Training Data for Machine Learning to Enhance Patient-Centered Outcomes Research Data Infrastructure

**Project Goal**

Conduct foundational work to advance the future application of artificial intelligence (AI)/machine learning (ML) for patient-centered outcomes research (PCOR) by generating high-quality training datasets that can be used in ML models for a kidney disease use case.

**Objectives**

- Prepare high-quality training datasets from the United States Renal Data System (USRDS) data to address a kidney disease use case.
- Develop ML models based on three algorithms – eXtreme gradient boosting (XGBoost), logistic regression, and multilayer perceptron – to provisionally test the training datasets.
- Validate the approaches for building the ML models by evaluating their performance using conventional metrics such as area under the curve (AUC).
- Disseminate project outputs that future researchers can refer to when preparing training datasets and ML models for new kidney disease use cases.

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**Data Source & Use Case Selection**

Data Source: **United States Renal Data System (USRDS)**

Use Case: **Predicting mortality in the first 90 days of dialysis**

The first 90 days following initiation of chronic dialysis in end-stage kidney disease patients represent a high-risk period for adverse outcomes, including mortality.

While the sudden and unplanned start of dialysis is a known risk factor, other factors leading to poor outcomes during this early period have not been fully delineated.

Studies of the end-stage kidney population have conventionally excluded the first 90 days from analyses.

Tools to identify patients at highest-risk for poor outcomes during this early period are lacking.

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**High Quality Training Datasets Development**

**METHODOLOGY**

**PATIENTS**

n=3,161,638

- Existing first dialysis date
  n=3,096,526

- Death date NOT before first dialysis date
  n=3,096,515

- Age at first dialysis greater than or equal to 18
  n=3,065,026

- First dialysis date between 2007-2018
  n=1,150,195

- Study cohort
  n=1,150,195

**RESULTS**

- High-quality training dataset criteria:
  - Features cleaned and correctly labeled (well-labeled)
  - Dataset reliable and well curated (well-structured)
  - Features use common data elements

- 7.5% of patients died in the first 90 days of dialysis in the study cohort

- Training dataset includes 188 features, including demographics, prior care, clinical variables, comorbidities, patient education

- Two versions of the dataset prepared: imputed (using multiple imputations by chained equations) and non-imputed

- Full dataset divided into a training and a test dataset using a 70%-30% split
Machine Learning Models Development

RESULTS

- Area under the receiver operating characteristic curve (ROC AUC) ranged from 0.811 to 0.827
- Top features ranked in XGBoost and logistic regression models include patient age, whether the patient had inpatient stay claims, had received exogenous erythropoietin (anti-anemic treatment), serum albumin value, and presence of arteriovenous fistula (for hemodialysis)

Area Under the Curve (AUC)

- XGBoost Non-imputed AUC = 0.826
- XGBoost Imputed AUC = 0.827
- Logistic Regression AUC = 0.811
- Multilayer Perceptron AUC = 0.812

Project Outputs - Dissemination

Click Below to Access

- Final Report
- Implementation Guide
- Code
- Webinar Slides