PREDICTING ICU MORTALITY FOR PATIENTS WITH MULTIPLE CHRONIC CONDITIONS

Polislava Kalcheva
SNR: 2071490
polislava.kalcheva@tilburguniversity.edu

Supervisor: Dr. Phillip Brown
p.c.brown@tilburguniversity.edu

Project Definition
- This is research about machine learning (ML) usage to predict Intensive Care Unit (ICU) mortality focusing on patients with multiple chronic conditions (MCC) because the traditional methods may not be good enough to capture these conditions' complexity.
- The goal is to evaluate whether there is a difference in mortality prediction accuracy between MMC patients and general ICU patients.

Motivation
- MCC patients in the ICU have an increased risk of death (Kong et al., 2020) and traditional methods are static and use fixed scores, so they do not fully understand the differences between chronic conditions interaction (Nistal-Nuño, 2022).
- Machine learning can make accurate predictions and prioritize patients at higher risk (Darabi et al., 2018).
- Nonetheless, while using machine learning, we need to make sure of good data quality and simplicity so doctors can understand the data (Mamandipoor et al., 2021).

Background
- ICU mortality prediction is significant for enhancing clinical decision-making and patient outcomes (Kong et al., 2020).
- Standard techniques used in the past are limited in managing challenging interactions between patient variables and lack generalization across different ICU populations (Nistal-Nuño, 2022).
- Machine learning models have been used in general ICU populations only and it is still ambiguous whether these models execute equally well in this unsafe MCC subgroup.
- Machine learning models have found previously unidentified risk factors, and the traditional scoring methods did not identify them (Gao et al., 2024).
- The focus of this research is on MCC patients in the ICU, comparing ML models for general ICU patients and MCC patients searching for identification of the most significant clinical features for predicting and which model gives the most accurate results.
- In the end, binary classification will be used to predict 1 for survival and 0 for mortality.

Research Question
Can machine learning accurately predict ICU mortality in patients with multiple chronic conditions compared to general ICU patients?

Dataset Description
MIMIC-III Clinical Database (Medical Information Mart for Intensive Care) includes multiple CSV files from which I will need ten of them. From each file, between two and six columns will be used for this research.

Hypotheses
- H_0 (Null Hypothesis): Machine learning models do not significantly improve ICU mortality prediction accuracy for patients with multiple chronic conditions compared to general ICU patients.
- H_1 (Alternative Hypothesis): Machine learning models significantly improve ICU mortality prediction accuracy for patients with multiple chronic conditions compared to general ICU patients.

Statistics, Algorithms, and Software
- The dependent variable (Y) is ICU Mortality, 1 is death, and 0 is survival.
- For the independent variable (X) some of the most significant features that have been explored previously by researchers such as age, gender, chronic conditions, vitals, lab tests, and ICU treatments.
- I will use the ML models Random Forest (RF) and XGBoost (Extreme Gradient Boosting), and Logistic Regression (LR) to handle different data challenges.
- Then I need to classify the data into two groups general ICU patients and MCC patients. So, I will find the probability of survival and not survival in each group and I will use LR to predict 1 and 0 for survival and not survival. Finally, I will compare the accuracy between the three models and see which one predicts the best.

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Department of Cognitive Science and Artificial Intelligence, School of Humanities and Digital Sciences

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