

## Introduction

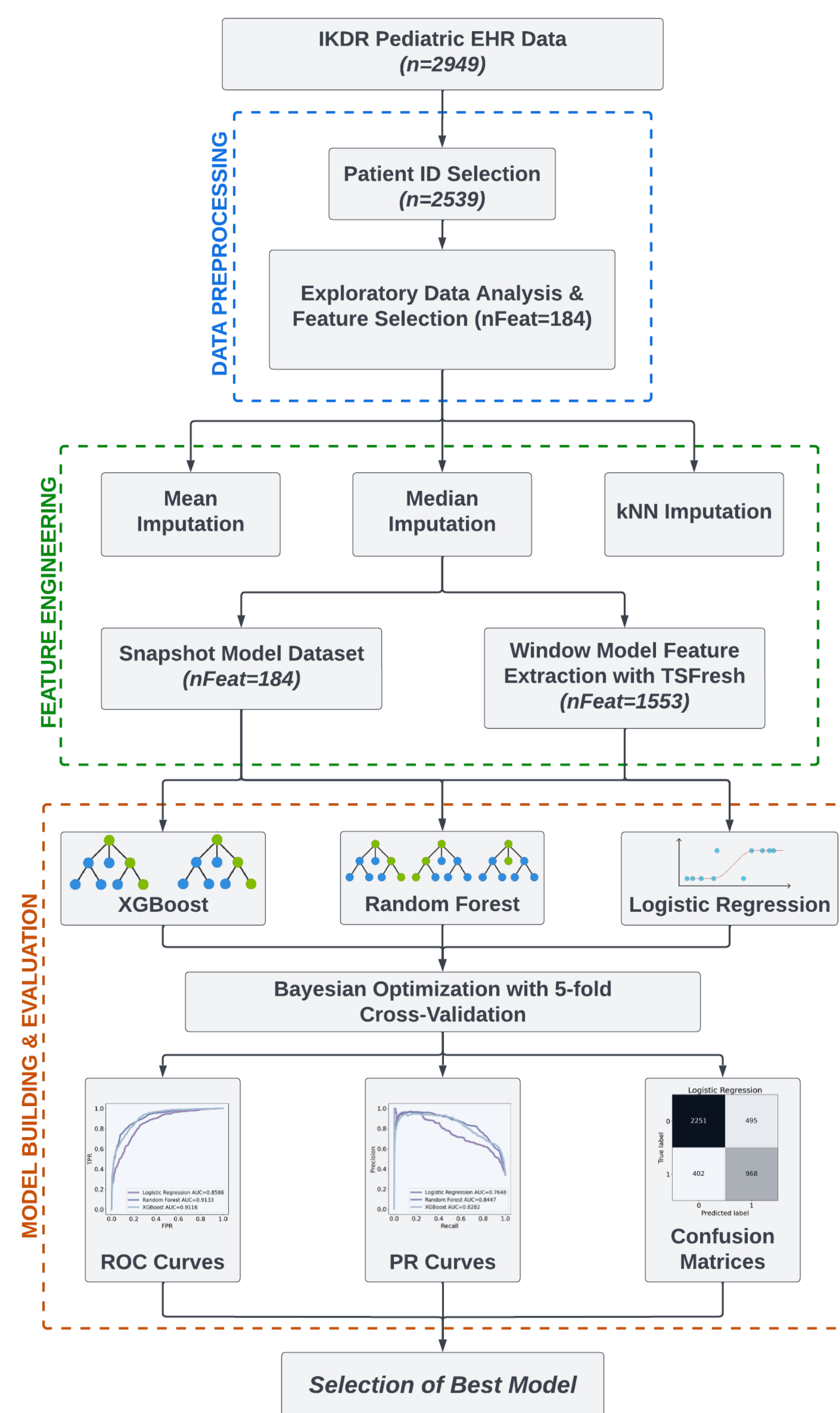
- Cardiac Inflammatory Syndrome (CIS) is a difficult-to-diagnose, life-threatening condition that leads to long-term consequences in pediatric patients.
- Early ICU admission has shown to significantly increase the survival rates for pediatric patients.

## Objective

- Develop machine learning models to predict ICU admissions for children with CIS to improve clinical outcomes.
- Identify clinical features driving the risk associated with CIS.

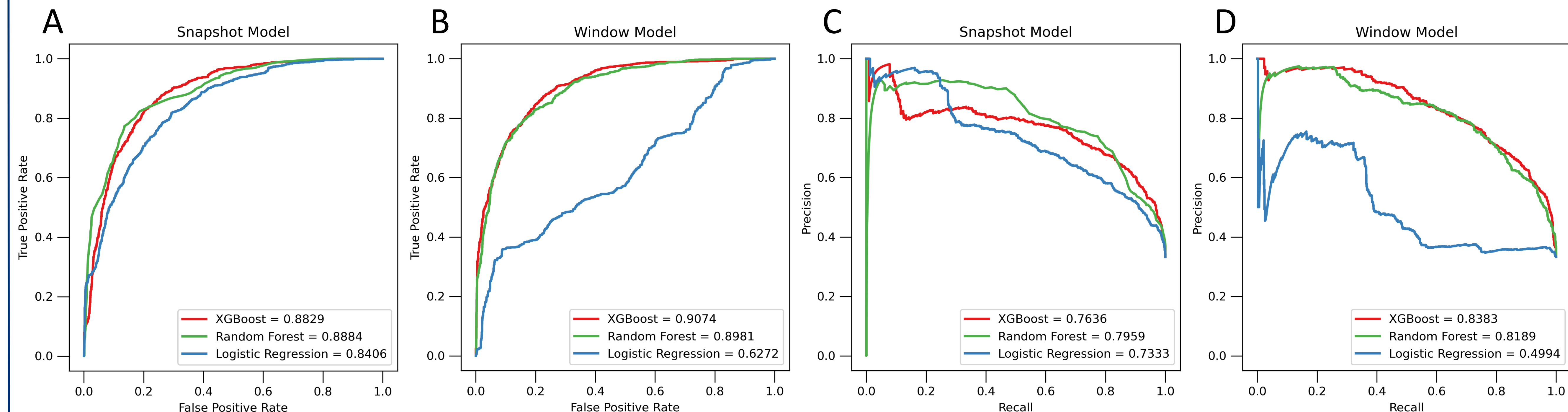


## Methods

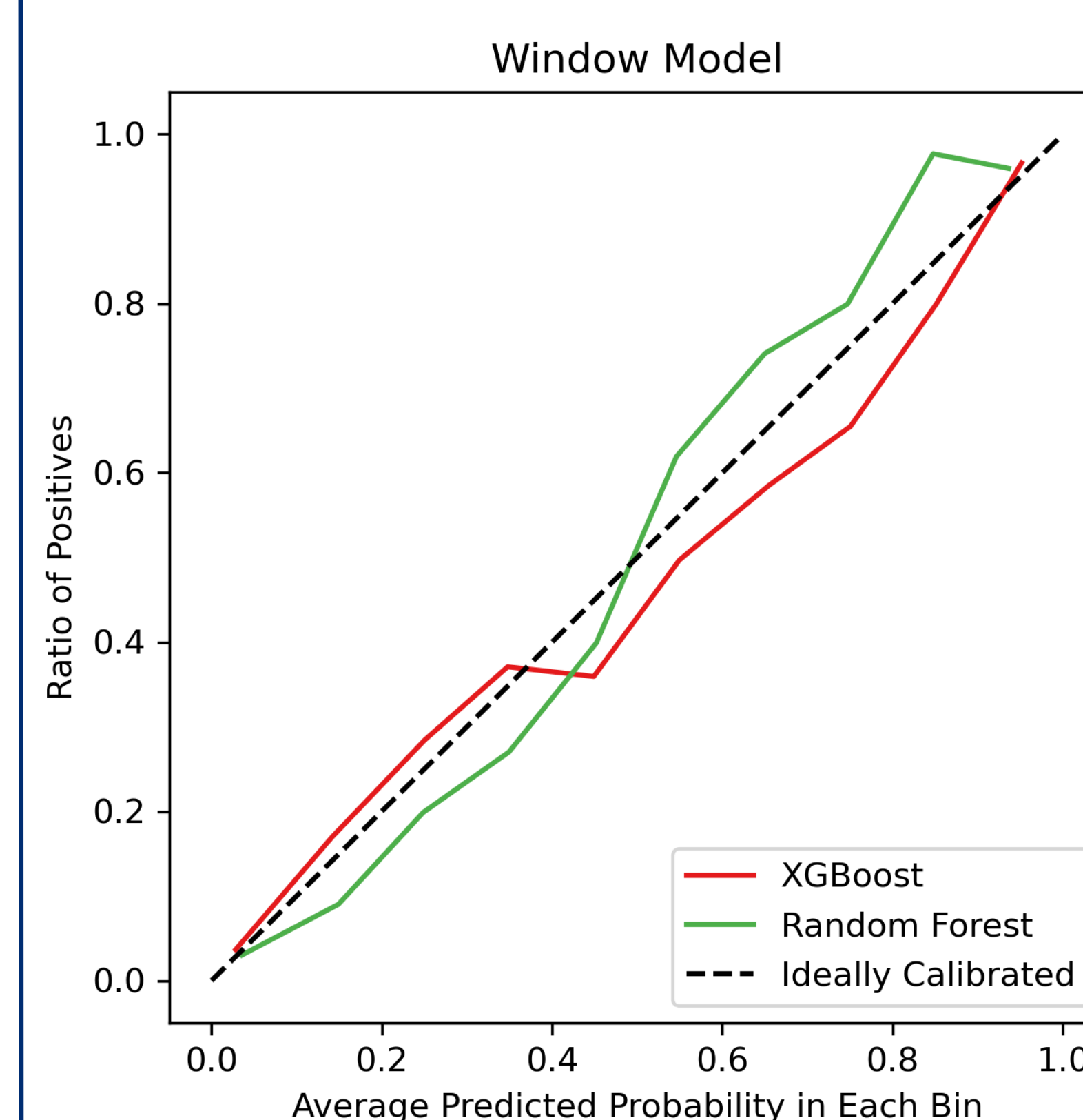


The data used for this study is collected by the International Kawasaki Disease Registry Consortium (IKDR).

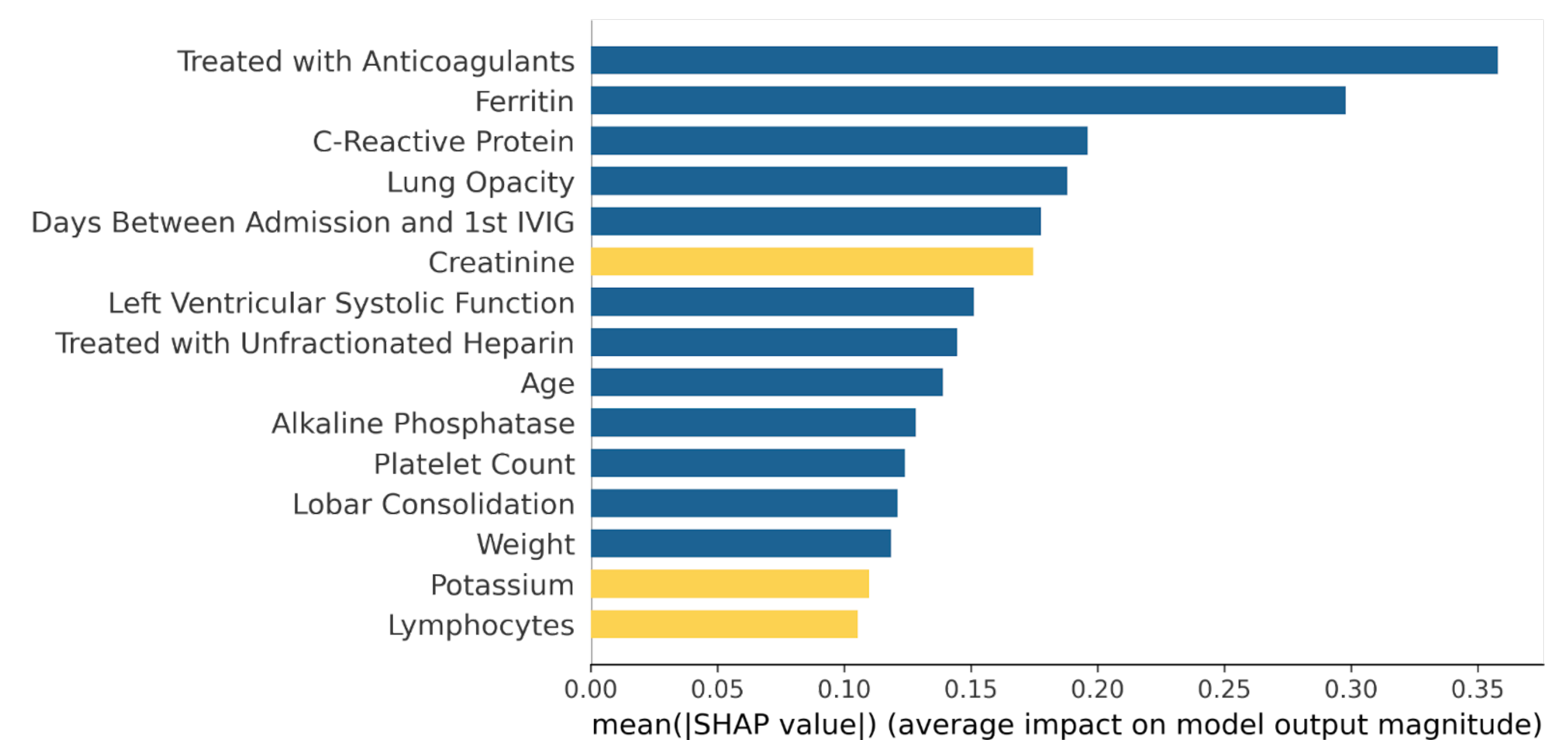
## Results



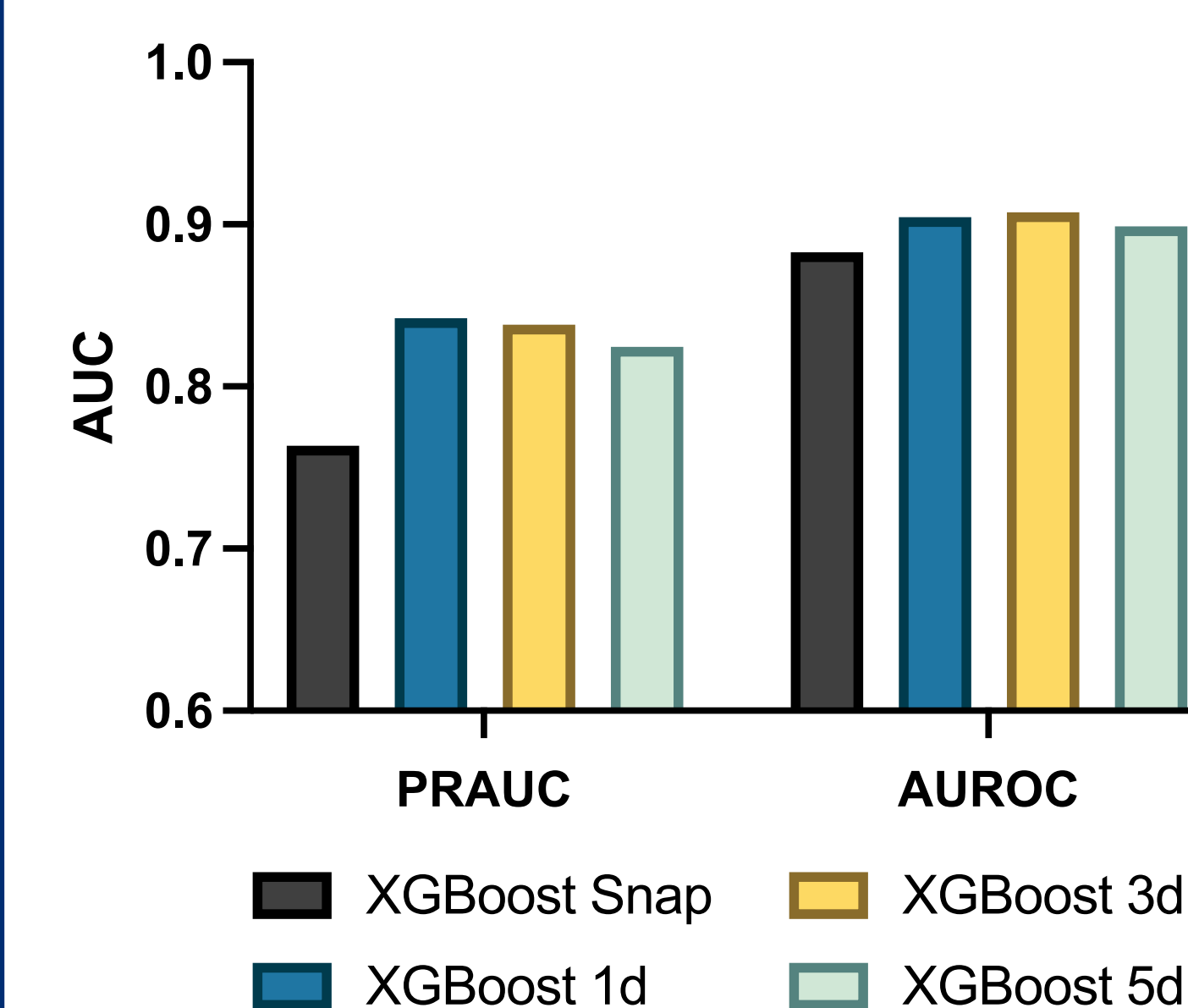
**Result 1. Machine learning models can effectively predict if the patient will be admitted to ICU within 48 hours at the time of evaluation.** Snapshot Models use discrete time-point clinical features. Window Models use both discrete time-point and engineered time-series clinical features. Areas under each curve are noted on the legend. **(A)** Receiver-operator characteristic curves of Snapshot Models. **(B)** Receiver-operator characteristic curves of Window Models with 3-day sampling window. **(C)** Precision-recall curves of Snapshot Models. **(D)** Precision-recall curves of Window Models with 3-day sampling window.



**Result 2. XGBoost and Random Forest Window Models can be well calibrated via Bayesian optimization and 5-fold cross-validation.**



**Result 3. Machine learning models reveal the feature importance levels associated with CIS.** The plot shows 15 most important features measured by Shapley Additive Explanations (SHAP) on 3-day XGBoost model. Blue represents discrete time-point clinical features. Yellow represents engineered time-series clinical features.



**Result 4. Incorporation of time-series clinical features improve predictive performances independent of sampling time.** PRAUC represents area under precision-recall curve. AUROC represents area under receiver-operator characteristic curve.

## Conclusion

- Machine learning models can **accurately predict ICU admission** for at-risk pediatric patients with CIS.
- Incorporation of **engineered time-series clinical features improves** predictive performances of the machine learning models.
- Machine learning models reveal **clinical features that drive the risks** associated with CIS.