Pressure Injury Risk Prediction Using Machine Learning and Explainable Artificial Intelligence

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Objective: to develop machine learning models that predict pressure injury risk and incorporate explainable artificial intelligence (AI) techniques for enhanced interpretability.

Methods:

A retrospective cohort study was conducted utilizing MIMIC-IV health records, focusing on data gathered within the first 48 hours of ICU admission. Several candidate machine learning models, such as Deep Neural Networks, Gradient Boosted Trees, and Logistic Regression, were used to create an ensemble super learner. The performance of these models was assessed via (5-fold) cross-validation on held-out data. Each model, and ensemble, was evaluated using performance metrics like overall accuracy, AUC, ROC curves, feature importance, and prediction breakdowns. Analysis was conducted using open-source R packages including HMISC, h2o, DALEX, and modelStudio.

Results:

Out of 28,398 patients with sufficient data, 1,395 (5%) developed at least one hospital-acquired pressure injury. The Super Learner model demonstrated good predictive validity, achieving an AUC score of 0.79. These models are presented via an interactive dashboard for enhanced transparency and interpretability.

Conclusions:

The study shows the potential of combining machine learning with human expertise for a more accurate, efficient, and transparent assessment of pressure injury risk assessment.

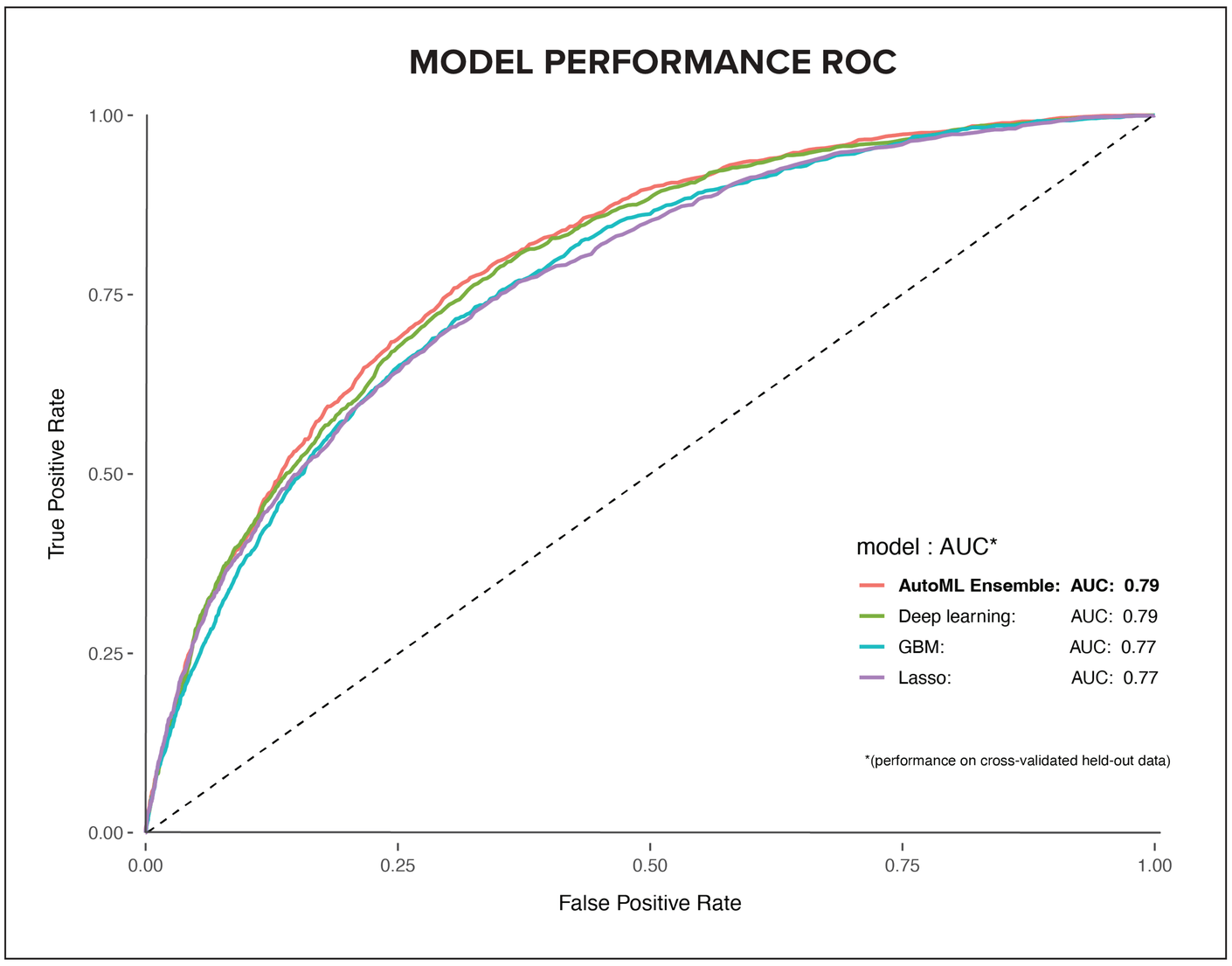
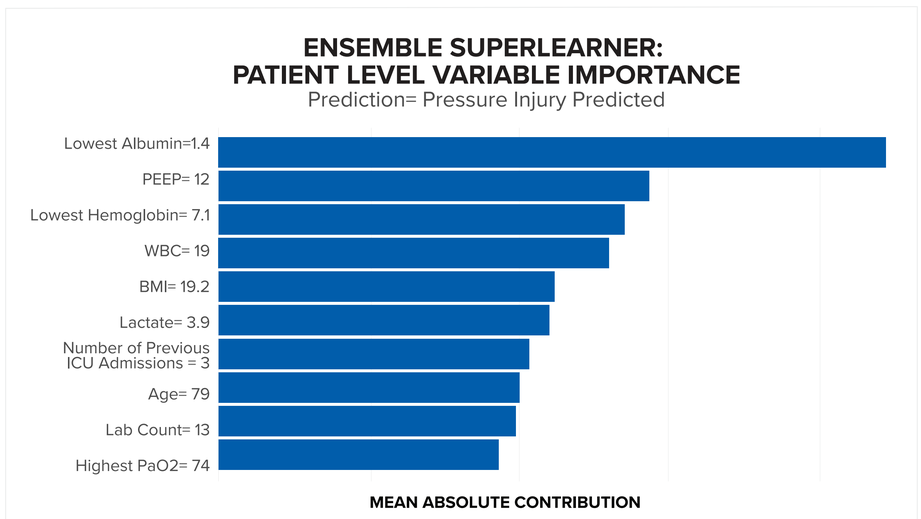


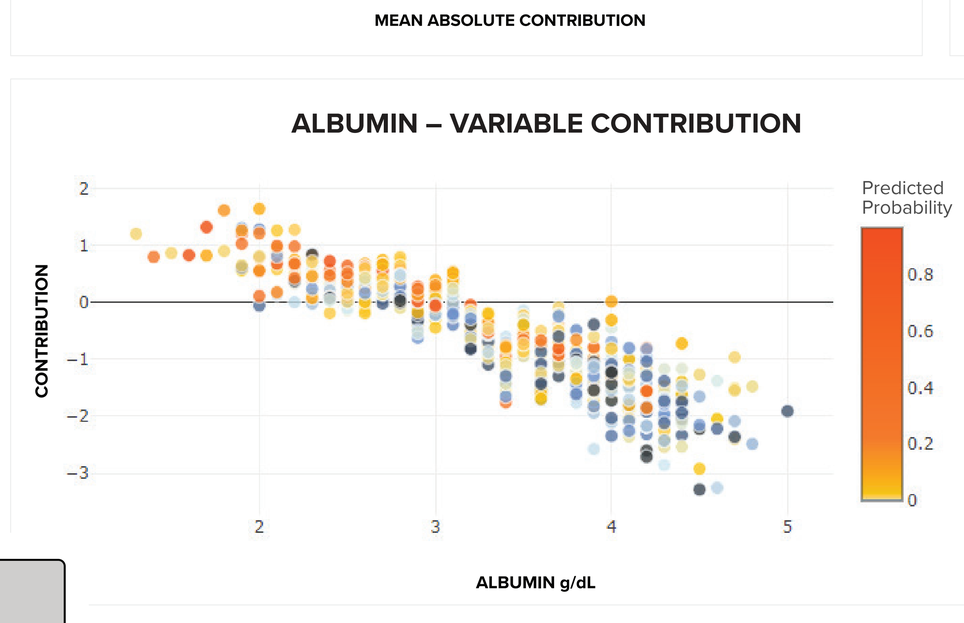
Fig. 1: Model Performance

PROTOTYPE PRESSURE INJURY DASHBOARD



Dataset

index	predictions	target	BMI	pH	age	hemoglobin	lactate
1	0	0	44.5	7.27	53	13.7	1.9
2	0	1	38.1	7.3642	72	9	1.2
3	1	0	21	7.33	86	9	1.654
6	0	0	31.1	7.43	51	9.9	0.8
8	0	0	26.8	7.34	38	7.8	3.9
16	0	0	30.22	7.28	58	6.6	3.6
17	0	0	31.6	7.3835	54	9.913	1.466
22	0	0	26.49	7.3945	78	13.1	1.546
24	0	0	29.1	7.3534	70	8.4	1.9
28	0	0	26.7	7.3832	69	15.2	2.269
32	0	0	27.4	7.3742	56	9.8	1.577



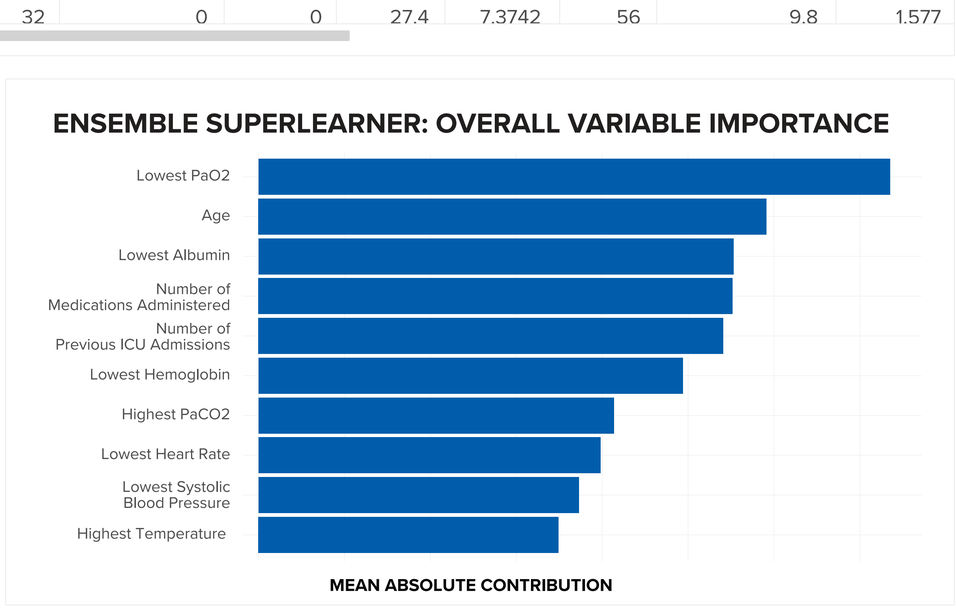
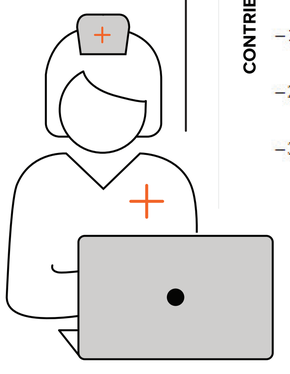


Fig. 2: Interactive Dashboard

Fig. 3: Data Schematic & Study Code



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