PREDICTING ICU TRANSFERS IN HOSPITALIZED CHILDREN

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BACKGROUND

- An ICU transfer is associated with:
  - Increased mortality
  - Increased neurological complications
  - Increased hospital cost

- Currently, University of Chicago Medicine uses the Pediatric Early Warning Score (PEWS) to recognize risk of ICU transfer.
- Subjective

VITAL SIGN MODEL

- Study Details
  - Pediatric patients (age < 18 years) admitted to the general ward during years 2009-2018.
  - 38,199 patients, 1,375 (3.7%) experienced outcome - ICU transfer
  - Variables: six vital signs (heart rate, temp etc.). plus patient characteristics (age, gender etc.)

- Train: 2009 – 2014 Test: 2015 – 2018
- 10-fold cross validation

- Performance
  - VS Model predicted ICU transfer better than PEWS (AUC 0.78 vs 0.72, $P < 0.01$ 12 hours in advance of event).

OBJECTIVE

- To investigate if
  - Adjusting for collinearity improved prediction
    - (used LASSO)
  - Adjusting for non-linear trends in vital signs improves prediction
    - (used RCS)
  - Adjusting for complex interactions between variables improves predictions
    - (used gradient boosting)

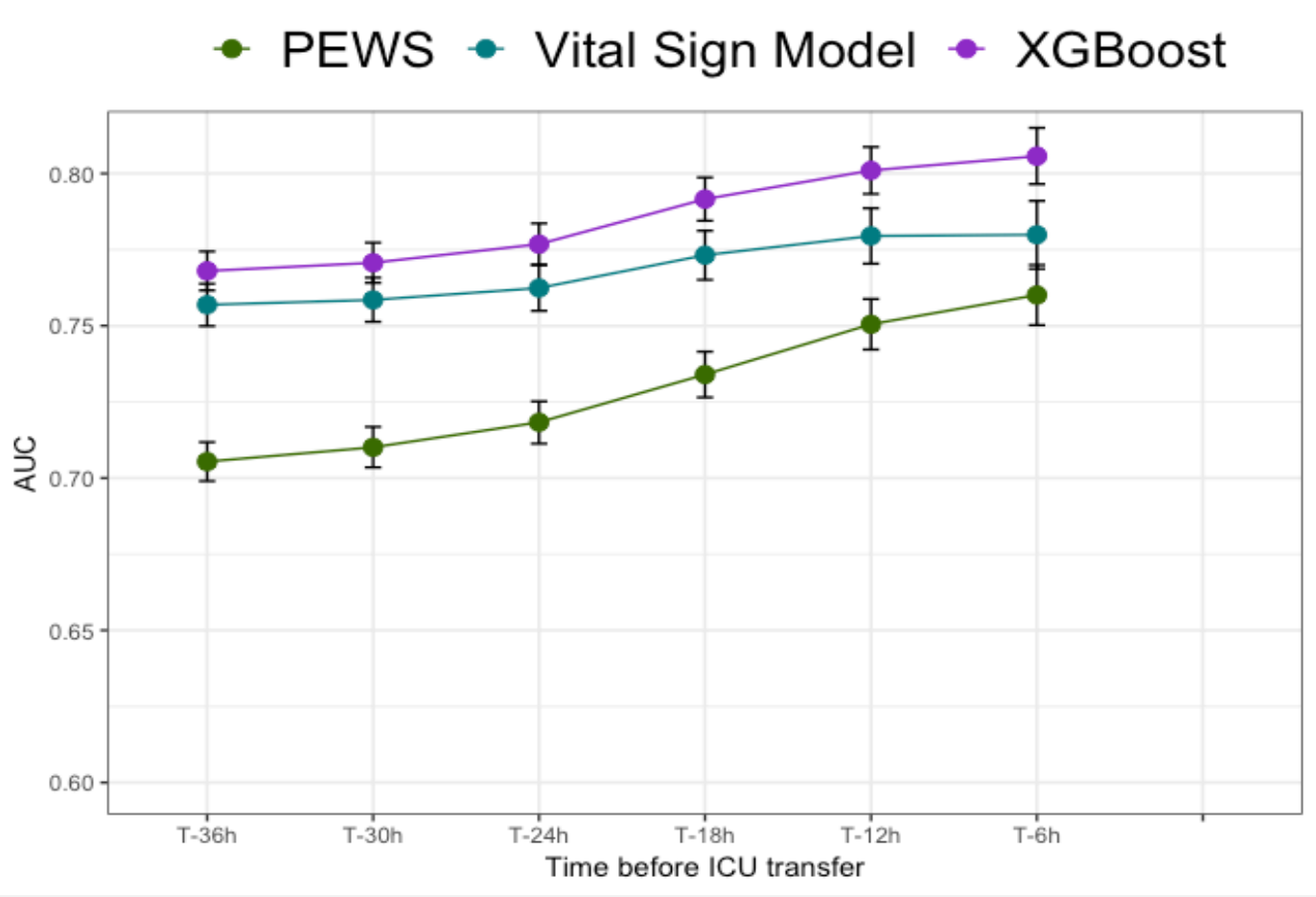
PATIENTS' STATISTICS

	Patient admissions with ICU transfer (n=1,375)	Patients admissions without ICU transfer (n=36,824)
Age yrs, mean (sd)	6 (6)*	7(6)
Female, n (%)	632 (46)	16,699 (45)
Race, n (%)		
Black	821 (60)	21,756 (59)
White	387 (28)	10,623 (29)
Other	167 (12)	4, 445 (12)
Hispanic, n (%)	183 (13)	4,308 (12)
Mortality, n (%)	44 (3)*	24 (0.07)
Hospital length of stay days, median (IQR)	9 (5, 18)*	2 (1, 4)
Admit Location, n (%)		
Ward	244 (18)*	4,893 (13)
ED	664 (48)	18,916 (51)
Other	467 (34)	13,015 (36)

* $p<0.01$

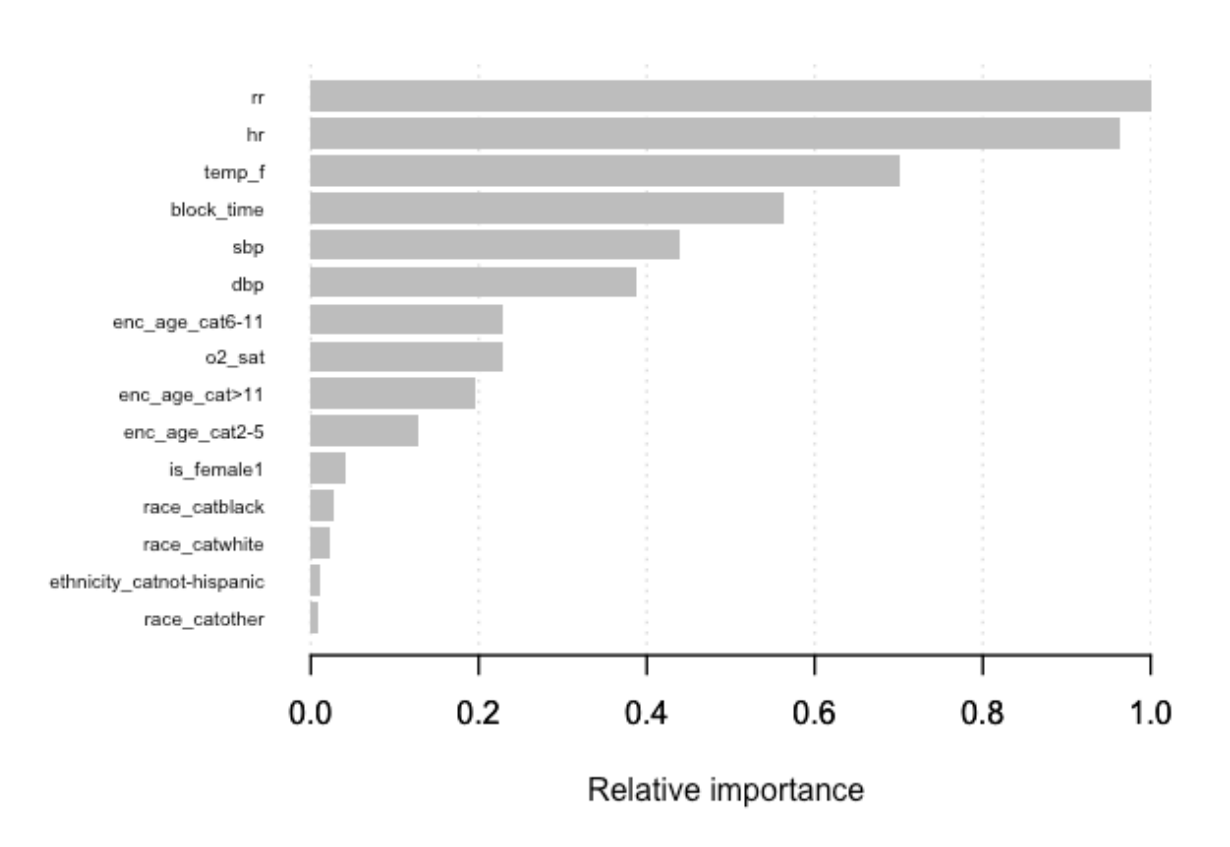
TABLE OF AUCS

Model	PICU AUC
VS Model	0.7798
Lasso	0.7798
rCS	0.7798
XGBoost	0.801



XG boost predicts ICU transfer better and earlier than VS model and PEWS

Variable importance plot – Gradient Boosting Model



Important variables (>50%):
Respiratory rate
Heart rate
Temperature