CSE558 Data Science Midsem Project

The Predictive Predators

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Dataset

Dataset (Link): Contains data points for 10 years of clinical care for 130 US hospitals relating to diabetes patients.

Size: (101766 x 48)

Some Features are:

Demographics	race, gender, age, weight
Clinical Info	Time_in_hospital (days), num_procedures, num_medications, A1Cresult (Result of HbA1c test which measures the blood glucose level), etc.
Diagnosis	diag_1, diag_2, diag_3 (diagnosis coded as first three digits of ICD9)
Medication Change	Metformin, repaglinide, nateglinide, etc. (up, down, steady, no)
Label	Readmitted (If the patient was readmitted (<30, >30, No))

Problem Statement

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What are the key factors contributing to readmission in diabetic patients?

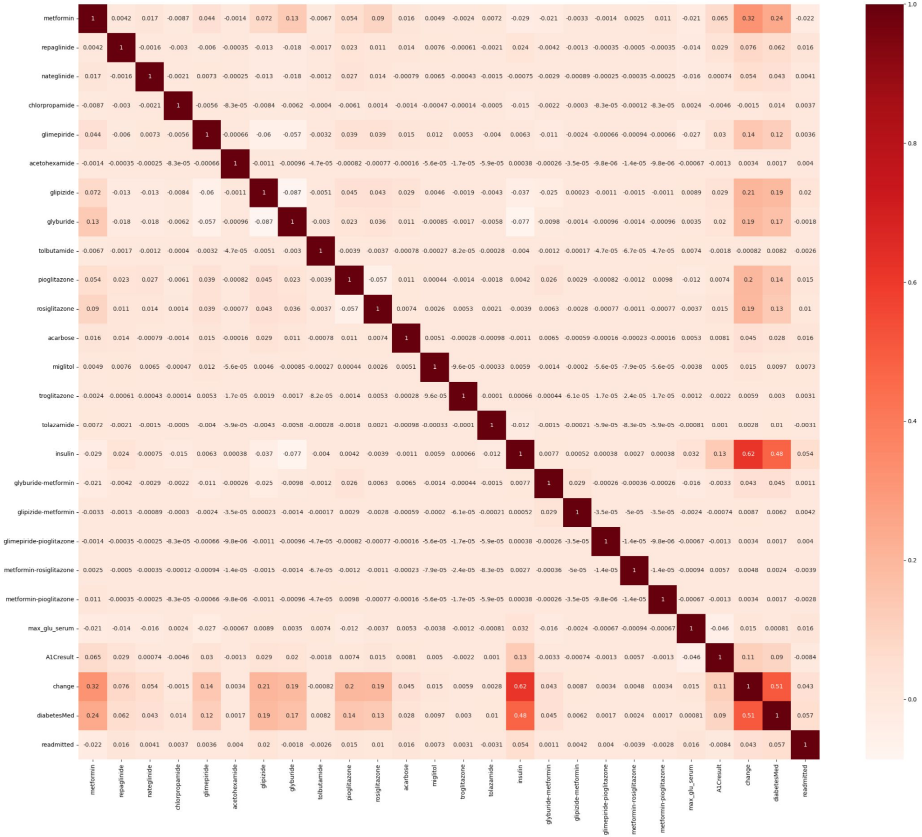
Objective:

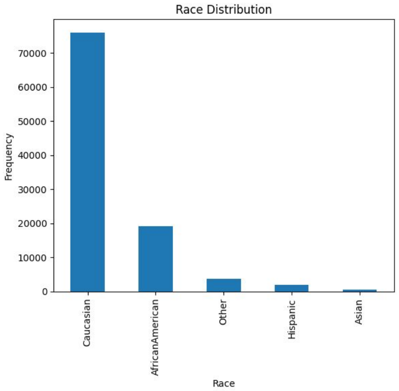
- Use **data analysis and feature importance methods** to identify factors (e.g., HbA1c levels, medication, length of stay, demographics) linked with readmission.
- Provide actionable insights for **customizing patient care** to minimize readmission risks.

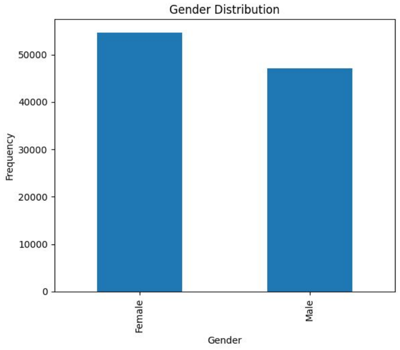
Importance:

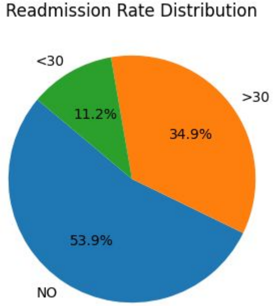
- **Improves Patient Outcomes**: Reduces risk of complications by focusing on critical readmission factors.
- **Optimizes Resource Use**: Helps hospitals allocate resources effectively, targeting high-risk areas.
- **Enables Targeted Interventions**: Insights guide adjustments in discharge planning, medication management, and follow-up care.

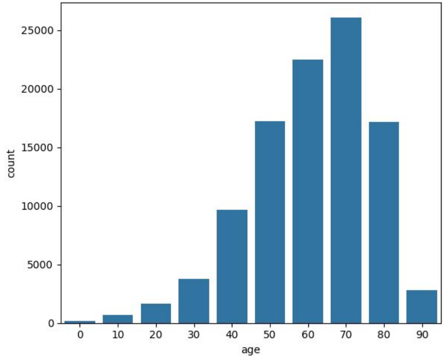
Exploratory Data Analysis











Exploratory Data Analysis

Insulin & Readmission: Moderate positive correlation with readmission, suggesting higher readmission likelihood for insulin users.

Insulin & Medication Change: Positive correlation with "change" and "diabetesMed," indicating frequent adjustments in insulin patients.

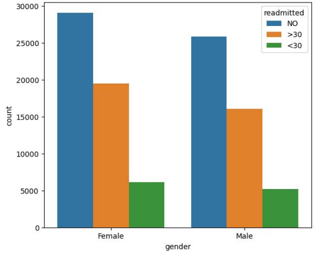
Weak Correlations: Factors like insulin usage contribute to readmission risk but are not standalone predictors.

Age Distribution: Higher concentration in 50-80 age group, especially 70-80, with higher readmission rates, particularly >30 days.

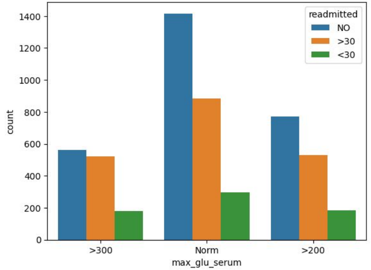
Gender Distribution: Slightly more females; similar readmission patterns for both genders with most patients not readmitted.

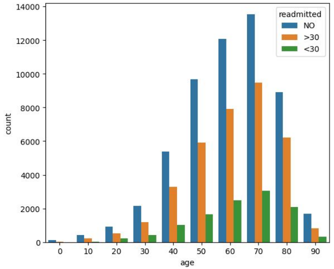
Race Distribution: Majority Caucasian, followed by African American; similar readmission trends across races with low <30-day readmissions.

Age Distribution by readmission: The distribution of all the readmitted classes seem to follow similar pattern.



Max Glucose Serum vs. Readmission





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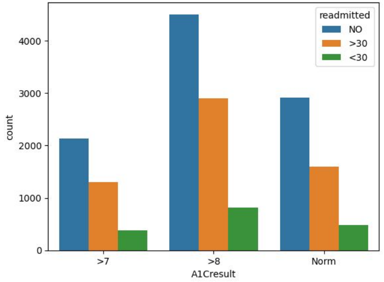

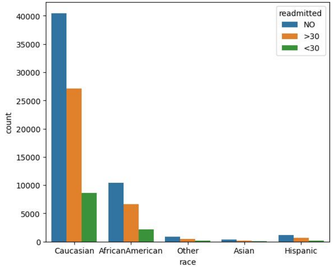

Preprocessing

To prepare the dataset for analysis and model building, we applied the following tasks to handle missing values :-

1. **race**: Missing values were categorized as "others" to retain data diversity without creating imbalance.
2. **weight**: Dropped due to ~97% missing values, as it would contribute minimal usable information.
3. **payer_code**: Dropped because it had limited relevance to readmission prediction (~40% missing)
4. **medical_specialty**: Filled missing values as "missing" to maintain the sample count without loss of potentially useful information. (~49% missing) [1]
5. **diag_1**: Primary diagnosis (21 rows) with missing values dropped, as these represented a very small portion of the data.
6. **diag_2** & **diag_3**: Filled missing diagnosis codes with values from the previous diagnosis column to retain continuity in patient health history.
7. **readmitted_binary:** New feature made to identify if a patient was ever readmitted.

Preprocessing

Label Encoding: Applied manual encoding to key features with ordinal relationships, like medication status (Up = 3, Down = 2, Steady = 1, No = 0) and test results for max_glu_serum & A1Cresult. For features like change and diabetesMed, we encoded binary values (Yes/No) to 1 and 0, and we encoded readmitted values as: >30 = 2, <30 = 1, and NO = 0 to reflect increasing levels of readmission concern.

Effects of Preprocessing:

1. Improved data consistency by addressing missing values systematically.
2. Retained a higher number of records by filling or encoding instead of excessive data removal.
3. Reduced dimensionality by removing irrelevant or highly sparse features (e.g., weight and payer_code).
4. Manual encoding preserved interpretive continuity, allowing the model to understand and differentiate levels of medication change or test results.

Final Dataset Size: (101742 x 45)

Hypothesis Tests

1. **t-test** to compare mean of time_in_hospital of those readmitted and those who were not readmitted. Null Hypothesis: The mean time spent in the hospital is equal for patients who were readmitted and those who were not readmitted.
2. **Chi-Square test of independence** to determine if age distribution varies across different readmission categories.

   Null Hypothesis: Age distribution is independent of readmission status, meaning the age distribution is similar across different readmission categories.
3. **Chi-Square goodness of independence** to check if A1C Result and Readmission are related. Null Hypothesis: A1C results (whether normal, >7, >8, etc.) are independent of the readmission status.
4. **Chi-Square goodness of independence** to check if insulin medicine and Readmission are related. Null Hypothesis: The use of insulin is independent of the readmission status.

Hypothesis Tests' results

1. The **t-test** result indicates a statistically significant difference in the average time spent in the hospital between readmitted and non-readmitted patients, suggesting that readmitted patients tend to have longer hospital stays, potentially reflecting more complex health issues.
2. The **Chi-Square** test result indicates a statistically significant difference in age distribution across different readmission categories, suggesting that certain age groups may exhibit unique patterns of readmission.
3. The **Chi-Square** test result indicates a statistically significant association between A1C results and readmission status, suggesting that poor blood sugar control (elevated A1C levels) may be linked to a higher likelihood of readmission.
4. The **Chi-Square** test result indicates a statistically significant association between insulin usage and readmission status, suggesting that patients on insulin may be at a higher risk of readmission, possibly due to more severe diabetes requiring closer monitoring.

References

[1] Strack B, DeShazo JP, Gennings C, Olmo JL, Ventura S, Cios KJ, Clore JN. Impact of HbA1c measurement on hospital readmission rates: Analysis of 70,000 clinical database patient records. Biomed. Res. Int. 2014;2014:781670.

Thank You