Title: Interpretable Machine Learning Identifies Risk Predictors in Patients with Heart Failure.

Introduction: Accurate identification of mortality risk and risk predictors is vital to optimize the management and treatment of patients with heart failure. Our goals were to predict risk of 1-year mortality, to stratify patients according to risk, and to identify risk predictors for patients within each risk stratum.

Hypothesis: That a novel machine learning method can be used to identify risk strata and identify risk predictors within each risk stratum.

Methods: "Stratified Linear Models" (SLIM) is a machine learning method built on the principle that different risk predictors are most relevant for different risk strata within a population. We apply this method to the Meta-analysis Global Group in Chronic Heart Failure (MAGGIC) dataset of 30,389 patients who have had heart failure, of whom 5,723 died within one year.

Results: SLIM achieves better predictive performance than the MAGGIC risk score for mortality among patients with heart failure. Among the risk predictors used by the MAGGIC score, SLIM discovers that some are of very different importance within different risk strata. For example, the New York Heart Association (NYHA) class has high predictive importance within the 20% of the population at lowest risk but low predictive importance within the 20% of the population at highest risk. SLIM also discovers that Rales and Shortness of Breath at Rest, neither of which is used in the MAGGIC score, have higher predictive importance within the 20% of the population at highest risk than any of the risk predictors used by the MAGGIC score. The relative importance of risk predictors within risk groups is shown in Figure 1; lighter colors indicate higher positive predictive value within the indicated risk quintiles.

Conclusion: SLIM provided more accurate mortality predictions and more accurate identification of risk predictors for patients in various risk strata.

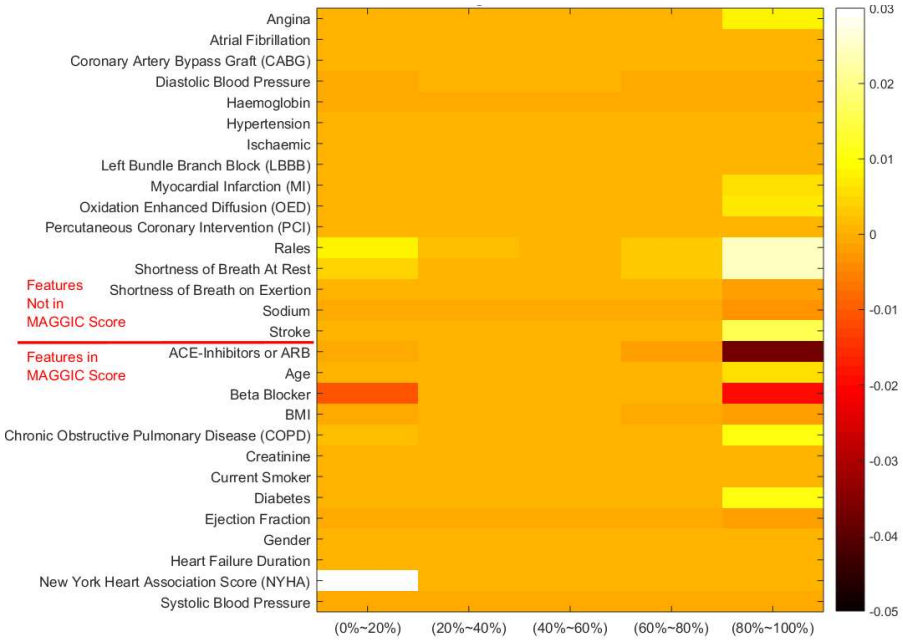

Fig 1. Importance of each risk predictor for each population quintile