

Predicting Next-Day Discharge via Electronic Health Record Audit Logs

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Introduction

- Hospital capacity management depends on accurate real-time estimates of hospital-wide discharges.
- Estimation by clinicians requires an excessively large amount of effort and human accuracy in forecasting next-day patient level discharge is poor.
- Next-day discharge predictions with machine learning** will move the hospital capacity management toward an automated way.
- EHR audit log data capturing EHR user's granular interactions with patients' records.**
- We are the first to incorporate EHR audit log data in discharge prediction.**

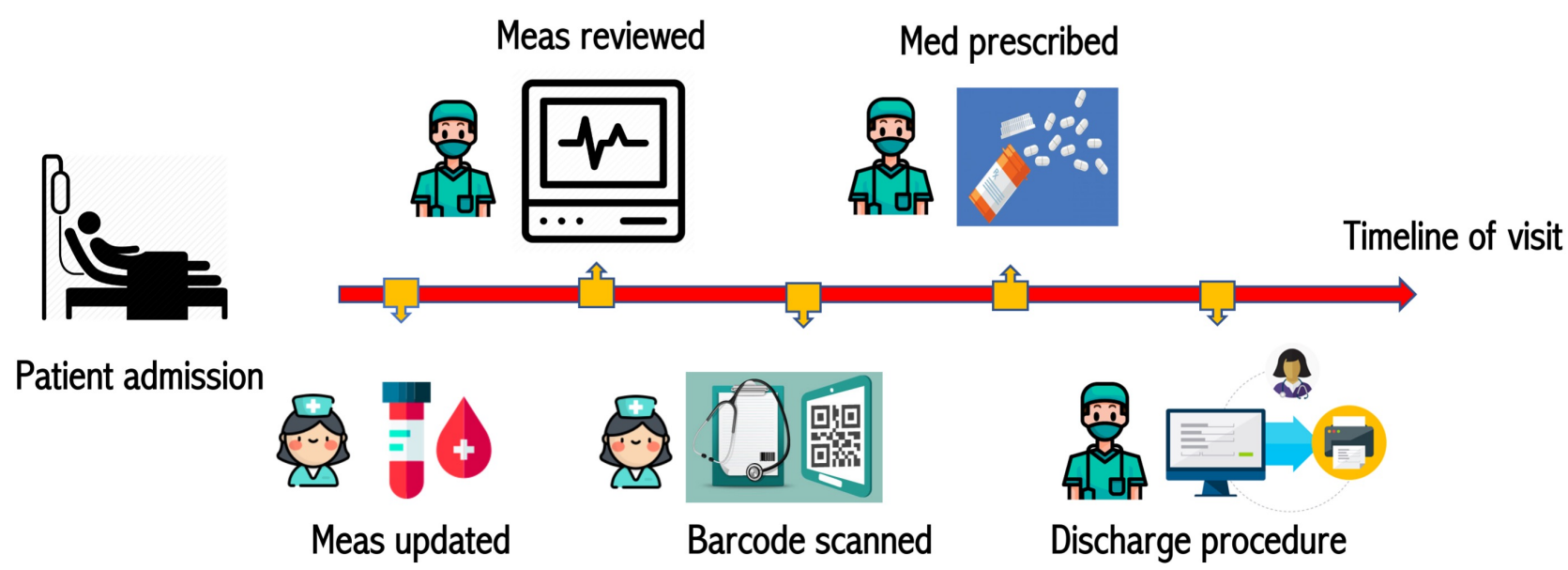


Figure 1: An example of EHR audit log trajectory associated with an inpatient visit.

Methods

- All inpatient-visit associated audit logs of 2019 extracted from Vanderbilt University Medical Center Epic system.
- Feature space** covers user-EHR interactions, demographics, admission diagnoses, admission dates, and clinical measurements.
- Light gradient boosting machine:** 85% for training, 10% for testing, and 5% for calibration. 5-fold cross validation.
- Shapley additive explanations (SHAP)** to identify the most influential types of user-EHR interactions for discharge prediction.

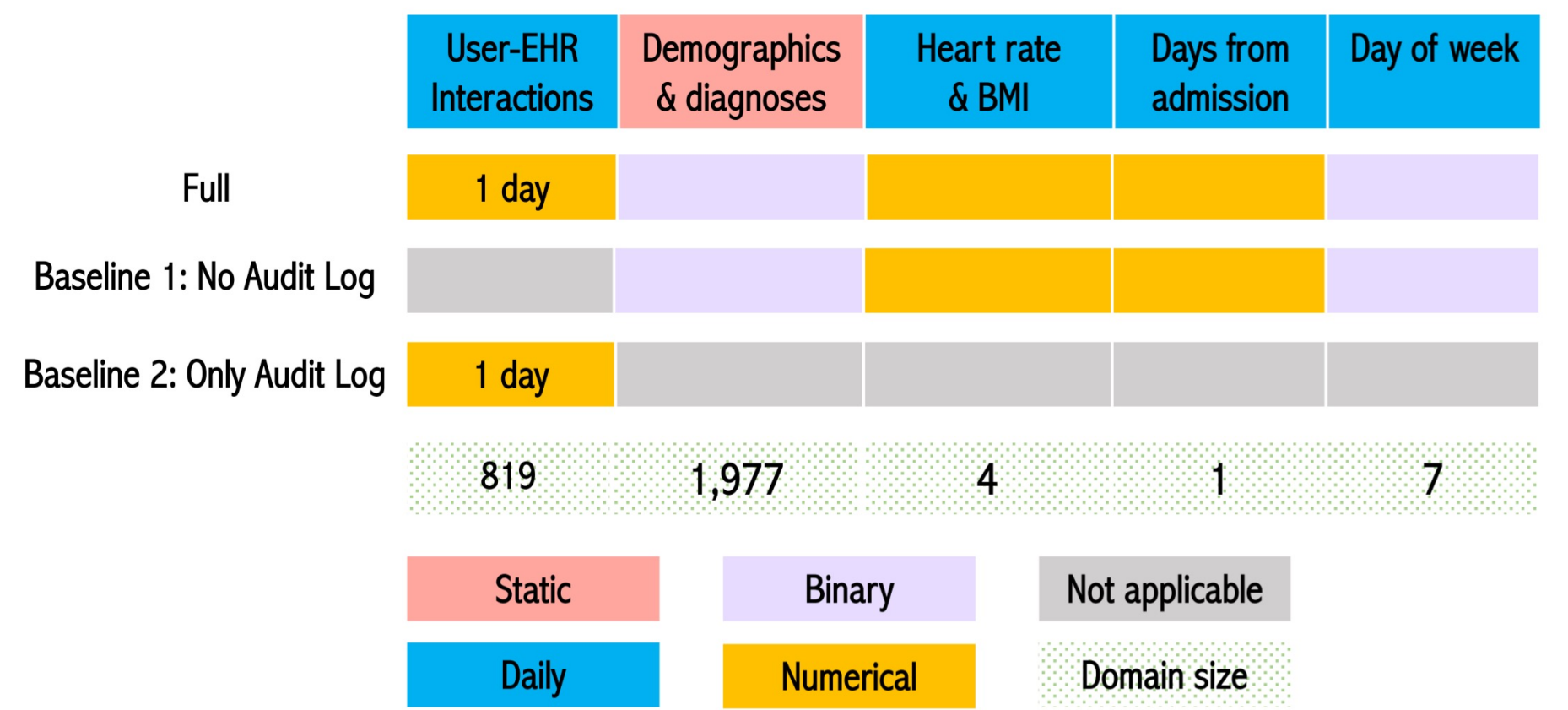


Figure 2: Input feature spaces of models.

Results

- Inputs: 26,283 inpatient stays, 133,398 patient-day observations, and 819 types of user-EHR interactions.
- The Full achieved the highest AUROC of 0.921 (95% CI: 0.919-0.923).**
- The baseline model based on user-EHR interactions achieved an AUROC of 0.890 (0.888-0.892)
- The baseline model without using user-EHR interactions achieved a significantly worse AUROC of 0.862 (0.860-0.892).
- The 10 most influential factors (in terms of SHAP values) were identified by of the best performing model.
- 6 of the 10 most influential factors were user-EHR interaction features.**
- The presence of Nurse's station mode monitoring access tends to contribute to a non-discharge prediction.

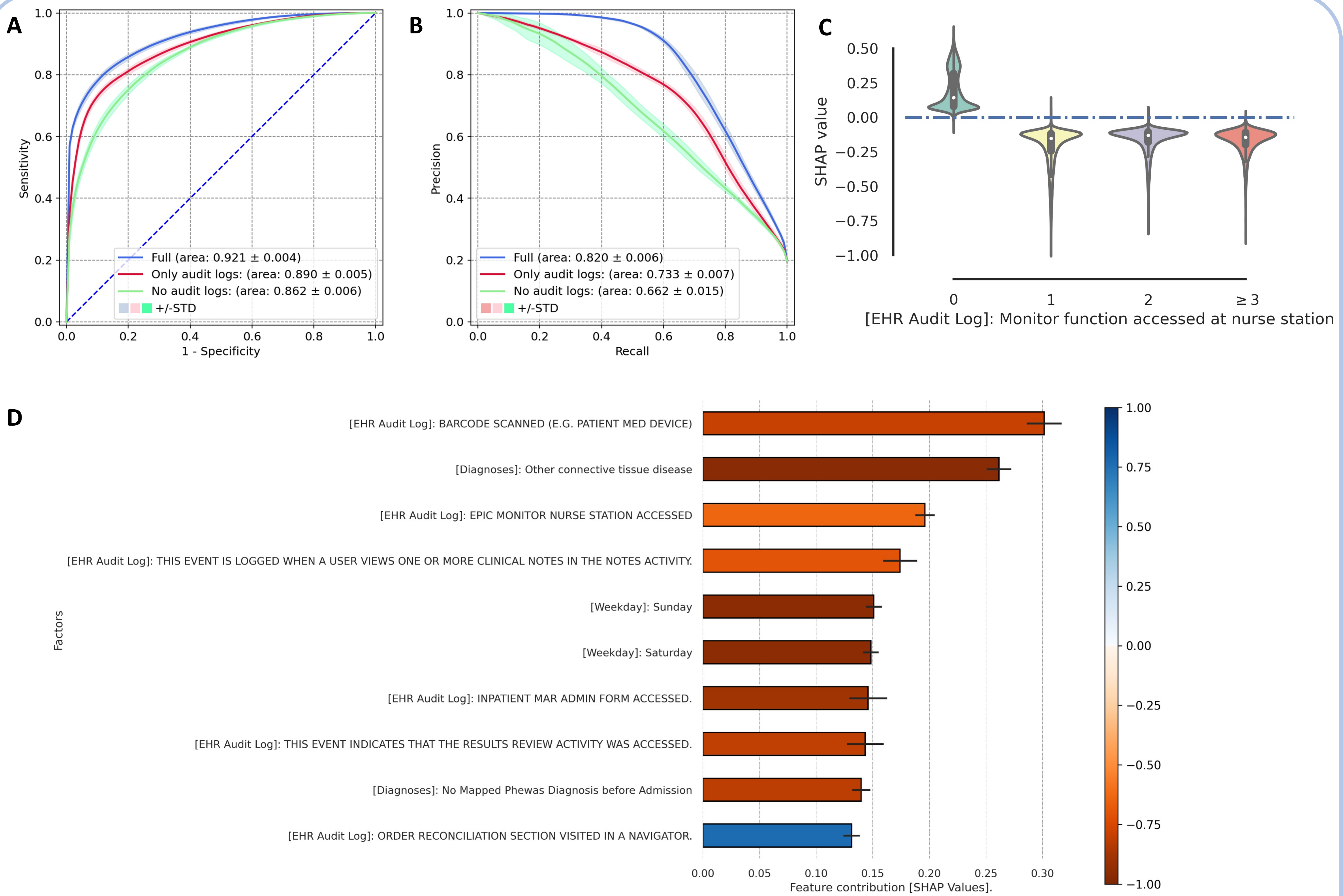


Figure 3: A,B: Next-day discharge prediction model performance (receiver operating characteristic curve, precision recall curve). C: Violin plots of factor values against the corresponding SHAP values. D: Top 10 risk factors in terms of SHAP values.

Conclusions

- EHR audit log **date captures clinicians' interactions with patient records** and provide clues into clinicians' assessments and insights into a patients' clinical status.
- We explored the novel functions of the audit log data in the discharge prediction and found the count of each type of user-EHR interactions in the past 24 hours to be the most effective for the prediction.
- We hope our study can raise researchers' awareness of **EHR audit log data in prediction analytics.**

Publication & Acknowledgements

- ❖ Zhang X, Yan C, Malin BA, Patel MB, Chen Y, Predicting next-day discharge via electronic health record access logs, *JAMIA*, 2021.
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