An Automated Machine Learning-Based Model Predicts Postoperative Mortality Using Readily-Extractable Preoperative Electronic Health Record Data

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Background: Rapid, preoperative identification of patients with the highest risk for medical complications is necessary to ensure that limited infrastructure and human resources are directed towards those most likely to benefit. Existing risk scores either lack specificity at the patient level or utilize the American Society of Anaesthesiologists (ASA) physical status classification, which requires a clinician to review the chart.

Methods: We report on using machine learning algorithms, specifically random forests, to create a fully automated score that predicts postoperative in-hospital mortality based solely on structured data available at the time of surgery. The model was created using a set of 59 features including basic patient information such as age, sex, BMI, blood pressure, and pulse rate; lab tests frequently obtained prior to surgery such as sodium, potassium, creatinine, and blood cell counts; and surgery specific information such as the surgical procedure codes.

Results: Using a random forest classifier we found that automatically obtained preoperative features (AUC of 0.931, 95% CI 0.918-0.944) outperforms Charlson comorbidity scores (AUC of 0.828, 95% CI 0.801-0.856) and ASA status (AUC of 0.873, 95% CI 0.853-0.892). Including the ASA status with the preoperative features achieves an AUC of 0.938 (95% CI 0.927-0.949).

Conclusions: This automated score outperforms both the ASA physical status score and the Charlson comorbidity score for predicting in-hospital mortality. Additionally, we integrate this score with a previously published postoperative score to demonstrate the extent to which patient risk changes during the perioperative period.