# MATERNITY HEALTH RISKS (2022)

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*Abstract*

The aim of this project is to provide a comprehensive overview on the broad topic of Maternal Health Risks. A fine number of models were built to predict the risks that might occur in women. Maternal Mortality Ratio (MMR) is one of the serious issues faced by most of the countries. There are various factors that affect the maternal risks. Based on these factors we can classify and determine level of risk. Early identification of risk factors is essential to develop strategies that can prevent pregnancy-related complications. It can save the life of the mother as well as the child. Some of the factors that affect maternal women are Age, Systolic BP, Diastolic BP, BS(Blood Glucose/ Sugar) and Heart Rate. All these factors are responsible and significant risk factors for maternal mortality. Analyzing these factors can help in easily determining the level of risk. The algorithms in Orange tool were used to develop a model. Tableau was used to visualize the efficiency of the models. The dataset was collected from UCI Machine Learning Repository website. They collected the data from different hospitals, community clinics, and maternal health cares that were located in the rural areas of Bangladesh.

**Keywords—** Maternal Mortality Ratio (MMR), Systolic BP, Diastolic BP, Orange tool, Tableau and UCI Machine Learning Repository.

## I. INTRODUCTION

Based on the recent studies made by UNICEF in India it was observed that the Maternal Mortality Ratio (MMR) was up to 113. This has to be considered as a serious issue. Common health issue deals with the life of a single person. Whereas the maternal health issue can cause severe issues to the life of both mother as well as the child. MMR is one of the serious issues faced by our Nation. Proper measures and strategies need to be obtained to tackle this issue. An idea can be developed only after learning in detail about the relationship among the factors that effect MMR

Most of the risks lead to death because of avoiding the symptoms, considering the treatment to be expensive, fear of death and so on. If the symptoms are identified at the initial stage, measures can be taken by the patient and might even cure the disease to some extent.

Based on certain factors such as; Age, Systolic BP, Diastolic BP, BS(Blood Glucose/ Sugar) and Heart Rate, we can classify the level of risk and provide necessary measures to avoid the risk.
The risk can be classified based on the above mentioned factors. The main aim of this project is to guide the user by providing information regarding the level of risk during maternity.

## II. LITERATURE REVIEW

A study was performed on Risk factors for maternal death and trends in maternal mortality in low- and middle-income countries by 3 scholars. The objective of the study was to describe maternal mortality rates in a large, multi-country dataset and to determine maternal, pregnancy-related, delivery and postpartum characteristics that are associated with maternal mortality. With the help of above mentioned featured the risks associated with pregnancy can be identified. The methods performed consist of Generalized Linear Model to identify the relationship among various features and Multivariable Regression Model to determine the factors that were associated with maternal mortality [1].

A study was conducted on Maternal Health Situation in India. It was discovered that despite the safe motherhood policies and programmatic initiatives conducted at the national level, still the MMR remains at a peak value. It analyzes the maternal mortality and the various programmes implemented to improve maternal health. It also recommends several strategies that can be adopted to obtain a rapid progress. They selected several features that

were closely related to MMR and studies their relationship to have a clear idea about its effect on MMR. Based on the study of relationship new strategies were developed that were shared to develop the Nation, [2]

A paper was published by WHO regarding the Maternal Mortality. It was observed that the deaths that occurred due to Maternity Health issues were unacceptably high and most of these deaths could be prevented. The main reason for negligence of the symptoms that occurred during the initial stage were low- resource settings. They identified Severe Bleeding, Infections, High Blood Pressure during Pregnancy, Complications during Pregnancy and Unsafe Abortions as some of the reasons that lead to maternal deaths.[3]

An article was published on Maternal and newborn health risks of climate change. Climate change is observed as one of the largest global health threats. It is due to the least capacity of the poor countries to adapt to the changes. The article discusses about the reasons for the issues that were faced. The relationship between these factors and issue were studied in detail. They also predicted certain future steps that can be adopted to overcome this issue. [4]

Maternal and Child Health Journal consists of several articles that discusses about various factors that affect the MMR. They also come up with various measures to identify these issues at the initial stages. They also provide various medications and practices that can be performed. [5]

A scoping review was performed on The Impact of the Covid-19 pandemic on maternal and perinatal health. Perinatal health deals with the health of women and babies before, during and after birth. The review gives a clear idea that pregnant women experience more adverse outcomes compared to others. The methods that they used consist of Hand searches for articles containing the keywords such as "COVID, "corona", "maternal", "pregnant" and so on. They collected various evidences such as case reports, case series, qualitative studies and meta-analysis. Based on these papers they derived appropriate conclusions.[6]

A review was found on Long- term Effects of Pregnancy Complications on Maternal Health. Some of the factors that affect Maternal Health based on this paper are Preterm Labor, Placental Abruption, Preeclampsia, Obstetric Complications and Gestational Diabetes. In the review it was found that among the above mentioned complications, Obstetric Complication is considered as the factor that affects the Maternal Health the most. They derived this conclusion after studying various papers published on the same topic. Multiple Interventions including diet modifications, weight loss, and increased physical activity appear to be effective in reducing the risk. They also found that Moderate – Intensity Dancing reduces the risk of Cardiovascular Disease Mortality to a greater extent. [7]

An article was published on the topic Maternal Complications and Risk Factors for Mortality. The method that they used was Case – Control Study to study the causes for maternal mortalities amongst pregnant, delivering and postpartum mothers. They used Logistic Regression to identify the relationship of various features. They identified the potential risk factors as Nutritional Status, State of Anemia, History of Illness, Age, Delivery Method, Late Referral, Occupational Status and Pregnancy Complications. [8]

A Retrospective Cohort Study was conducted on the topic Maternal Age and the Risk of Adverse Pregnancy Outcomes. The study focused on the prevalence and the outcome of pregnancies conceived at extreme maternal ages. They collected the data from various sources and categorized the ages in 4 groups. The method used was Multivariate Analysis. The study found out that there is an increment of maternal age and so the women being pregnant at the extreme lower age is decreasing slowly which is considered as a positive sign. [9]

The Inter-Covid Multinational Cohort study was published on Maternal and Neonatal Morbidity and Mortality among Pregnant Women with and without COVID-19 Infection. The study deals with pregnant as well as non – pregnant women. They conducted a large- scale, prospective, multinational study to access the symptoms and associations between COVID – 19 in pregnancy and maternal and neonatal outcomes. The collected live data and came up with volunteers to study in detail about the situation. The final outcome consisted of 3 unweighted indices – (1) Maternal Morbidity and Mortality Index, (2) Severe Neonatal Morbidity Index (SNMI) and (3) Severe Perinatal Morbidity and Mortality Index (SPMMI). [10]

Systematic Review and Meta – Analysis was done on Clinical Manifestations, Risk Factors, and Maternal and Perinatal Outcomes of Coronavirus Disease 2019 in Pregnancy. The study found that the most common Clinical Manifestations of COVID – 19 in pregnancy were Fever and Cough. It was also discovered that most of the pregnant and recently pregnant women are admitted to the Intensive Care Unit and babies are more likely to be admitted to the Neonatal Intensive Care Unit.[11]

## III. IMPLEMENTATION

The implementation part in Orange begins with the study of the structure of the dataset. The attributes in the dataset can be used to determine the level of risk that the patient is undergoing. The dataset consists of 1014 instances and 7 features. Among the features, 6 of them are numerical and the remaining feature is categorical, which is also the Target variable. The Target variable consists of 3 levels, Low, Medium and High. Based on the numerical features we can classify a particular instance to its respective Target class.

Feature selection was one of the preprocessing techniques that were performed. It is the one of the best technique to identify the relevant features for classification. Here, the feature selection is performed on the basis of information gain. Once it was performed, it was identified that BS is the most important feature. BS and the level of risk are closely related, as the BS increases the level of risk also increases. Other important features are Systolic BP, Diastolic BP, Heart Rate and Age respectively.



*Figure 3.1 Feature Selection (Ranking of features)*

The dataset was split using the data sampler technique in the ratio of 8:2, where 80% of the data is selected as the training data and the remaining 20% data is considered as the test data. The Training set consists of 812 instances which is used to train the model that was built using the algorithms. Whereas the Test data consists of 202 instances, which is used to check where the model built predicts the outcome correctly. In other words, the test data are certain values and based on these values the model will predict which class suits the test case.

The algorithms used in this scenario are Decision Tree, Gradient Boosting and Naïve Bayes. Decision tree is a structure that consists of a root node, branches and leaf nodes. The top-most node is the root node. Each internal node denotes a test on an attribute. Each branch node denotes the outcome of a test. Each leaf node holds a class label. The leaf node denotes the final class that the respective node falls to.

Gradient boosting is a machine learning technique for regression and classification problems. It produces a prediction model. It can predict continuous as well as categorical target variable. Here, since the target variable, level of risk, is categorical therefore it classifies the data and predicts the target class.

Naïve Bayes Theorem considers the features in the dataset as independent from each other. It deals with each feature and predicts the result. It can be built and implemented much faster when compared to other algorithms. Due to the above mentioned advantages, this theorem is preferred whenever a dataset with huge size is observed.

Once these algorithms are performed, the model that suits the dataset needs to be identified. It was performed using the Test and Score technique. The measures used to calculate the efficiency of the model are AUC (Area Under Curve), CA (Classification Accuracy), F1 (Weighted Harmonic Mean of Precision and Recall), Precision and Recall.

A Confusion Matrix will be developed for the model that has got the highest values in Test and Score.
Prediction technique is also used to check whether the model classifies the model and predicts the correct value. The Prediction technique uses the test data to check the performance of the model.
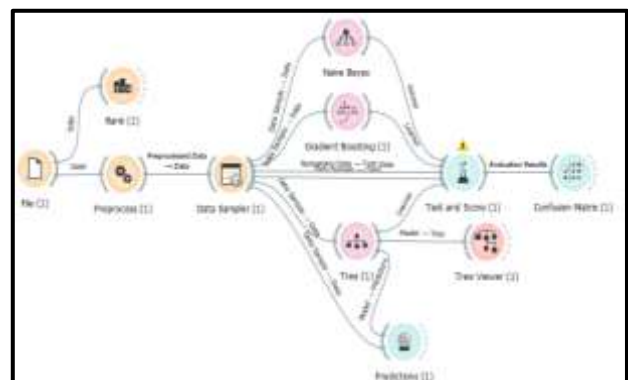


*Figure 3.2 Preprocessing and methods performed in Orange*

The implementation part of Tableau consists of creating an excel sheet containing the values derived from the Test and Score. Each model is provided with a score for each of the measures. The excel sheet is then uploaded in the Tableau and the visualization is performed on the models,

measures and their respective measure names. The data visualization methods consist of Pie Chart, Bar Chart, Bullet Graph and so on. From these methods appropriate model needs to be selected based on the relevance of the features and their relationships. Interdependencies among the features play an important role in determining the model that has to be used for visualizing.

## IV.    RESULT AND DISCUSSION MODEL

The dataset consists of 1014 instances and has got 7 attributes. The Data Sampler technique is used to divide the dataset in the ratio of 8:2. Where 80% of the data were considered as the Training data and the remaining 20% of the data were considered as the Test data.
The Training data was used to Train the models that were developed using various algorithms. The algorithms that were used are Decision Tree, Gradient Boosting and Naïve Bayes Theorem. .

| Model | AUC | CA | F1 | Precision | Recall |
|---|---|---|---|---|---|
| Tree (1) | 0.971 | 0.860 | 0.859 | 0.859 | 0.860 |
| Naive Bayes | 0.832 | 0.711 | 0.699 | 0.706 | 0.711 |
| Gradient Boosting (1) | 0.946 | 0.821 | 0.818 | 0.821 | 0.821 |

*Figure 4.1 Test and Score measures for various Models*

The Test and Score technique was used to identify the model that suits the dataset. It provided a number of measures to identify the most suitable model for the dataset. AUC, Precision and Recall are the measures that were taken into consideration in this scenario. These values were selected due to the relevance and the effectiveness of these values in the given dataset. From the Test and Score values it was identified that Decision Tree model has achieved the highest Accuracy of 97.1% and Precision of 85.9% and Recall of 86.0%.

|  | Predicted | | | |
|---|---|---|---|---|
|  | high risk | low risk | mid risk | Σ |
| high risk | 209 | 4 | 11 | 224 |
| low risk | 10 | 285 | 34 | 329 |
| mid risk | 14 | 41 | 204 | 259 |
| Σ | 233 | 330 | 249 | 812 |

*Figure 4.2 Confusion Matrix formed for Decision Tree*

Since the Decision Tree was selected as the suitable model, a Confusion Matrix was formed. When the Confusion Matrix is observed it can found that 209 High Risk instances were correctly interrupted as High Risk. Similarly 285 instances were correctly predicted as Low Risk and 204 instances were correctly predicted as Medium Risk. It was also observed that the highest error occurred was when 41 instances of Medium Risk were identified as Low Risk and 34 instances of Low Risk were identified as Medium Risks. There were also some error in predicting the High Risk instances, but they were comparatively lower than the above mentioned values.

The Test data was used for Prediction technique and Decision Tree is assigned to the Prediction technique to check the accuracy of the model. Data Visualization was performed with the help of Tableau. It provides a detailed view regarding the various measures to determine the suitable model. Tableau provided several ways to visualize the data. From the Bar Chart used to visualize the models, it can be easily identified that Decision Tree is the appropriate model for the dataset.
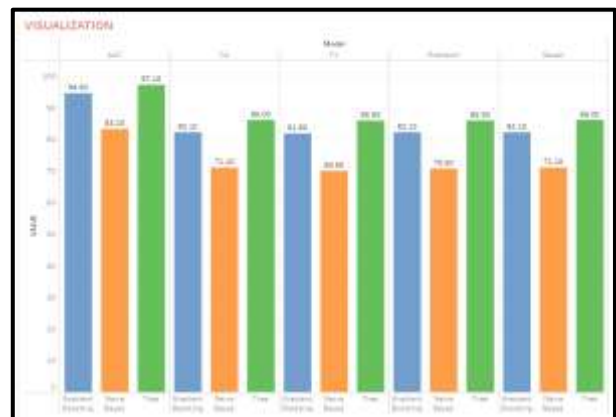


*Figure 4.3 Data Visualization of Models using Bar Chart in Tableau*

## V.    CONCLUSION

The project aims at identifying the Level of Risk during Maternity. The features present in the dataset determine the Level of Risk. When the Level of Risk is identified it becomes much easier to implement the necessary treatment and medications.

Feature selection technique provided an insight about the importance and relation of various factors present in the dataset with respect to the

Target Variable - Level of Risk. It was identified that BS (Blood Sugar) was closely related to the Target Variable. A hike in BS will also lead to a hike in Level of Risk and vice- versa. Therefore according to the model whenever there is hike in patient's BS proper attention need to provided and emergency medication should be provided.

The dataset undergoes several algorithms, such as Decision Tree, Gradient Boosting and Naïve Bayes Theorem. Decision Tree was selected as the appropriate model for this dataset. It was selected based on the scores received by the model in Test and Score technique. While observing the Test and Score values it can be identified that Decision Tree obtains Accuracy of 97.1%.

A Test instance containing values for all the attributes in the dataset, excluding the target variable, can provided for Prediction using Decision Tree model to check the Accuracy of the model.

The Model was developed in order to study in detail about the relationship among these factors and the Level of Risk. Once the relationship is identified, necessary measures and strategies can be developed to overcome the issue of MMR.

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