Machine learning to predict 30 days and 1-year mortality in STEMI and turndown patients

Aleeha Iftikhar[2], Raymond R. Bond[2], Victoria McGilligan[5], Stephen J. Leslie[3], Charles Knoery[3], Khaled Rjoob[2], Anne McShane[4], Aaron Peace[1]

[1]Department of Cardiology, Altnagelvin Hospital, Western Health and Social Care Trust, UK
[2]Ulster University, Computing Engineering and Build Environment, Northern Ireland, UK
[3]Cardiac Unit, Raigmore Hospital, Inverness, UK
[4]Letterkenny University Hospital, Letterkenny, Ireland
[5]Ulster University, Centre for Personalised Medicine, Northern Ireland, UK

Introduction:
Percutaneous coronary intervention (PPCI) is a minimally invasive procedure to unblock the arteries which carry blood to the heart. Patients are accepted or turned down for PPCI partly based on STEMI criteria and the ECG. We explored the features which may predict 30 days and 1-year mortality in accepted and turndown patients and report the performance of machine learning (ML) algorithms.

Method:
Over-sampling was applied as a class balancing method to eliminate bias in training the algorithm. After class balancing different ML algorithms, namely multiple logistic regression (MLR), decision tree (DT), and support vector machine (SVM) were used for the prediction of 30 days and 1-year mortality. The dataset was subdivided into two parts training (90%) and testing (10%). Upon significance of various features to predict the 30 days and 1-year mortality, the accuracy, sensitivity, and specificity were compared between algorithms.

Results:
The DT used 7 features (sex, age, out of hour, DTBT, call time, pain time, activation status) to provide the maximum accuracy of 77% (sensitivity=86%, specificity=72%) for predicting 30 days mortality in accepted (STEMI) group. When the same analysis was performed on the turndown group, DT used 5 features (sex, age, out of hour, call time, chest pain) providing the highest accuracy of 74% (sensitivity=72%, specificity=78%). To predict 1-year mortality in the turndown group, the highest accuracy for all the three algorithms was the same (acc=67%). However, the DT performed somewhat better in terms of predicting patients who did not die within 1-year (sensitivity=74%).

Conclusion:
DT outperformed the other algorithms (SVM and MLR) to predict mortality of PPCI referred patients. Greater sensitivity is achieved in predicting 30 day mortality in the accepted STEMI group compared to the turndown group, however the former model included more features.