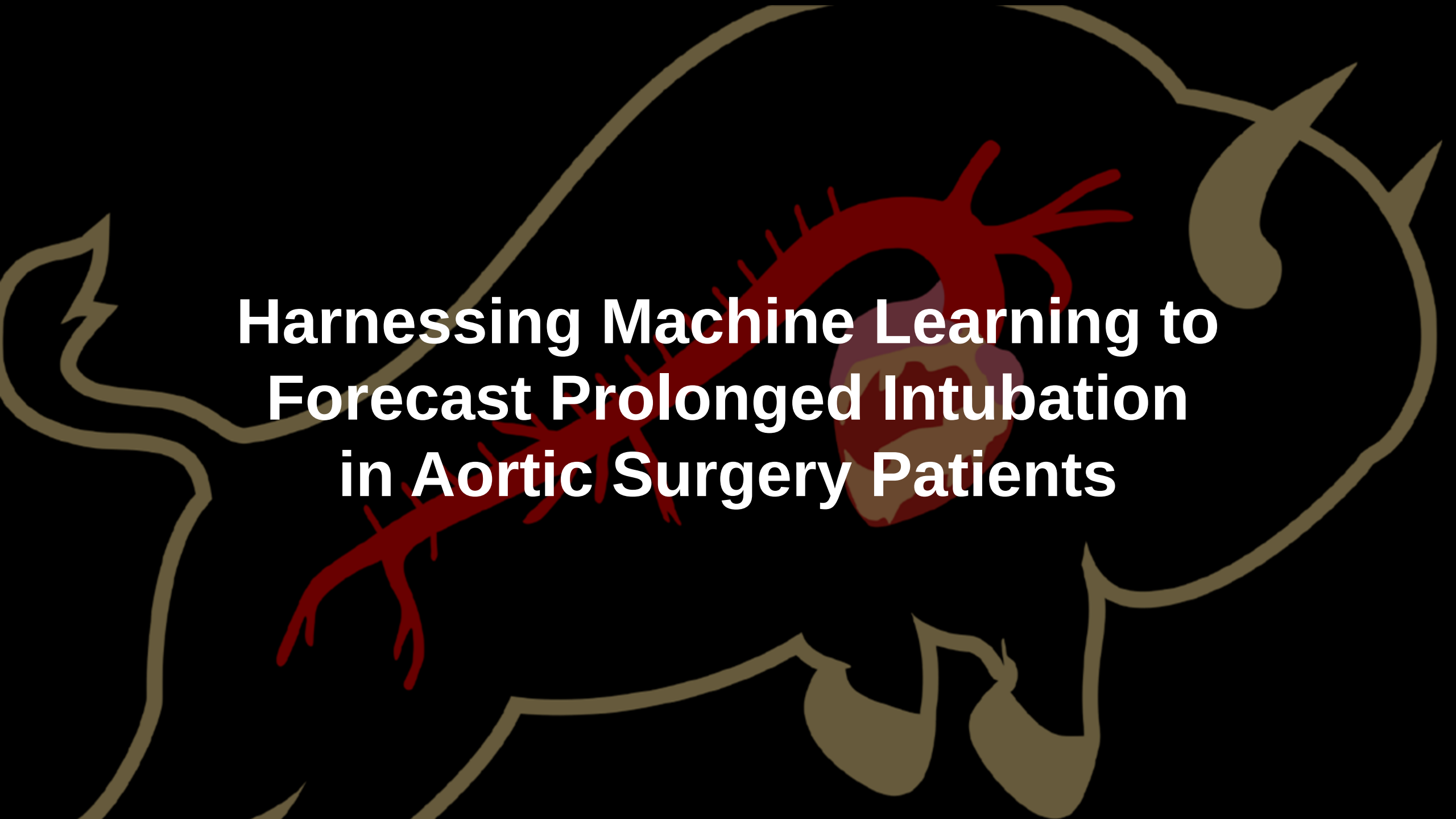
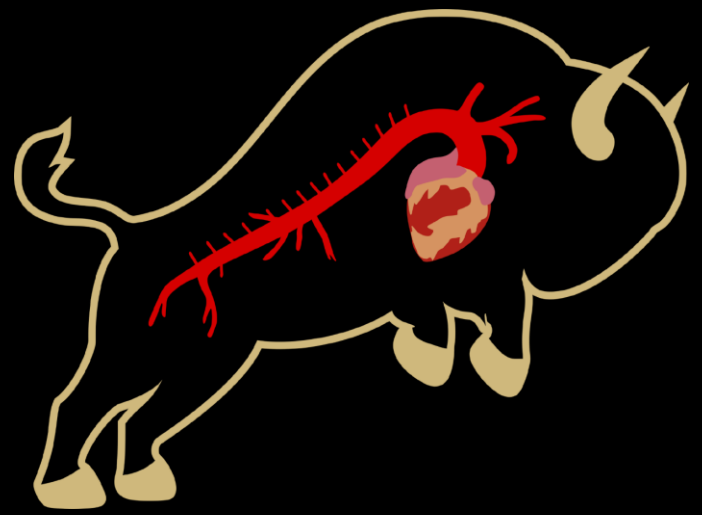
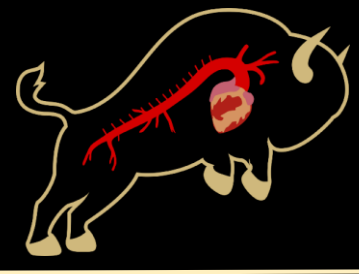


Harnessing Machine Learning to Forecast Prolonged Intubation in Aortic Surgery Patients

No disclosures



Introduction

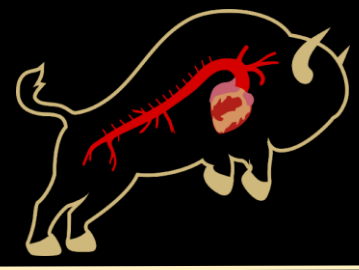


- Delayed extubation causes significant:
  - Patient harm
    - Increased ventilator-associated pneumonia
    - Delirium associated with sedation
    - Prolonged recovery
  - Burden on the health care system
    - Increased in-hospital costs
    - Increased length of stay
- Aortic surgery carries high risk for prolonged ventilation given its comorbid population and the potential for hemodynamic instability.

Aim

- We sought to apply state of the art machine learning algorithms to personalize patient risk for prolonged intubation following all aortic surgeries.

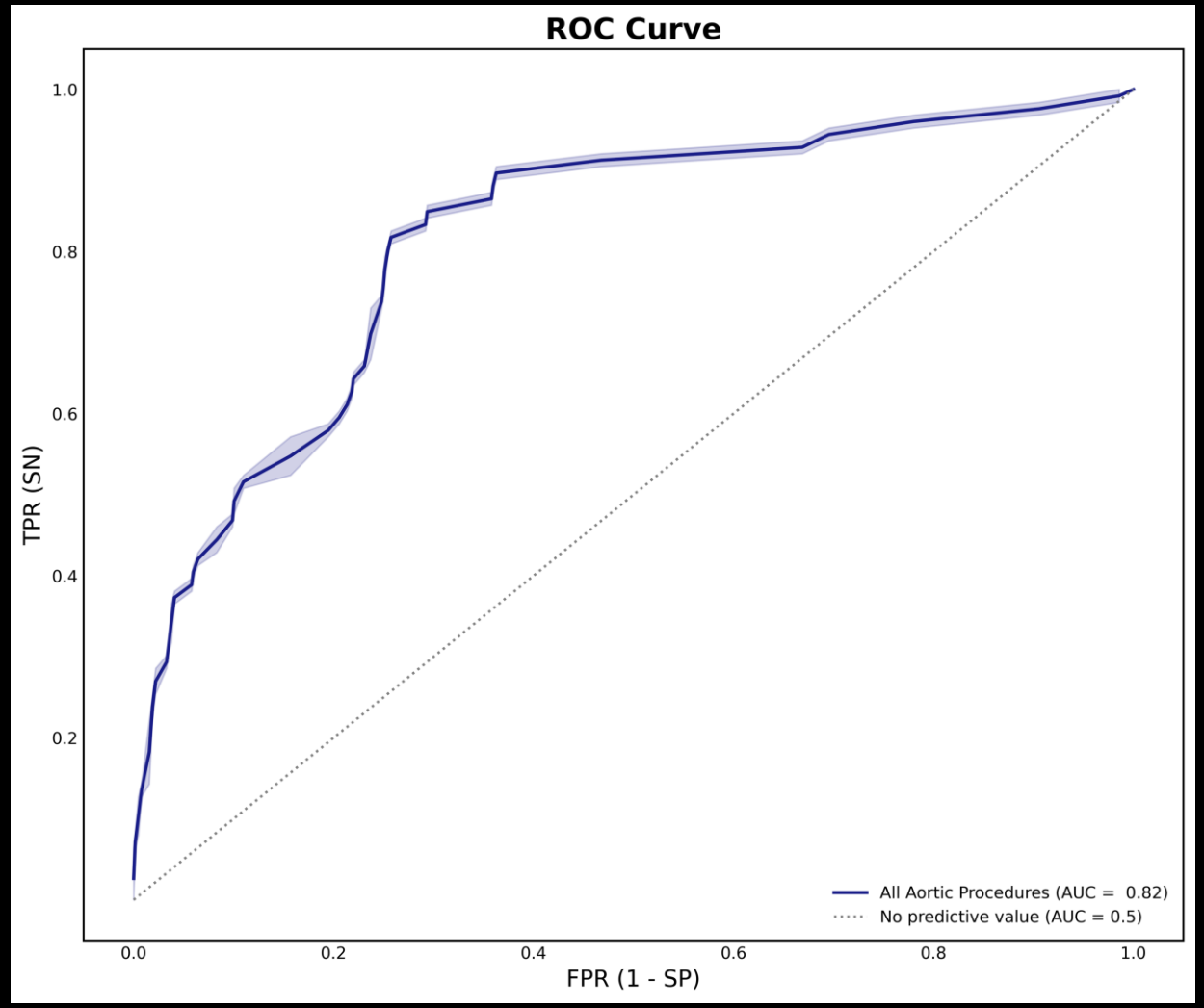
Methods



- Retrospective review of all adult patients undergoing aortic surgery from June 2009 to October 2022 (n = 875).
- 64 input parameters were identified from the index hospitalization, including 24 demographic characteristics as well as 8 preoperative and 32 intraoperative variables.
- Patients were randomly divided into training (80%) and testing (20%) sets.
- Various eXtreme Gradient Boosting (XGBoost) models were constructed to predict postoperative prolonged intubation (> 24 hours) in the CTICU.
- Model performance was evaluated using accuracy, Brier score, AUC-ROC, and AUC-PR.
- SHapley Additive exPlanation (SHAP) violin plot was created to explain the impact of individual features on the predictions of the XGBoost model.

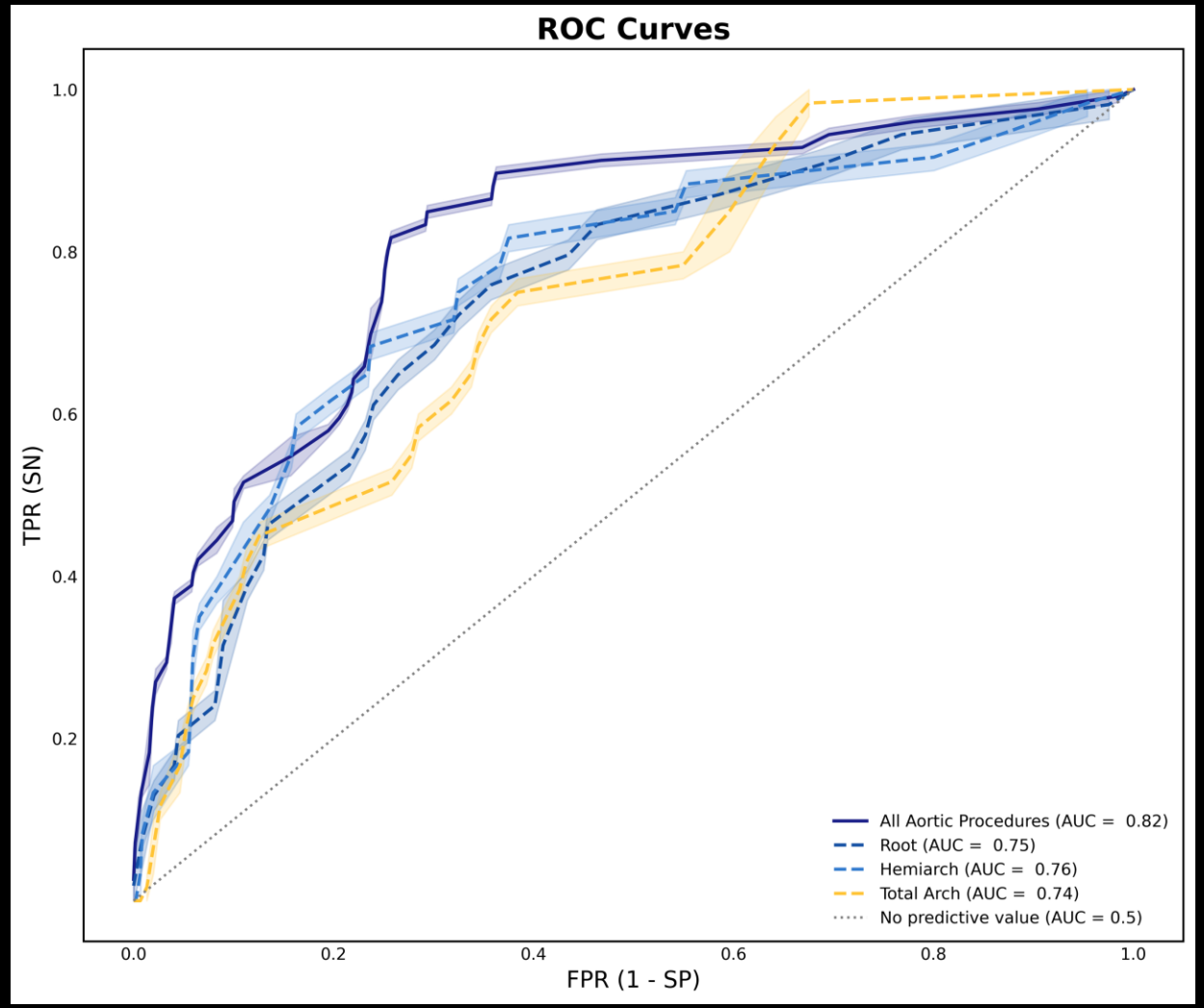
Results

- Postoperative prolonged intubation in the CTICU was noted in 81 patients (9.3%).
- The final XGBoost model demonstrated a cross-validation accuracy of 89% (90% on the testing set) and was well-calibrated as evidenced by the low Brier score of 0.09.
- Final overall model performance:
  - AUC-ROC: 0.82
  - AUC-PR: 0.39



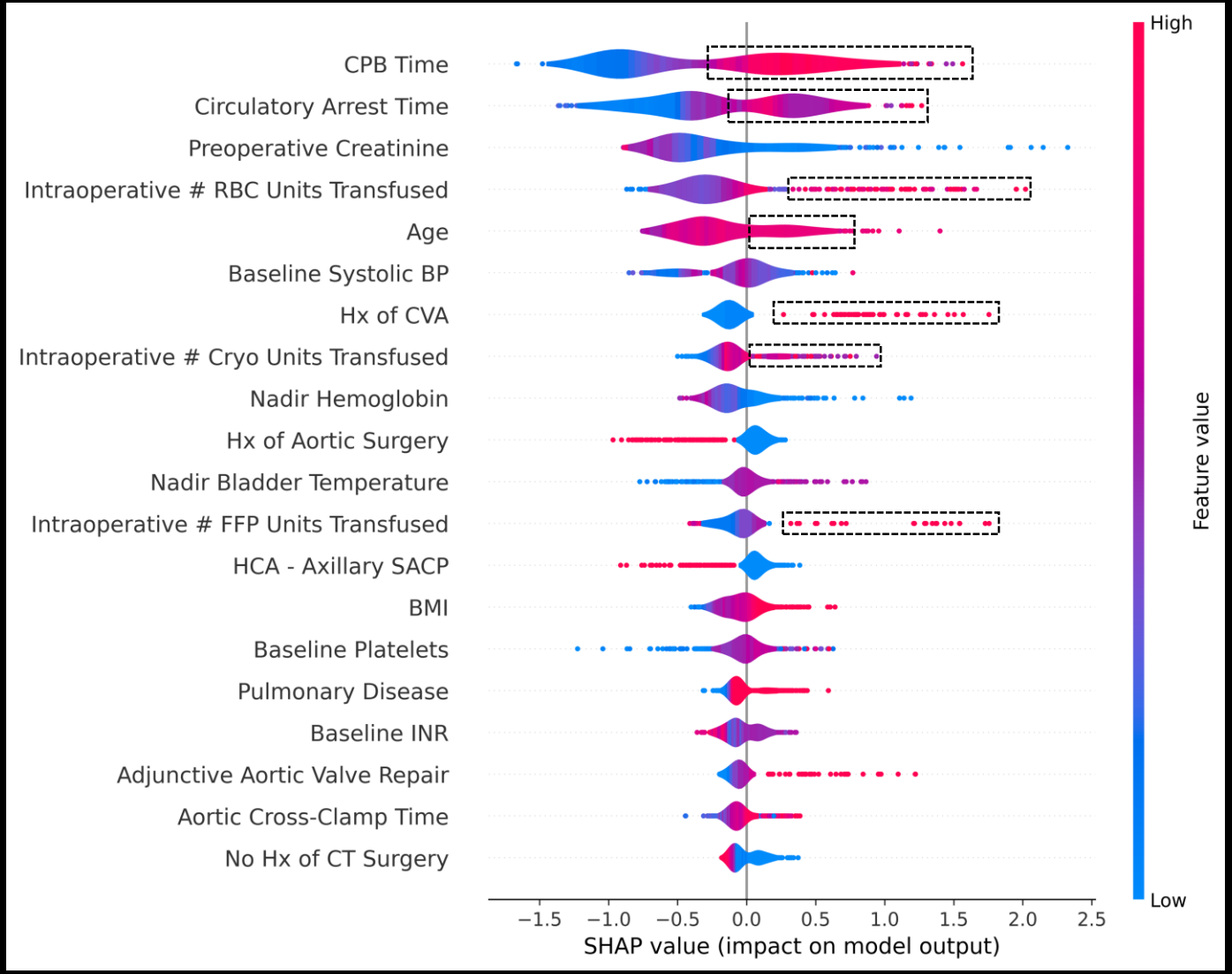
Results

- Model performance upon stratification by aortic procedure (AUC-ROC):
  - All procedures: 0.82
  - Root: 0.75
  - Hemiarch: AUC-ROC 0.76
  - Total arch: AUC-ROC 0.74



Results

- Increased risk of prolonged intubation:
  - Extended durations of cardiopulmonary bypass and circulatory arrest
  - Increased intraoperative blood product transfusion
  - Advanced age
  - Prior history of stroke



Conclusions

- Machine learning models can accurately predict those at most risk for prolonged ventilation.
- More complex procedures and hemodynamic instability significantly augment the risk of prolonged ventilation.
- Machine learning empowers clinicians to have better, data-driven discussions with patients, offering personalized insights that allow further optimizations to improve outcomes.

Questions???