Coma Predictor: Prediction of Neurological Trajectories in Non-Neurological ICU Patients

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Background

Decreased neurological responsiveness is a cardinal manifestation of brain dysfunction, which occurs in ICU patients without primary neurological disorders. Brain dysfunction may be treatable or even preventable with limited means to predict responsiveness changes. There is an unmet need for models to predict responsiveness outcomes in patients admitted to the ICU.

Objectives

1. Predict neurological responsiveness trajectories of non-neurological ICU patients
2. Identify and rank predictive features associated with specific neurological responsiveness trajectories

Methods

We used the eICU database (200,859 ICU stays) as training and testing set; the MIMIC-IV database (69,619 ICU stays) for external validation.

Data Preprocessing

Model Development

Two classifications: responsive admission (RA) and unresponsive admission (UA) group.

Results 1

Unresponsive Admission (UA) Group

Responsive Admission (RA) Group

External Validation

ROC Curves for LOS ≤ 7 Days: UA

Results 2 – Feature Importance

UA & RA Feature Importance SHAP Plots

• The mean (±SD) AUROC for predicting responsiveness was 0.80 (±0.01) for RA Group and 0.79 (±0.01) for UA Group. We chose gradient boosting models for best results.
• Top ranked features included physiological signals: respiratory rate, systemic blood pressure and heart rate; lab features: blood urea nitrogen and red blood cell count.

Conclusions

A machine learning model trained with data collected in the first 24h after ICU admission can accurately predict neurological responsiveness at discharge of patients in ICU for 7 days or less. This information could be critical in identifying strategies to prevent neurological deterioration or enhance neurological recovery.

Future Directions

1. Develop neural network models for prediction and feature importance interpretation;
2. Explore additional features to enhance prediction accuracy

Additional Information

If you have any other questions or comments, welcome to contact us via rstevens@jhmi.edu

Responsive Admission

Unresponsive Admission

Data Filter

First mGCS < 12h; 12h
24h Data collection

Lead Time

Remainder of stay"