesh	Philippines
3	Diarrhoeal diseases	Nigeria	India	Pakistan	Ethiopia	Democratic Republic of the Congo	Angola	Niger	Indonesia	Bangladesh	United Republic of Tanzania
4	HIV/AIDS	South Africa	Nigeria	Uganda	Zimbabwe	United Republic of Tanzania	Kenya	Malawi	Mozambique	Ethiopia	India
5	Injuries	India	China	Nigeria	Pakistan	Bangladesh	Indonesia	Democratic Republic of the Congo	Ethiopia	United Republic of Tanzania	Afghanistan
6	Malaria	Nigeria	Democratic Republic of the Congo	Burkina Faso	Mozambique	Côte d'Ivoire	Uganda	Niger	Mali	United Republic of Tanzania	Angola
7	Measles	India	Nigeria	Democratic Republic of the Congo	Ethiopia	Somalia	Indonesia	Bangladesh	Burkina Faso	Chad	Niger
8	Meningitis/encephalitis	India	Nigeria	Pakistan	Democratic Republic of the Congo	Ethiopia	Niger	Indonesia	China	United Republic of Tanzania	Bangladesh
9	Other Group 1 and Other noncommunicable	India	Nigeria	Pakistan	Ethiopia	China	Democratic Republic of the Congo	Indonesia	Afghanistan	Angola	Bangladesh
10	Prematurity	India	Pakistan	China	Nigeria	Ethiopia	Democratic Republic of the Congo	Indonesia	Bangladesh	Afghanistan	Sudan
11	Sepsis and other infectious conditions of the ...	India	Nigeria	Pakistan	Bangladesh	Ethiopia	Democratic Republic of the Congo	Brazil	Indonesia	Niger	Afghanistan
12	Tetanus	India	Nigeria	Ethiopia	Pakistan	China	Afghanistan	Chad	Democratic Republic of the Congo	Angola	Niger
13	Tuberculosis	India	Indonesia	China	Nigeria	Bangladesh	Pakistan	Myanmar	Philippines	Democratic Republic of the Congo	Viet Nam

Country	Value_Numeric	IM_rate	Ranking
Afghanistan	2055397	103	1
Somalia	1591790	85	2
Central African Republic	470829	82	3
Equatorial Guinea	75591	78	4
Sierra Leone	781812	72	5
Niger	2045169	66	6
Chad	1570557	64	7
South Sudan	777622	62	8
Mozambique	2037039	60	9
Democratic Republic of the Congo	6363786	59	10
Mali	1731634	59	11
Angola	2498657	57	12
Comoros	38809	56	13
Nigeria	17885129	55	14
Benin	772158	54	15
Côte d'Ivoire	1634345	54	16
Pakistan	9223117	53	17
Mauritania	235559	50	18
Guinea	982264	48	19
Burkina Faso	1618613	48	20

Analyzing the causes of Under-5 Deaths

- Among all the causes listed, the vaccine-preventable diseases are Measles, Meningitis/encephalitis, Tuberculosis, Tetanus.
- HIV?AIDS can be prevented with medication during pregnancy.
- Malaria and diarrheal diseases can be prevented through safe drinking-water and adequate sanitation and hygiene.
- Other genetic or developmental causes like Congenital anomalies, Birth Asphyxia, Prematurity etc can be prevented by early detection and treatment.



Cardiotocography (CTG)

Cardiotocography (CTG) is used during pregnancy to monitor fetal heart rate and uterine contractions. It monitors fetal well-being and allows early detection of fetal distress.

CTG interpretation helps in determining if the pregnancy is high or low risk. An abnormal CTG may indicate the need for further investigations and potential intervention.

This dataset contains 2126 records of features extracted from Cardiotocogram exams, which were then classified by expert obstetrician into 3 classes:

1. Normal
2. Suspect
3. Pathological

Features

- 'baseline value' FHR baseline (beats per minute)
- 'accelerations' Number of accelerations per second
- 'fetal_movement' Number of fetal movements per second
- 'uterine_contractions' Number of uterine contractions per second
- 'light_decelerations' Number of light decelerations per second
- 'severe_decelerations' Number of severe decelerations per second
- 'prolongued_decelerations' Number of prolonged decelerations per second
- 'abnormal_short_term_variability' Percentage of time with abnormal short term variability
- 'mean_value_of_short_term_variability' Mean value of short term variability
- 'percentage_of_time_with_abnormal_long_term_variability' Percentage of time with abnormal long term variability
- 'mean_value_of_long_term_variability' Mean value of long term variability
- 'histogram_width' Width of FHR histogram
- 'histogram_min' Minimum (low frequency) of FHR histogram
- 'histogram_max' Maximum (high frequency) of FHR histogram
- 'histogram_number_of_peaks' Number of histogram peaks
- 'histogram_number_of_zeroes' Number of histogram zeros
- 'histogram_mode' Histogram mode
- 'histogram_mean' Histogram mean
- 'histogram_median' Histogram median
- 'histogram_variance' Histogram variance
- 'histogram_tendency' Histogram tendency
- Target: 'fetal_health' Tagged as 1 (Normal), 2 (Suspect) and 3 (Pathological)

Machine Learning models used to predict fetal health

LOGISTIC REGRESSION

Accuracy: 89.71%

DECISION TREE

Accuracy: 91.66%

SUPPORT VECTOR MACHINE

Accuracy: 90.65%

RANDOM FOREST CLASSIFIER

Accuracy: 94.08%

Accuracy with Hyperparameter tuning: 94.98%

GRADIENT BOOSTING CLASSIFIER

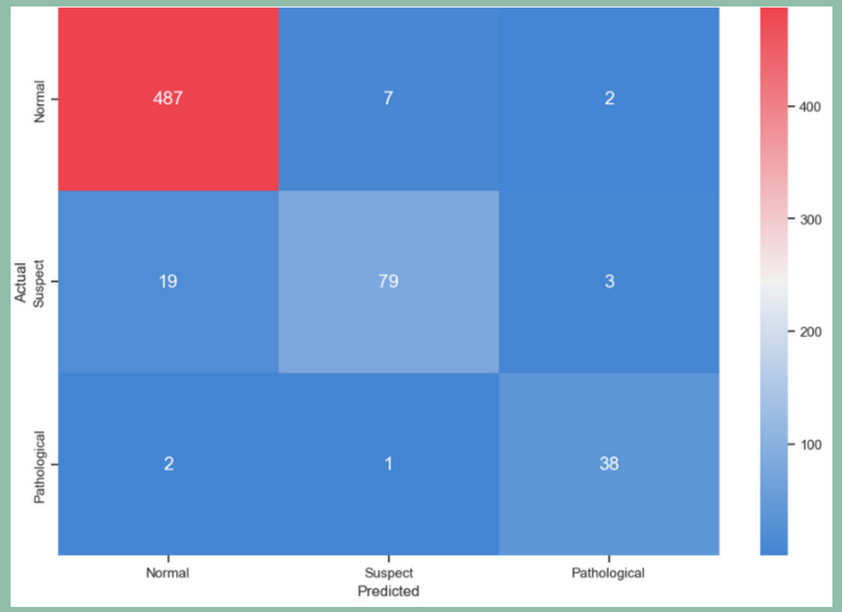
Accuracy: 93.95%

Accuracy with Hyperparameter tuning: 95.76%

Classification Report and Confusion Matrix:

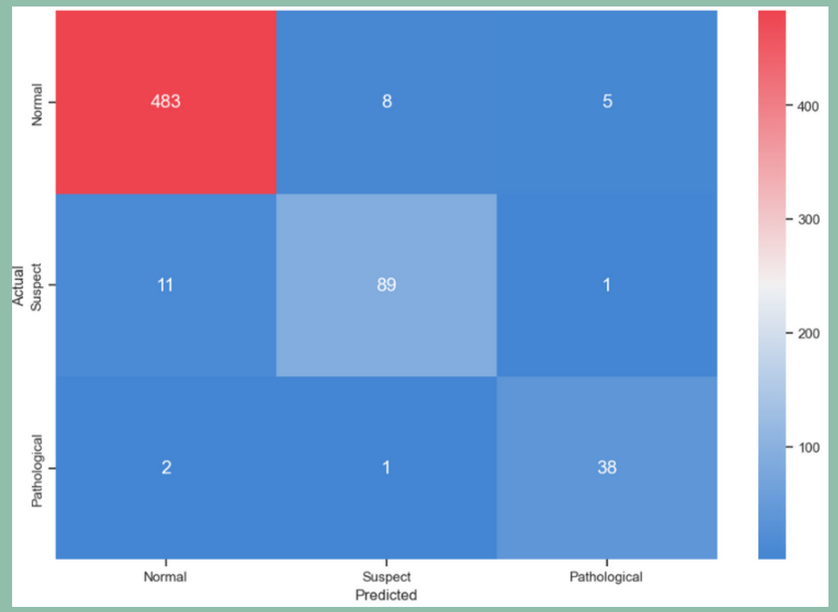
Random Forest Classifier

Class	precision	recall	f1-score	support
Normal	0.96	0.98	0.97	496
Suspect	0.91	0.78	0.84	101
Pathological	0.88	0.93	0.9	41
accuracy			0.95	638
macro avg	0.92	0.9	0.91	638
weighted avg	0.95	0.95	0.95	638



Gradient Boost Classifier

Class	precision	recall	f1-score	support
Normal	0.97	0.97	0.97	496
Suspect	0.91	0.88	0.89	101
Pathological	0.86	0.93	0.89	41
accuracy			0.96	638
macro avg	0.92	0.93	0.92	638
weighted avg	0.96	0.96	0.96	638



Predicting fetal health would require a better recall.

Gradient Boost Classifier wins

Conclusions

NEXT STEPS

Research and Develop a system for continuous monitoring of fetal health throughout pregnancy, which can alert healthcare providers to potential issues.

POLICY CHANGES

Vaccination is an effective way to prevent these diseases, and in many countries, vaccination and region specific strategies are in place to protect children from vaccine-preventable and other illnesses.

MACHINE LEARNING

The Gradient boost classifier model can be deployed into the Healthcare system where the Cardiotocogram readings are monitored. Suspected and Pathological fetal health can be sent for further diagnosis and necessary preventive steps to take.

INFANT MORTALITY AND PREVENTION

Thank you