

# Assignment - 3

## Ethical Diabetes Readmission Prediction – Project Report

### 1. Introduction

This project focuses on building an ethical, interpretable machine learning model to predict 30-day hospital readmissions among diabetic patients. Hospital readmission is a critical healthcare metric associated with patient outcomes, financial costs, and operational efficiency. The goal of this assignment was not only to develop a predictive model but also to evaluate ethical implications such as fairness, bias, transparency, and responsible use of patient data.

### 2. Dataset Specifications

The dataset used in this project is the Diabetes 130-US Hospitals dataset, which contains over 100,000 hospital encounters for diabetic patients collected over 10 years. The dataset includes demographic variables, lab values, diagnoses, types of medications, and utilization history. The primary target variable is whether a patient was readmitted within 30 days.

Key dataset characteristics include:

- **Number of encounters:** Approximately 100,000+
- **Features:** Demographics, lab tests, diagnoses, procedures, medications, and hospital usage patterns
- **Target variable:** Readmitted within 30 days (Yes/No)
- **Sensitive attributes considered:** Race, gender, age

### 3. Key Findings and Insights

#### 3.1 Data Exploration Insights

- Readmission rates were relatively low, creating a natural class imbalance that needed to be addressed during modeling.
- Older patients and those with multiple previous admissions showed a higher likelihood of being readmitted.
- Some medication-related features exhibited strong correlations with readmission trends, indicating possible effects of treatment plans.
- Racial distributions were uneven, requiring fairness checks to avoid biased outcomes.

#### 3.2 Model Performance Insights

- The final predictive models (such as logistic regression or random forest) achieved reasonable performance in identifying high-risk patients.

- Feature importance analysis revealed that prior hospitalization history, number of medications, and comorbidity indicators were among the strongest predictors.
- Although accuracy was moderately high, precision for the positive class was lower due to class imbalance, indicating the need for cost-sensitive evaluation.

#### 4. Ethical Evaluation

Ethical considerations were central to this project. Key issues evaluated:

- **Fairness:** Model predictions were examined across demographic groups such as race and gender. No severe disparities were observed, but continuous monitoring is required.
- **Transparency:** We ensured interpretability through feature importance and model explanation techniques to help clinicians understand predictions.
- **Data Privacy:** The dataset was de-identified, and all analysis adhered to ethical standards regarding handling sensitive health information.
- **Responsible Use:** Models should support but not replace clinical decision-making. Ethical safeguards must be implemented before deployment.

#### 5. Conclusion

This project successfully demonstrated how machine learning can assist healthcare providers in identifying patients at risk of hospital readmission. Equally important, it highlighted the need for ethical considerations in model development. By analyzing fairness, transparency, and data privacy, the project ensures that predictive tools can be deployed responsibly to improve patient care without introducing unintended harm.