AI-BASED DECISION SUPPORT SYSTEM TO PREDICT THE SEVERITY OF ACUTE PANCREATITIS

CHALLENGES: Health, demographic change and wellbeing

PROBLEM DESCRIPTION

Roughly 15-25% of all patients with acute pancreatitis (AP) develop severe AP. Furthermore, the mortality from AP is very high in subgroups of patients with severe disease. Therefore, it is important to appropriately assign degrees of urgency at the time of hospitalization and to send those patients to intensive care units who are at risk of developing severe AP.

CHALLENGES AND GOALS

Our goal is to predict whether a patient will develop severe acute pancreatitis or not, based on data that are available at the time of hospitalization. We also aim to identify the most important factors and their contribution to the prediction. Furthermore, a final goal is to develop a web application that gives a prediction (severity score) for a given input (measurements of patients) and explains the prediction.

PRODUCTIVE SECTOR: Software research & development in healthcare

MATHEMATICAL AND COMPUTATIONAL METHODS

The aim was to use machine learning (ML) algorithms to predict the severity of acute pancreatitis. In other words, our problem is a binary classification problem where the target variable takes 1 if the patient developed severe AP and 0 otherwise. One of the challenges was to handle the imbalanced class distribution since only 6% of the patients were labeled as severe. We applied the SMOTE algorithm to oversample the data of the severe patients. Handling missing data was another challenge that we had to overcome. We have examined several techniques to handle missing data, such as kNN Imputer, Multiple Imputation by Chained Equations (MICE), but finally, we performed data imputation with the kNN algorithm. The best performing ML model was the XGBoost with 84% accuracy and the AUC was 0.82. We used the SHAP values to explain the prediction of the model which is based on a game-theoretical concept, called the Shapley value. The SHAP value quantifies the contribution of each feature to the final prediction (severity score). Finally, we used a bootstrapping method to estimate the confidence of the prediction of the ML model.

Pancreatitis előjelzése

Írja a be a megadni kívánt adatokat a megfelelő cellába, a többit hagyja üresen.

Kor	Nem (0: Nő, 1: Férfi)	BMI

Alkoholfogyasztás (0: Nem, 1: Igen)	Dohányzás (0: Nem, 1: Igen)	Diéta (0: Nem, 1: Igen)

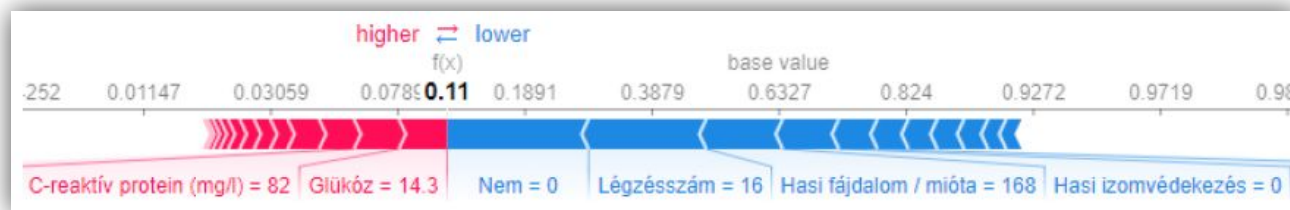Mióta áll fenn hasi fájdalom (órában)

A screenshot of the application

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Results and Benefits

We used advanced machine learning techniques to predict the severity of acute pancreatitis based on hospitalization data. We developed a decision support system that helps in the early triage, it also provides explanations that help the physicians understand why the patient is at risk of developing severe AP, furthermore, it can be an educational app for the patients since it highlights the factors that push the severity score higher.

Our application **identifies patients at-risk.** It provides explanations for the predictions. Helps both patients and physicians understand **why the patient is at risk** of developing **severe** acute pancreatitis by **highlighting the contributing factors** that push the severity score higher. Also shows the confidence of the prediction.

A mild case

A severe case

Example outputs of the application for a mild (top) and severe (bottom) case. The contributing features push the model output from the base value (the mean severity score) to the model output (prediction).

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