Title: Early intensive care unit (ICU) prognostication; time to re-evaluate?

Background: ICU prognostication is a difficult task due to various reasons for admission along with patients' prior comorbidities. The model used for ICU prognostication in Sweden is the Simplified Acute Physiology Score (SAPS 3) from 2005, which is based on almost 17,000 patients from 303 ICUs. It has been used in Sweden for over a decade now to evaluate every patient's mortality risk on ICU admission.

Research question: This PhD project aims to investigate whether adding new variables (i.e. lactate) or changing the statistical methods behind the prediction can improve the performance of SAPS 3. By combining the laboratory values of lactate on ICU admission at Skåne University Hospital in Lund from January 2008 to June 2017 and SAPS 3 data retrieved from the Swedish Intensive Care Registry (SIR), we investigated whether these laboratory values could improve the performance of SAPS 3. Secondly, based on all first-time admissions in Sweden from 2009-2017 retrieved from SIR, we investigated if a machine learning algorithm called Artificial Neural Network (ANN) could improve the performance of SAPS 3 using the same variables.

Preliminary results: Lactate was an independent SAPS 3 predictor for 30-day mortality in the logistic regression model. However, the overall discrimination measured by the area under the receiver operating characteristic curve (AUC) was not improved as lactate was added to SAPS 3. In a subgroup analysis, the AUC was improved for cardiac arrest and septic patients. The overall performance of the SAPS 3 model in Sweden was improved by using ANN (by utilizing the same input data). Both the discrimination (AUC 0.889 vs 0.850, p<0.001) and the calibration were improved (Brier score 0.096 vs 0.110, p<0.001) with the ANN model on a separate test set (n=36,214).

Significance: ANN was found to be superior to the SAPS 3 model based on the same dataset. This could potentially change the way early ICU prognostication will be performed in the future. It should be investigated further whether lactate can improve the future of ICU prognostication, particularly for cardiac arrest and septic patients.

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