A Computational Model To Predict Discharge Responsiveness In Non-Neurological ICU Patients

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Background and Purpose:

Though commonly associated with a primary neurological disorder, states of decreased responsiveness are frequently seen in non-neurological ICU patients. Here, we build and validate a computational model to predict the discharge responsiveness phenotype in this population.

Methods:

The eICU and MIMIC-IV datasets were used for train-and-test and external validation, respectively. We selected adult patients whose ICU length of stay was ≥ 2 and ≤ 7 days, and only data collected in the first 24h following ICU admission were used. Responsiveness was evaluated on ICU admission and discharge using the motor subscore of the Glasgow Coma Scale (mGCS), with responsive and unresponsive states defined as mGCS = 6 and mGCS < 6, respectively. Binary classifications were trained on the full population and on the subsets who were responsive on admission (RA), and unresponsive on admission (UA). The final feature space contained demographics, physiological signals, lab values, and medications. A gradient boosted (GB) decision tree model was selected as the classifier. After 5-fold cross validation, model performance was determined by area under the receiver operating characteristic (AUROC) analysis.

Results:

The final dataset consisted of 37,568 stays for eICU and 20,127 stays for MIMIC-IV. Model discrimination expressed as AUROC(SD) was 0.86 (0.01), 0.84 (0.01), and 0.79 (0.01) for the entire sample, RA subset and UA subset, respectively. Features strongly associated with unresponsiveness at discharge were higher heart rate, lower systemic blood pressure, higher blood urea nitrogen and higher red blood cell count.

Conclusions:

In patients admitted to the ICU with a non-neurological diagnosis, a machine learning model trained with data collected in the first 24 hours of ICU stay accurately predicts responsiveness at discharge. These predictions were interpretable and could inform strategies to prevent neurological deterioration or enhance neurological function during critical illness.