



Team Beaver

Prediction of Neurologic Injury in Pediatric ECMO

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Background

- **Extracorporeal Membrane Oxygenation (ECMO)** partially replaces function of heart and lungs: **life support**.
- 25% of pediatric ECMO patients develop neurologic injury such as **stroke or hemorrhage, increasing mortality by 85%**. Injuries occur due to the delicate balance between bleeding and clotting during ECMO.
- Clinicians **need a method to predict the onset of neurologic injuries** to better inform the administration of blood products and anticoagulation factors.

Objective and Hypothesis

- **Objective:** Using the PEDECOR database, develop models to predict neurologic injury: 1) using pre-ECMO data and 2) adding time series lab and blood product data.
- **Hypothesis:** Models trained on lab measurements and blood product time-series data will better predict the risk of neurologic injury in pediatric ECMO patients than pre-ECMO demographic and patient history features alone.

Dataset

- **Inclusion Criteria:** Patients less than 18 years of age.
- **Exclusion Criteria:** Patients cannulated at non-PEDECOR institution for >24 hours, death within 6 hours of ECMO cannulation.

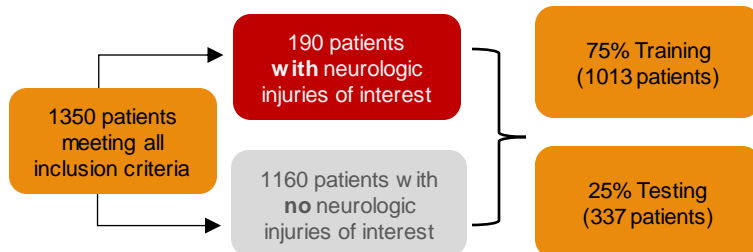
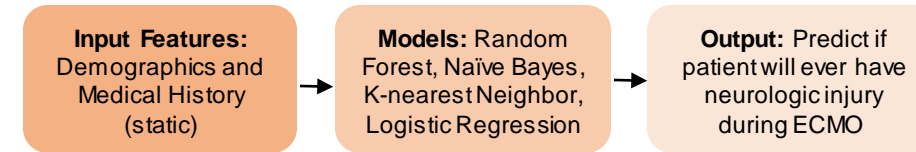


Fig 1: Breakdown of Pediatric ECMO Outcomes Registry (PEDECOR) dataset based on neurological outcomes, and training / testing split used in the model.

Methods and Results

Pre-ECMO Model: Low AUC, Non-iterative predictions on static data



Time-Series Model: Higher AUC, Daily predictions on dynamic data

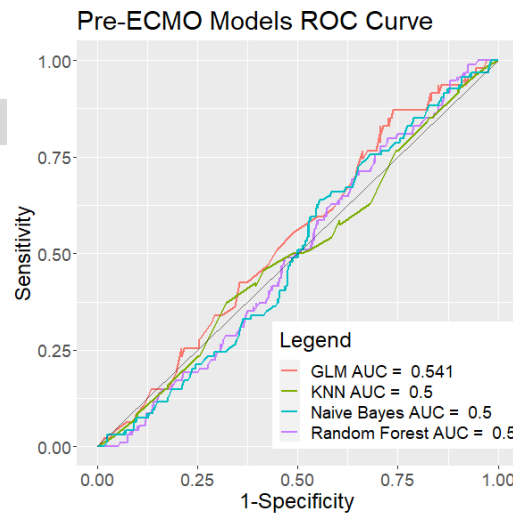
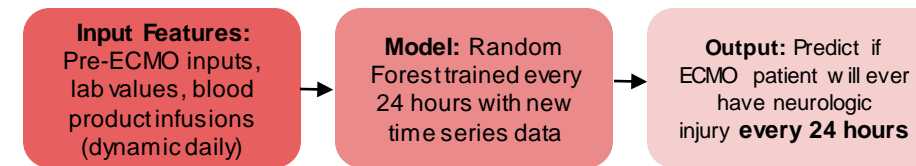


Fig 2: ROC curves for Pre-ECMO prediction models. All have AUC < 0.55.

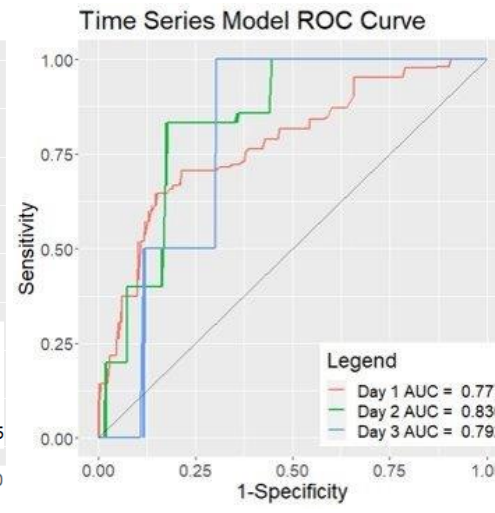
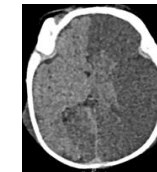
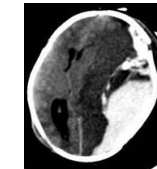


Fig 3: ROC curves for time series Random Forest model for days 1-3. All have AUC > 0.77.

Neurologic Injuries of Interest:



Stroke



Hemorrhage

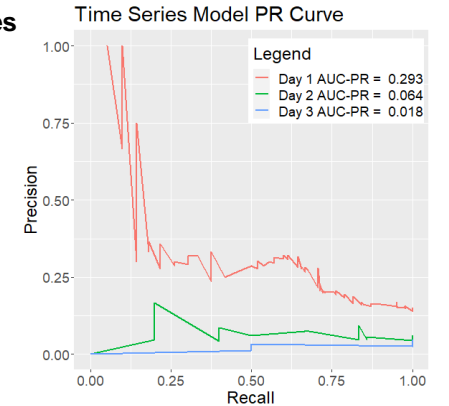


Fig 4: Precision recall curves for time series Random Forest model for days 1-3. All have PR AUC < 0.3 decreasing with day.

Discussion and Conclusion

Model Performance

- Results support the hypothesis: Time series model has a higher AUC (> 0.77) than pre-ECMO model AUC (< 0.55).
- Models including data on daily lab measurements and blood products given perform better predictions of neurologic injury.

Feature Importance:

- The Pre-ECMO highest risk factors for onset of neurologic injury were **age, illness, and ventricular dysfunction**.
- The time series features identified as the highest risk factors were **antithrombin III and bilirubin**, which are lab measurements relevant to coagulation in the blood.

Future Work

- The time series prediction model has low precision indicating a high false positive rate. Improving this metric could improve the clinical application of this prediction model.