

EP16.45 Dynamic blood-pressure phenotypes for second-trimester prediction of hypertensive disorders and related adverse pregnancy outcomes

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Introduction

To develop and validate a machine learning (ML) model for the prediction of hypertensive disorders of pregnancy (HDP) and related adverse outcomes, based on dynamically engineered blood pressure (BP) phenotypes derived from routine prenatal measurements at 12-28 weeks' gestation.

Methods

- This retrospective cohort study included 8114 singleton pregnancies.
- A CatBoost model was trained using 13 baseline maternal characteristics and 28 dynamic BP features (e.g., slope, variability) extracted from systolic, diastolic, pulse, and mean arterial pressures.
- Model performance was evaluated on a held-out test set by the area under the receiver operating characteristic curve (AUC).
- The added value of dynamic BP features was assessed through an ablation study, and model interpretability was achieved using SHapley Additive exPlanations (SHAP).

Results

- For the prediction of preeclampsia (PE) complications (n=385), the AUC was 0.868 (95% CI: 0.867-0.869), significantly outperforming a baseline model with maternal factors alone (AUC 0.847, P<0.001).
- Integrating dynamic BP features increased the detection rate for PE complications from 57.6% to 65.4% at a 15% screen-positive rate.
- For severe composite outcomes, such as HDP with both PE complications and low birth weight (n=97), the model achieved an AUC of 0.911 (95% CI: 0.909-0.912).
- SHAP analysis identified the maximum of mean arterial pressure as the most important predictor, revealing a data-driven threshold for sharply increased risk.

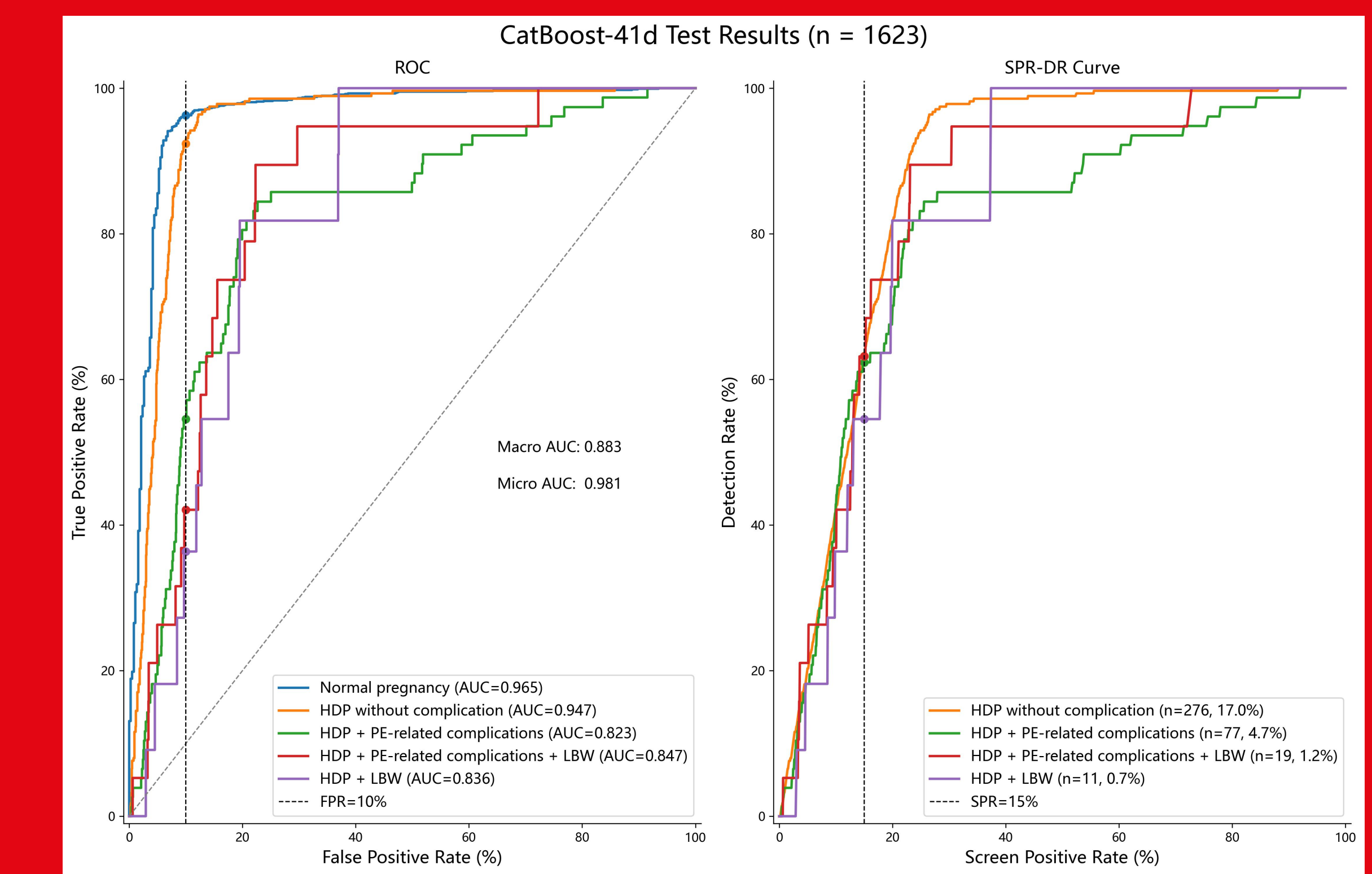


Figure 1. ROC and SPR of DR curves for hypertensive disorders of pregnancy and related complications

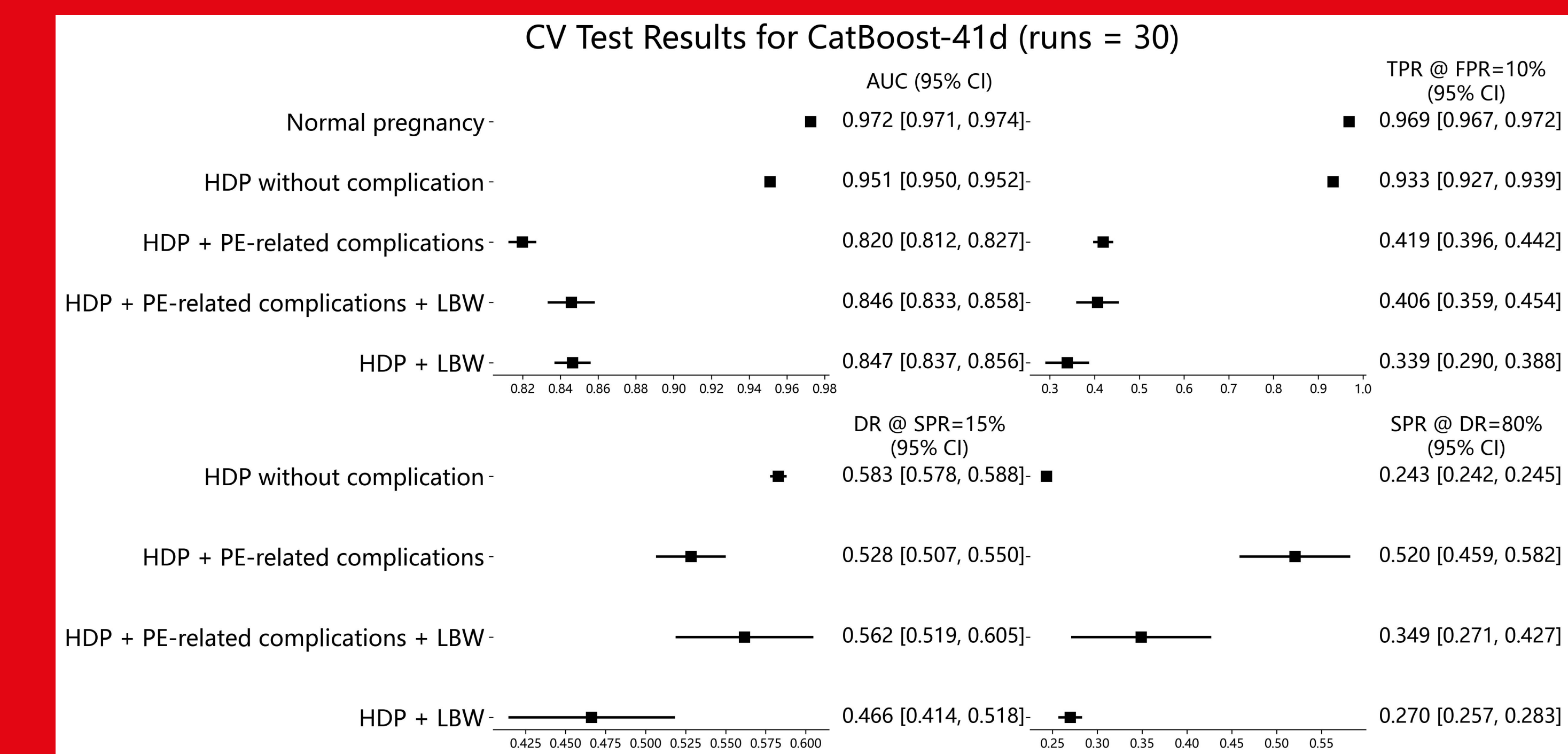


Figure 2. Relationship between detection rate (DR) and screen positive rate (SPR) for the prediction of any hypertensive disorder and severe adverse outcomes in cross validation performance.

Conclusion

A machine learning model incorporating dynamic BP phenotypes from the second trimester accurately predicts HDP and related adverse outcomes. This approach provides a practical and accessible tool for risk stratification beyond the first trimester.

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