



Master's Project Defense
Master of Science in Intelligent Systems

“Interoperable and Explainable Models to Predict Morbidity and Mortality in Acute Neurological Injury in the Pediatric Intensive Care Unit” by **Neil Munjal**

Date: April 27, 2022

Time: 09:00AM – 10:00AM

Place: Room 536B, Department of
Biomedical Informatics, 5607 Baum Boulevard,
Pittsburgh PA 15206

Committee:

- Harry Hochheiser, PhD, Associate Professor, Department of Biomedical Informatics, School of Computing and Information
- Christopher Horvat, MD, MHA, Assistant Professor, Department of Critical Care Medicine, School of Medicine
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Abstract:

Acute neurological injury is a leading cause of permanent disability and death in the pediatric intensive care unit (PICU). No predictive model has been validated for critically-ill children with acute neurological injury. We hypothesized that PICU patients with concern for acute neurological injury are at higher risk for morbidity and mortality, and advanced analytics would derive robust, explainable subgroup models. We performed a secondary subgroup analysis of the Trichotomous Outcomes in Pediatric Critical Care (TOPICC) study, predicting mortality and morbidity from admission physiology. We analyzed patients with concern for acute neurological injury using standard machine learning algorithms. Feature importance was analyzed using SHapley Additive exPlanations (SHAP). We created a Fast Healthcare Interoperability Resources (FHIR) application to demonstrate potential for interoperability using pragmatic data.

There were 1860 patients with concern for acute neurological injury at PICU admission, with higher morbidity (8.2 vs 3.4%) and mortality (6.2 vs 1.9%). The ensemble regressor produced the best model, with Area Under the Receiver Operating Characteristic Curve (AUROC) of 0.91 (95% CI [0.88, 0.94]) and Average Precision (AP) of 0.59 [0.51, 0.69] for mortality, and decreased performance predicting simultaneous mortality and morbidity (0.83 [0.80, 0.86] and 0.59 [0.51, 0.64]). For mortality, the TOPICC logistic regression had AUROC of 0.90 [0.84, 0.93], but a significantly inferior AP of 0.49 [0.35, 0.56]. Feature importance analysis showed that pupillary non-reactivity, Glasgow Coma Scale, and temperature were the most contributory vital signs, and acidosis and coagulopathy the most important laboratory values. The FHIR server/client application demonstrated real-time health record query and model deployment.

PICU patients with risk for acute neurological injury have higher mortality and morbidity. Our machine learning approach recognized known secondary CNS. Advanced modeling achieves improved precision compared to published regression models, suggesting these models may be useful in interoperable bedside decision-support tools.