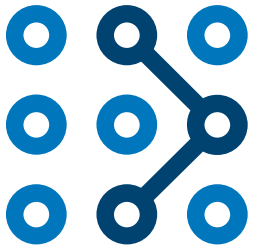

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Interpretable Machine Learning for Gender Specific Prediction of Mortality

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Introduction

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- Numerous studies have shown that female tend to live longer than male, and this is believed to be due to physiological differences.
- This work aims to find the predictors of all-cause mortality by developing a machine learning model that is gender-specific and interpretable. To help personalized dissemination of urgent care.
- Factors like age, gender, surgical procedures, and disease progression are linked to patient mortality rates. Identifying personalized predictors of mortality can help manage it.

Problem Statement

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- **Q1** Can interpretable machine learning be used to
  - predict mortality accurately?
  - Explain the reason for mortality prediction?

- **Q2** Are there gender differences in the primary mortality predictors?

Data Source

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- The Texas Public Use Data File contains data on discharges from Texas hospitals.
- For this study, data from Texas hospital Inpatient Discharge General Use Data File containing 1,493,150 patient records of 710,385 male and 782,765 female were analyzed.
- As we review the patient records, it becomes evident that the data exhibits nearly equal distribution between male and female.

Input Variables

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Primary Variables

- **Admission type**
  - "Admission type" refers to the reason or method a person enters a hospital.
- **Race**
  - "Patient race" refers to a demographic characteristic related to an individual's racial or ethnic identity.
- **Admission Source**
  - "Admission source" is how a person enters at the hospital for treatment.
- **Length of Stay**
  - "Length of stay" in healthcare refers to how long a patient is in the hospital for treatment.
- **Age**
  - "Patient age" refers to the chronological age or number of years a person has lived.
- **Illness Severity**
  - "Illness severity" is how much a person is affected by a medical condition.

Derived Variables

- **Types of Complications Developed during Stay**
  - It refers to the length of the patient's hospital stay resulting from the development of complications.
- **Total Surgeries during The Stay**
  - It refers to the length of the patient's hospital stay resulting from the total surgeries.

Methodology

- We used three machine learning models : Logistic Regression with Ridge and Lasso, and Gradient Boosting with Ensemble learning to predict gender-specific mortality risk

ML Algorithms	Description
Logistic Regression **+** **Lasso** **OR** **Ridge**	**Logistic regression - binary outcomes (yes/no)** **Logistic regression with Lasso and Ridge provide:** • **better model stability** • **prevents overfitting** • **performs feature selection** • **identify important predictors** • **flexibility to control model complexity** • **useful with high-dimensional data**
Gradient Boosting **+** **Ensemble Learning**	**Gradient Boosting - an ensemble machine learning technique.** • **builds predictive models sequentially to minimize errors** • **combines multiple weak models to create a strong predictor** • **used in various applications for its high accuracy.** **Ensemble learning enhances Gradient Boosting by:** • **improving predictive accuracy,** • **reducing overfitting and** • **increasing robustness.** **It combines the strengths of multiple models for better performance.**

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Demographic Information: Race and Gender

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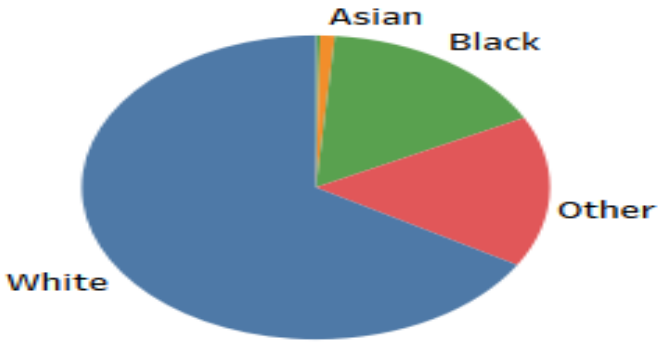
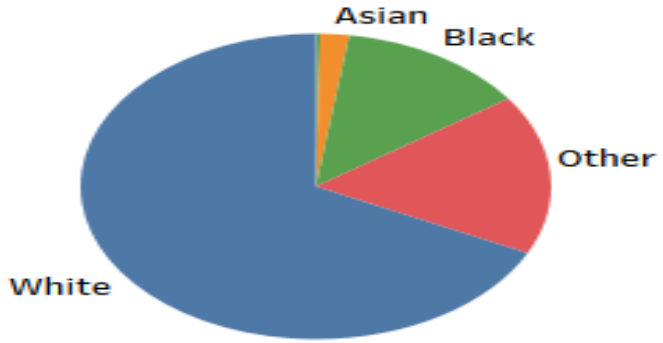
FEMALE



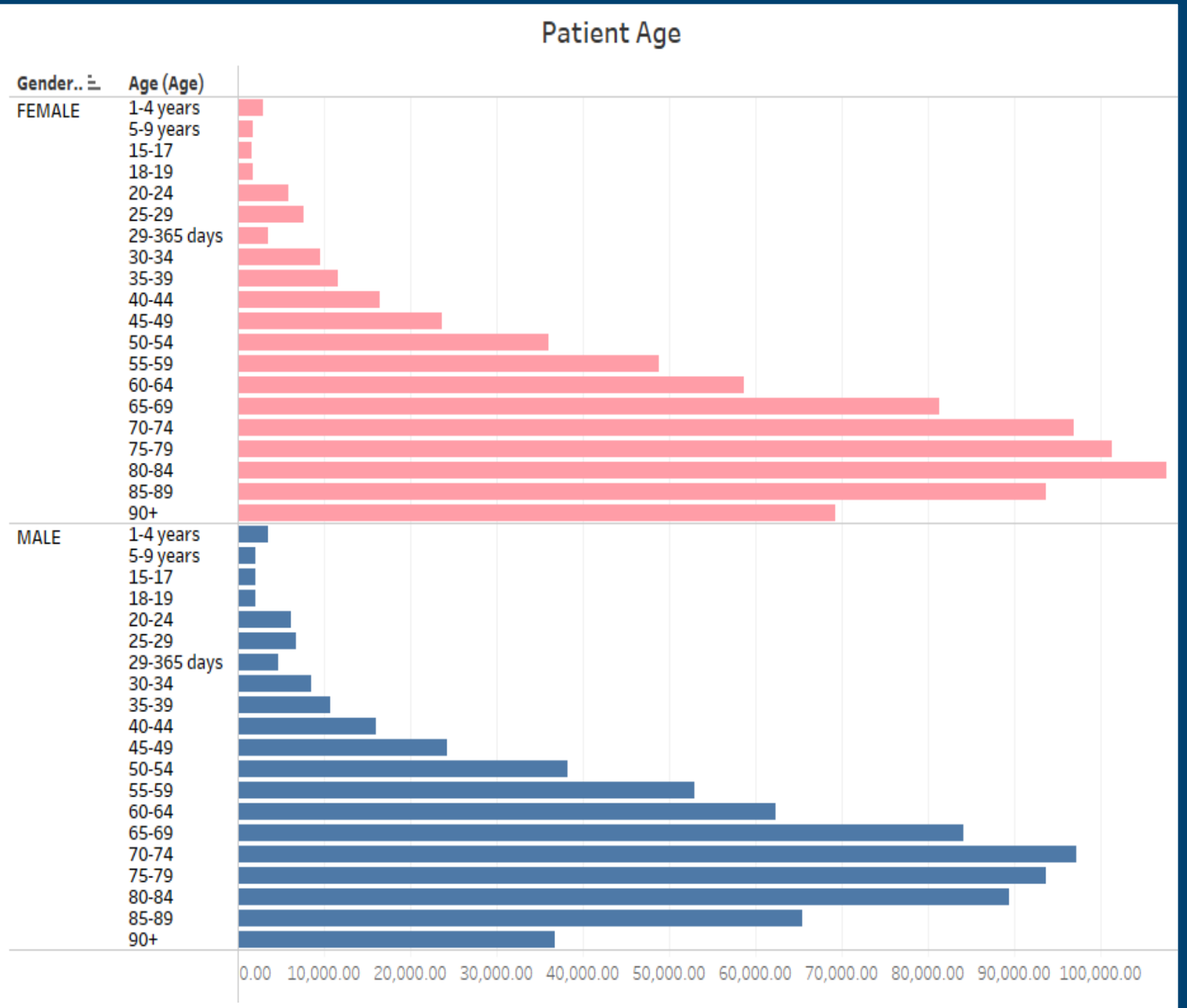
MALE



Predictive mortality race distribution by gender is almost the same for male and female.

Demographic Information: Age and Gender

According to data visualization, evidence highlights that female tend to live longer than male.



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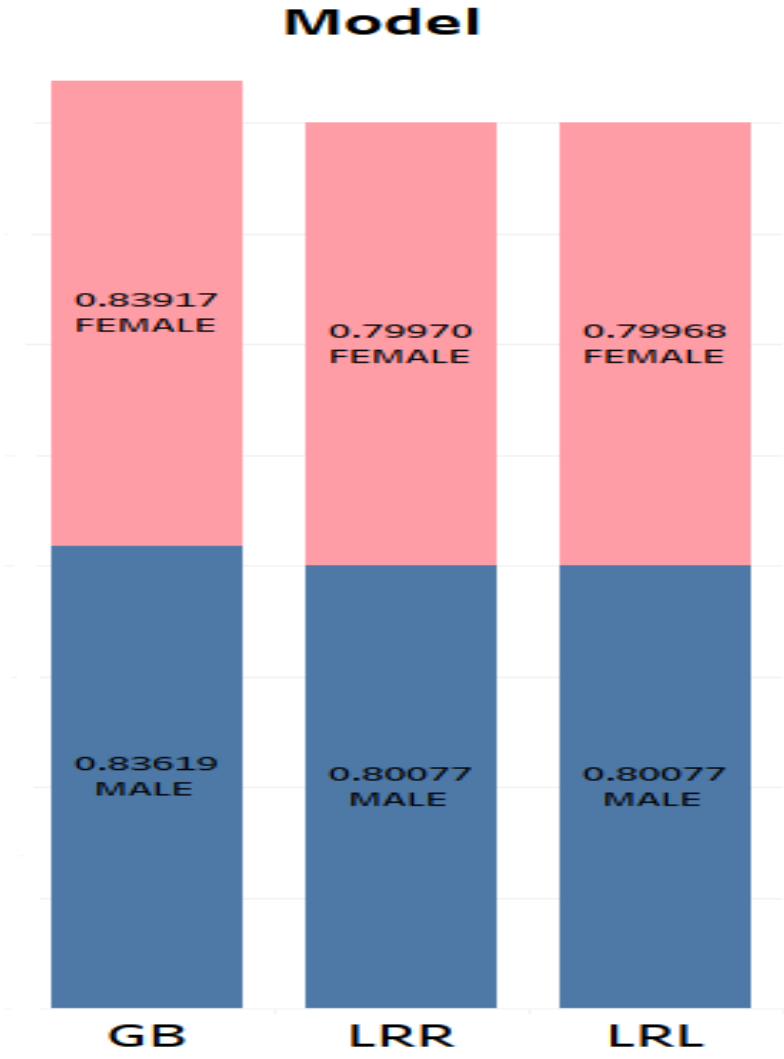
Machine Learning Model Results

- In our study, we discovered that the most effective model is the **Gradient Boosting model** for both men and women.
- The best AUC-ROC with 5-fold cross validation was found to have a mean of **0.836** for male and **0.839** for female respectively using Gradient Boosting.



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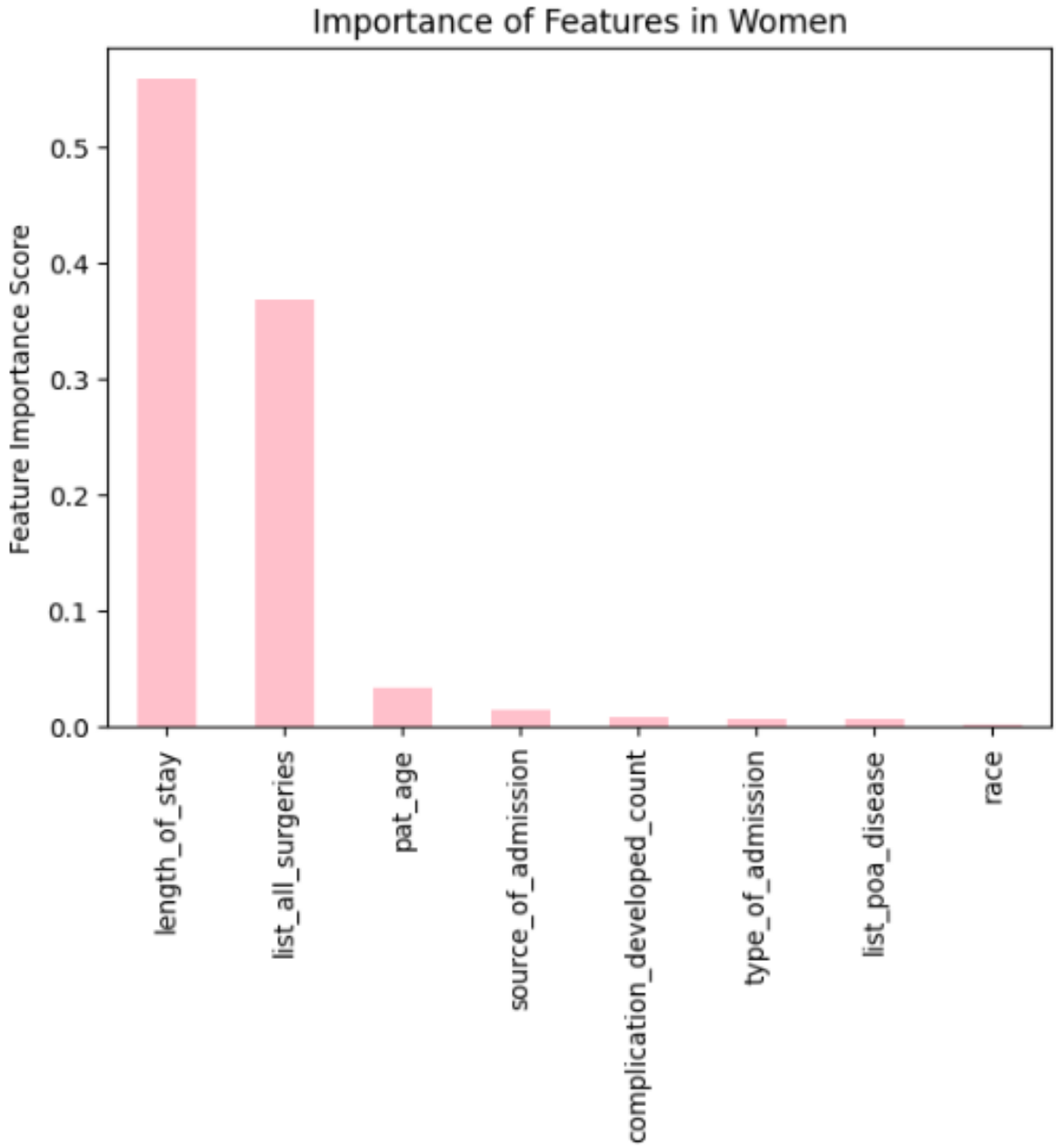
Results: The top three variables for female

- Top three variables that impact mortality in female.
- The top 3 variables impacting mortality in women were **length of stay(day), total surgeries during the stay(day), and patient age** respectively.



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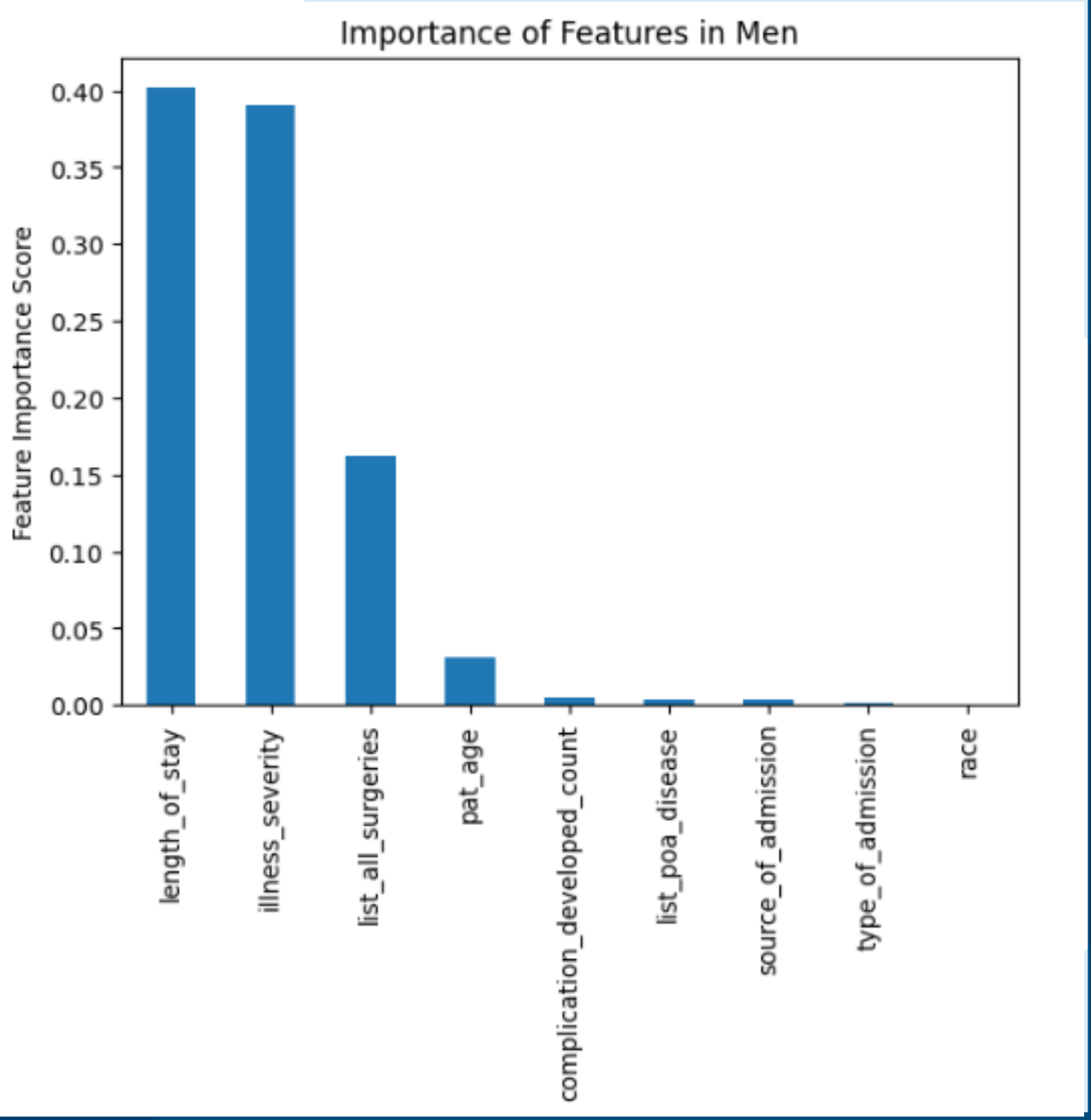
Results: The top thre variables for male

- We identified the top three variables that impact mortality in male.
- The top 3 variables impacting mortality in men were **severity of illness, length of stay(day), and total surgeries during the stay(day)**.



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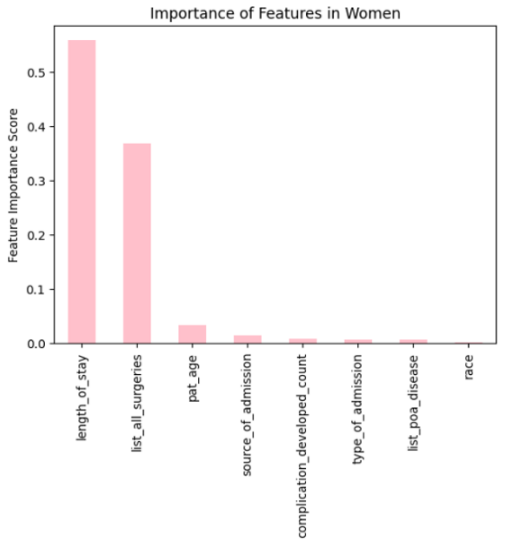
- Comparison of top three variables affecting the mortality rate in male and female.
  Outcome: female's **patient_age** and male's **severity_of_illness** were different.

Result

- We identified the top three variables that impact mortality in women.
- The top 3 variables impacting mortality in women were length of stay, total surgeries conducted during the stay, and patient age respectively.



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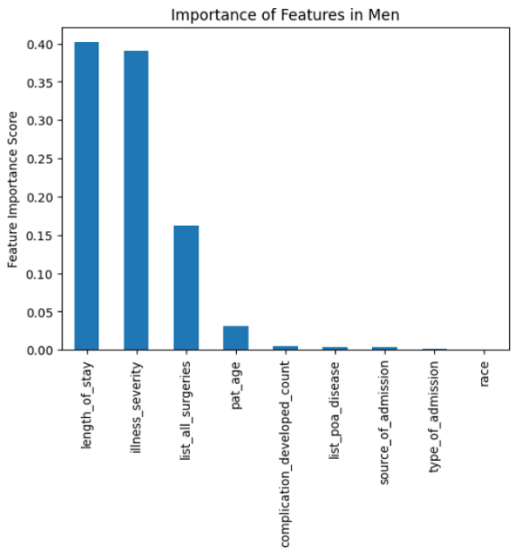
Result

- We identified the top three variables that impact mortality in women.
- The top 3 variables impacting mortality in men were severity of illness, length of stay, and total surgeries during the stay.



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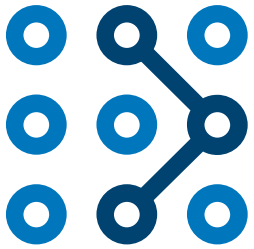
Conclusion

Our research suggests that considering gender-specific input variables might give insights to manage mortality.



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Thank you for your attention!

Any Questions / Comments