

Multimodal AI-Augmented Radiomics and Spectral Doppler Ultrasound for Early Prediction of Preeclampsia

“From prediction to prevention: home placental monitoring + edge-AI → timed prophylaxis.”

Sunday Adetunji, MD, PhD (cand.)

Department of Epidemiology (Maternal & Reproductive Health), Oregon State University, USA



Background / Significance

Problem: Preeclampsia (PE) is a leading cause of maternal–fetal morbidity; clinic screening is episodic and often late.

Limits of status quo: UtA Doppler or biomarkers alone have modest screening utility and rarely change management in real time.

Inflection point: Multimodal AI (radiomics + spectral Doppler) and low-power edge compute now make at-home placental monitoring feasible.

What’s missing: No prior system combines home ultrasound + on-device inference + closed-loop prophylaxis to move from prediction → prevention.

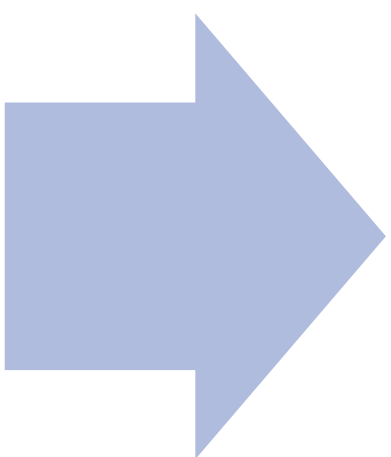
Equity: Home monitoring can extend high-quality screening beyond tertiary centers.

Objective

From prediction to prevention: evaluate whether at-home placental monitoring with edge-AI that triggers/titrates aspirin can reduce severe/early-onset PE vs usual care.

Specific Aims

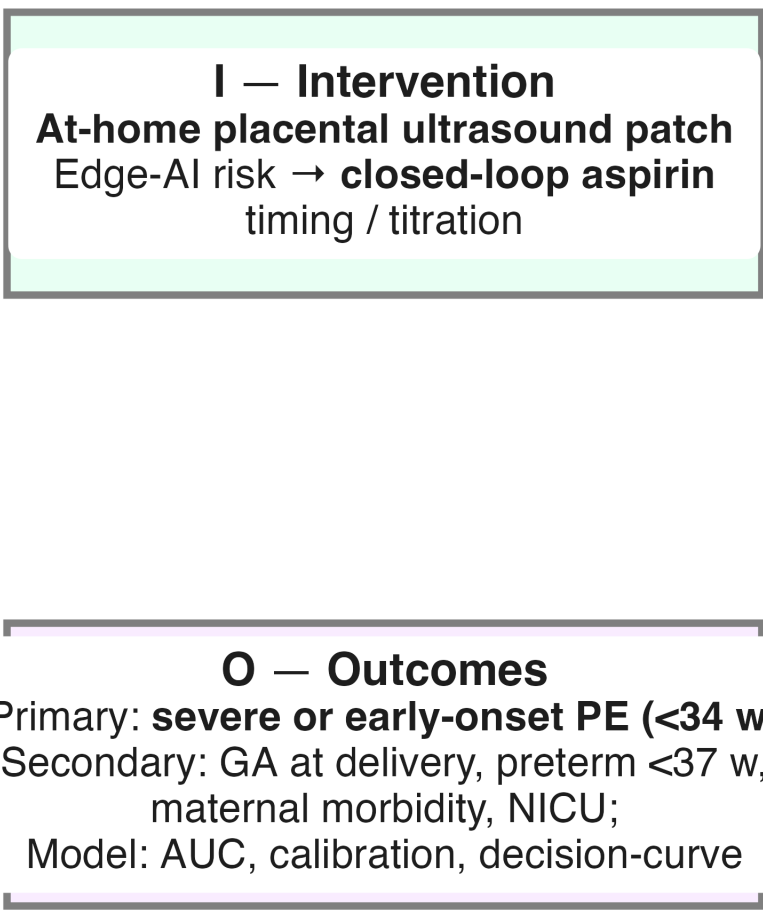
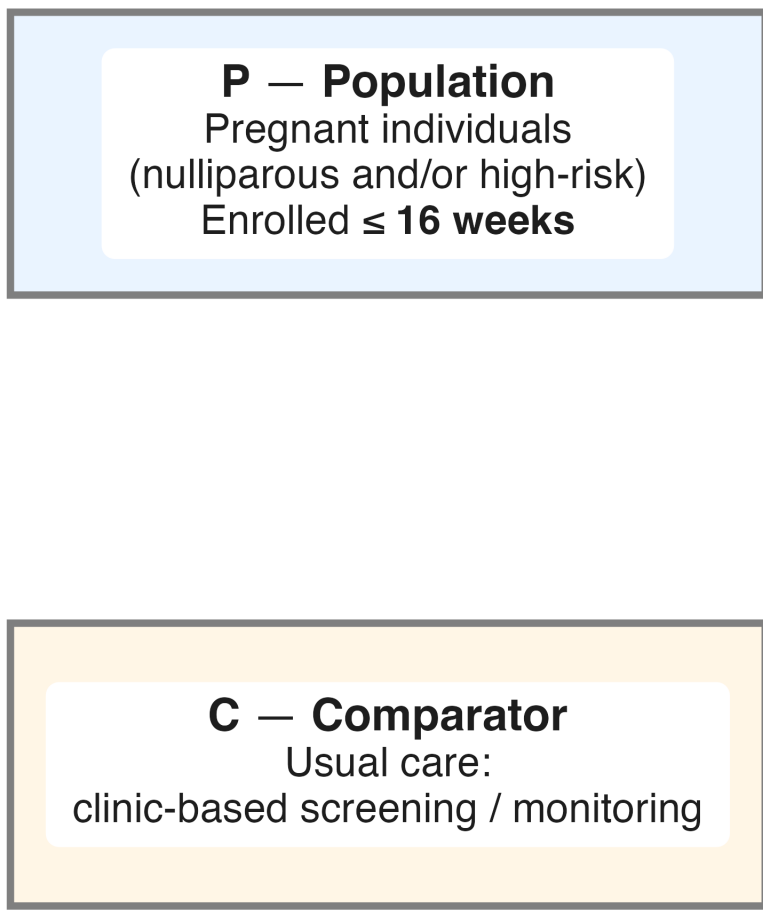
1. Develop & validate a compact multimodal model (radiomics + UtA Doppler + maternal signals) with AUC, calibration, and decision-curve reporting.



2. Simulate closed-loop prophylaxis to estimate absolute risk reduction (ARR) and define actionable risk thresholds for a pilot study.

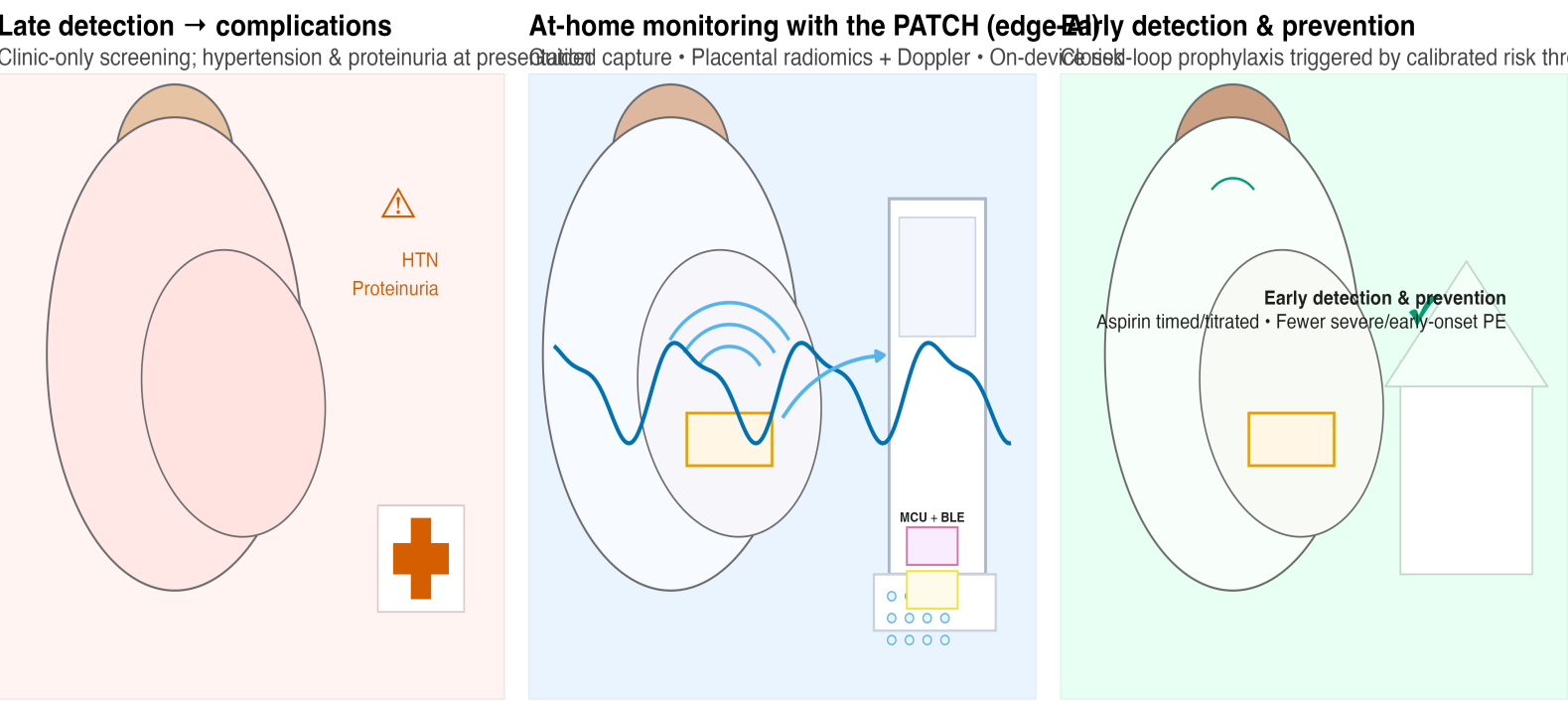
PICO — Trial Framing

From prediction → prevention: home placental monitoring + edge-AI → timed prophylaxis



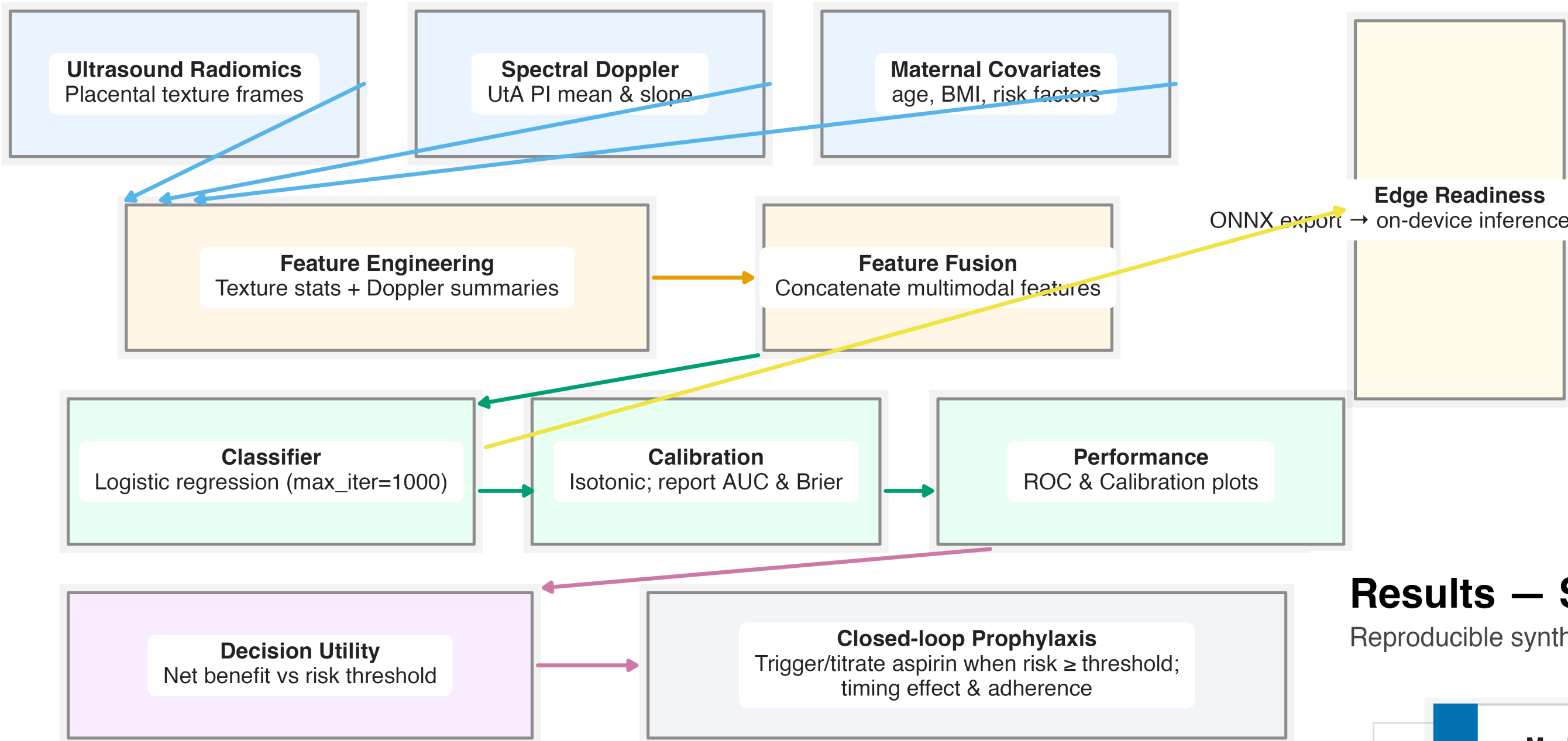
Trial Timeline

Enroll ≤16 w → Weekly home monitoring (W1–W6) → Threshold crossing → Aspirin timing/titration → Outcomes & analysis



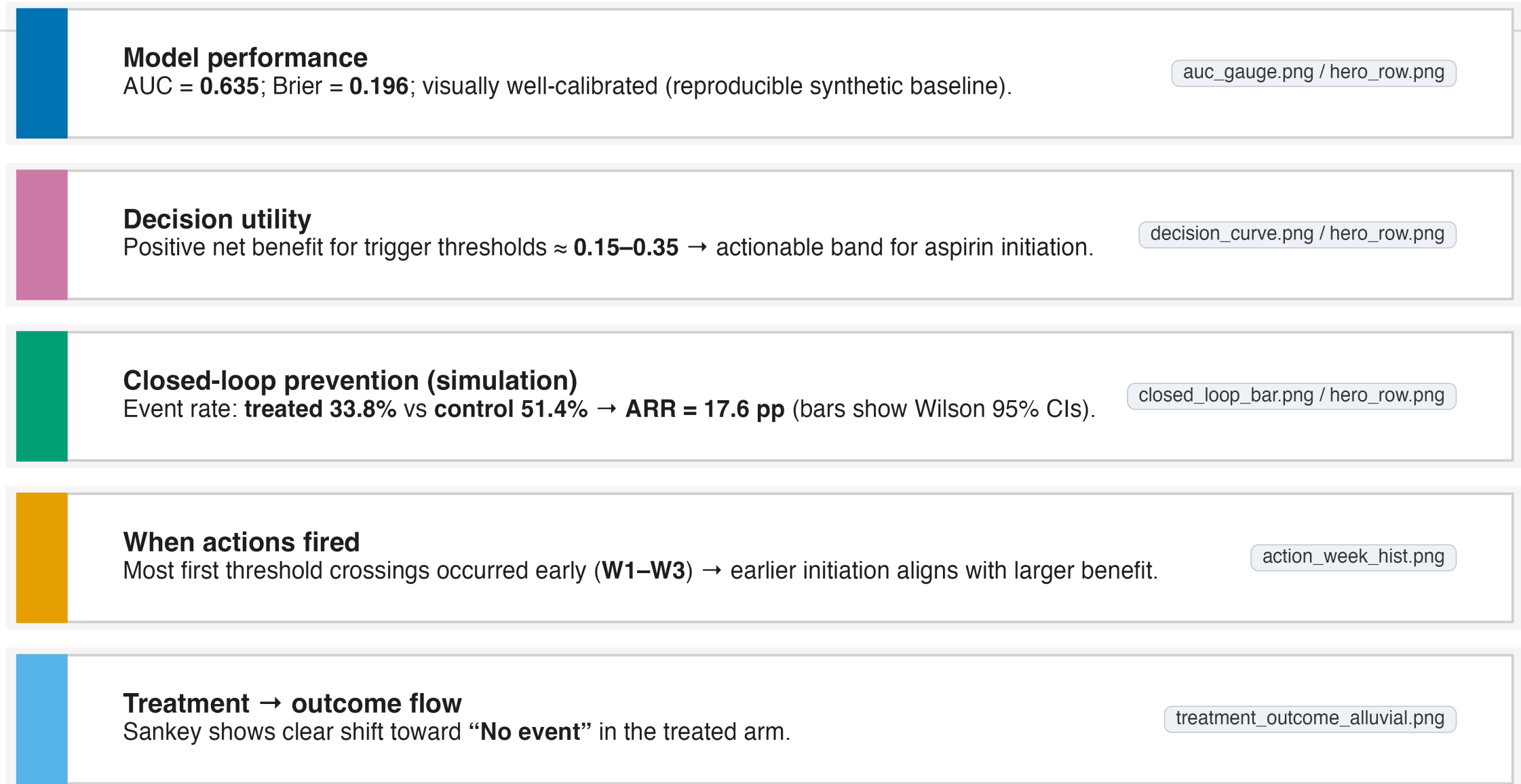
Methods Blueprint

Signals → Features/Fusion → Model/Calibration → Decision Utility → Closed-loop Prophylaxis • Edge AI: ONNX → on-device inference



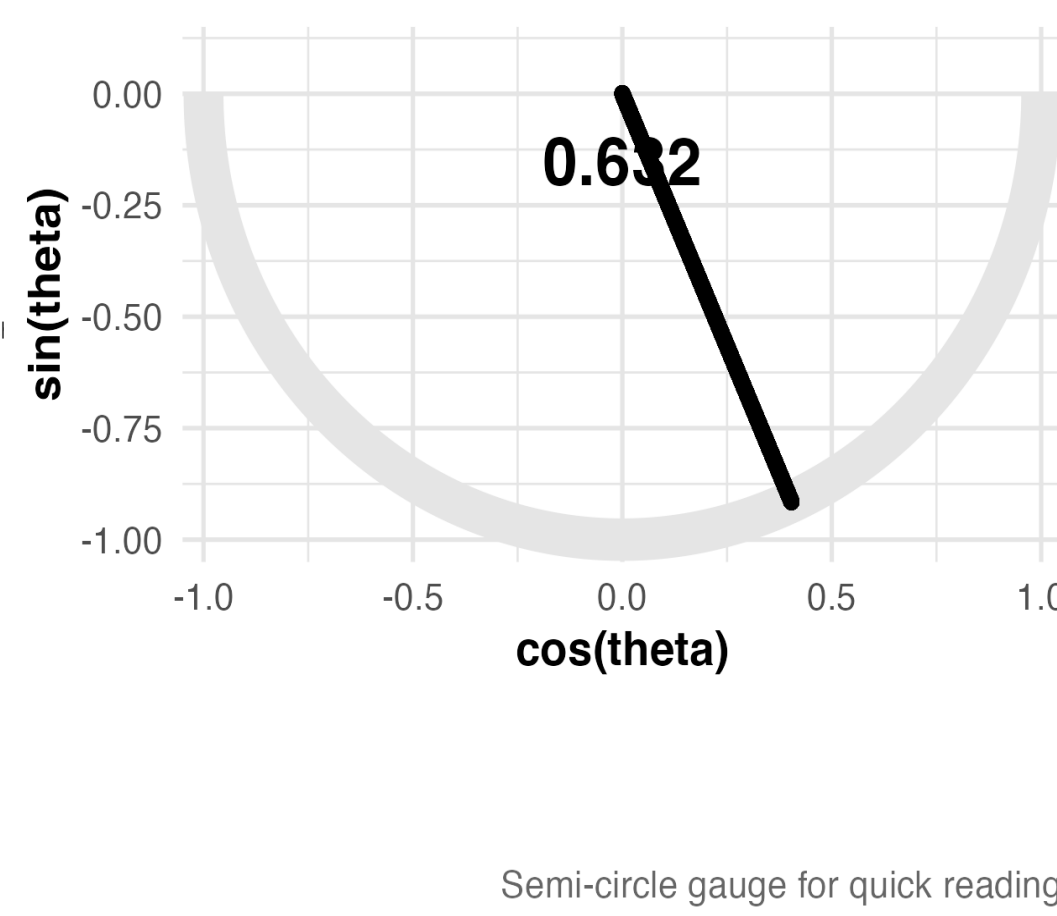
Results — Summary

Reproducible synthetic baseline (swap with pilot data on ingestion)



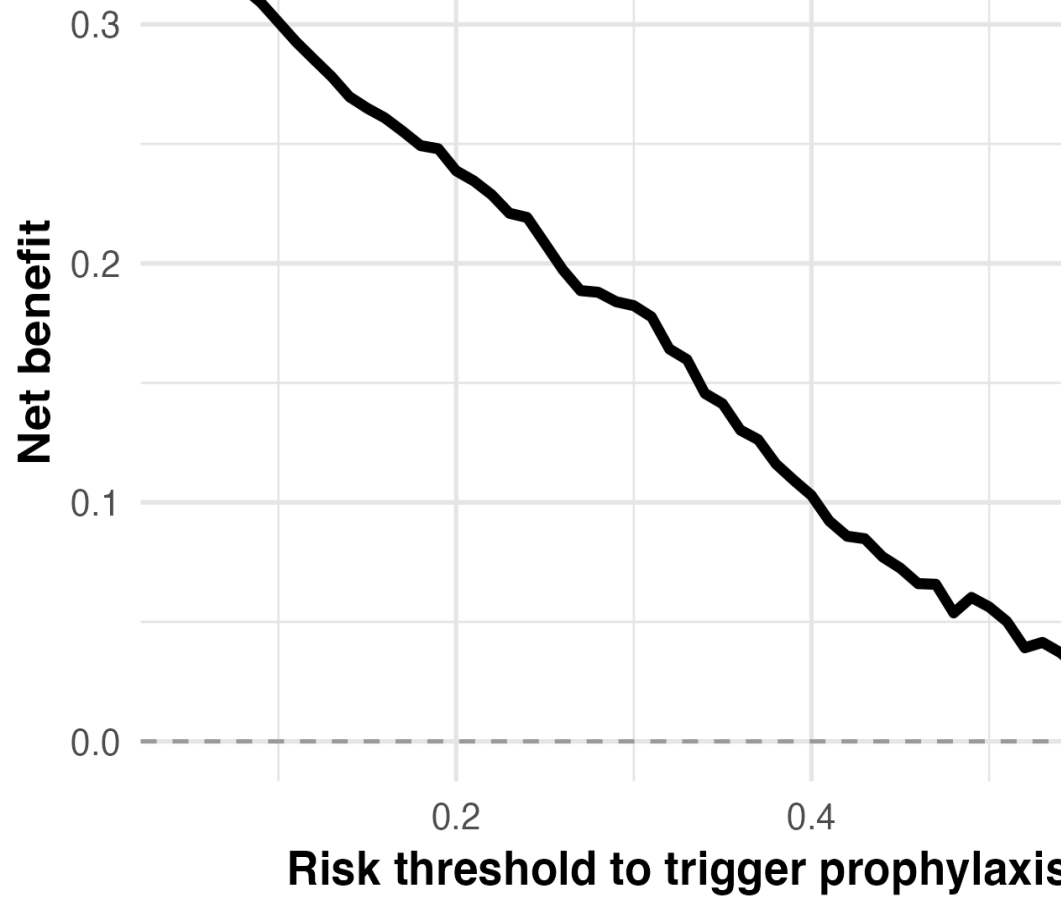
Discrimination (AUC)

Brier = 0.194



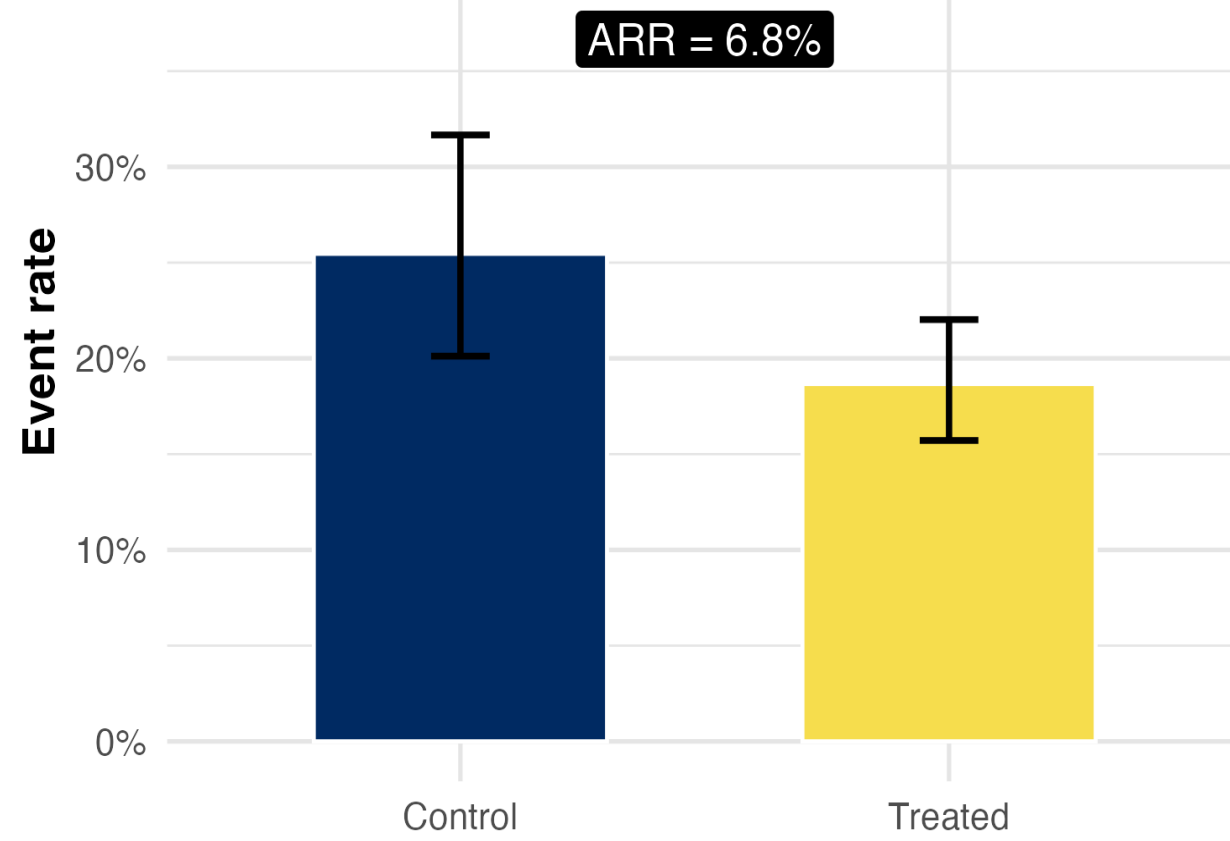
Decision-style net benefit curve

Illustrative shape; replace with real predictions when available



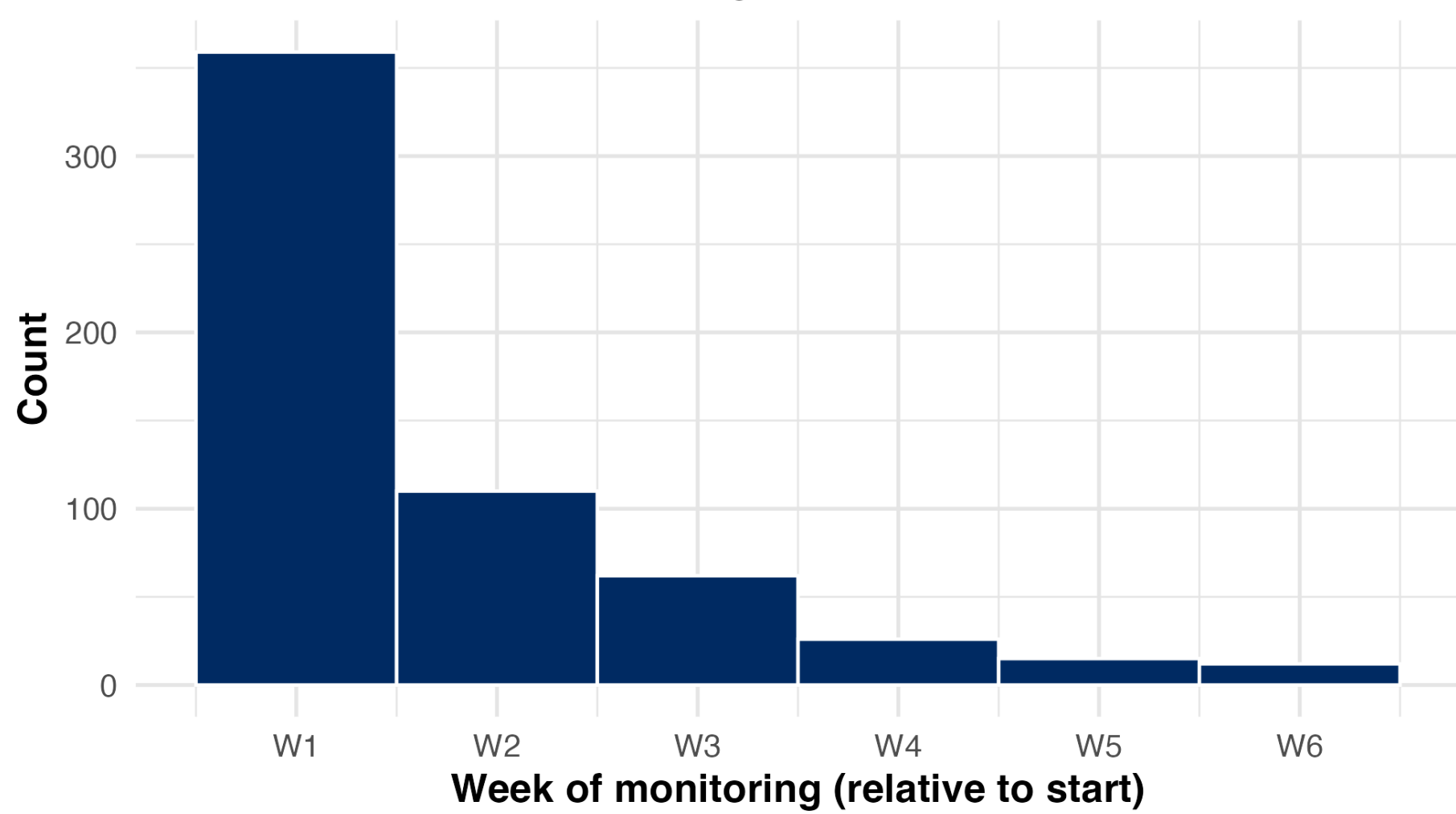
Closed-loop prevention simulation: eve

Wilson 95% CI; annotation shows Absolute Risk Reduction

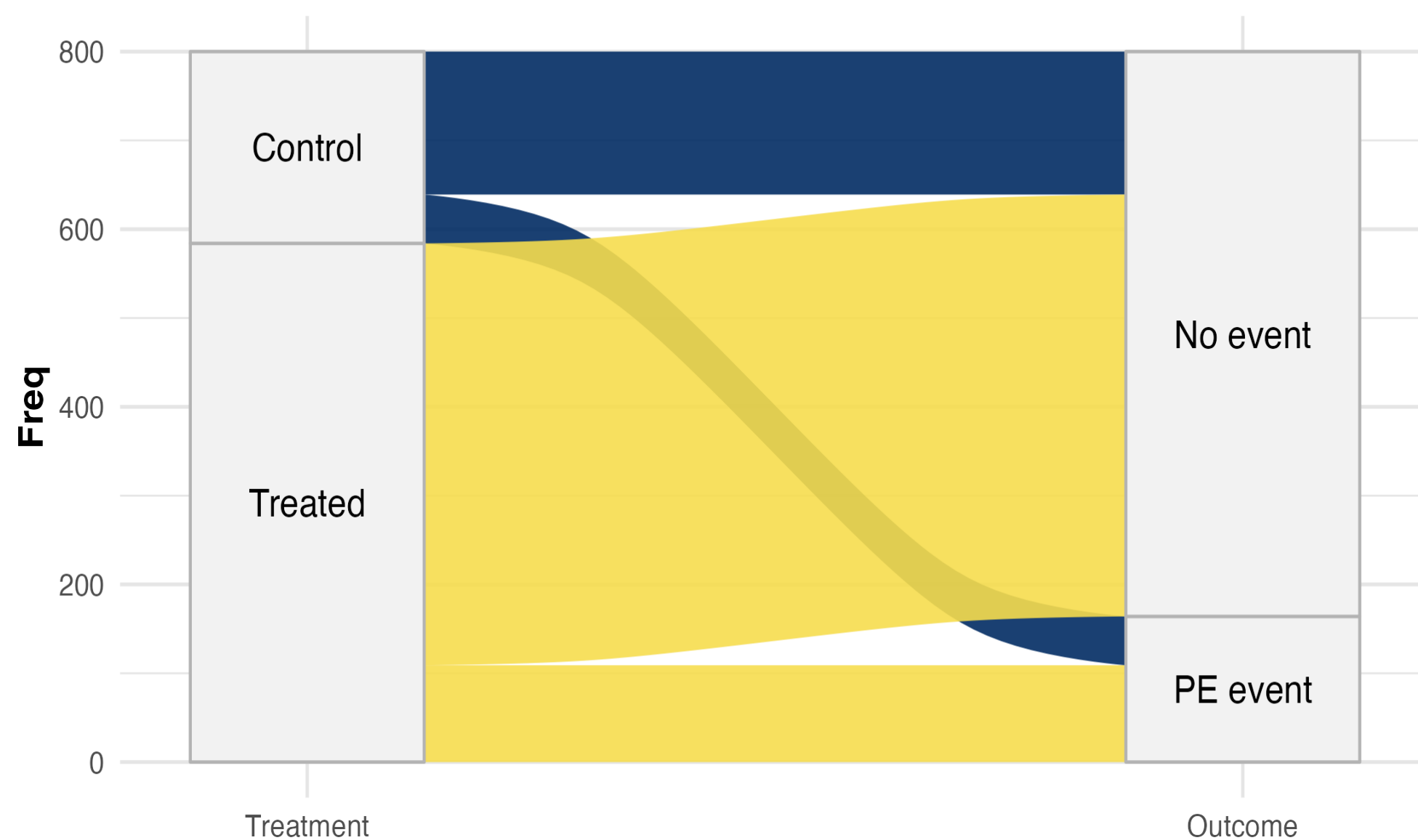


Timing of closed-loop action

Distribution of first week exceeding risk threshold



Flow from treatment to outcome



Conclusion

Home patch + edge-AI + closed-loop prophylaxis → from prediction to prevention

- Feasibility & shift in care**
Home ultrasound patch + edge-AI + closed-loop prophylaxis is feasible and moves care from prediction → prevention.
- Baseline evidence**
Reproducible baseline shows credible discrimination, useful decision-curve behavior, and a large simulated ARR when aspirin is triggered.
- Clinical target**
Defines a novel target for pilot & pragmatic RCT: earlier detection and reduction of severe/early-onset PE (<34 w).
- Next steps**
Swap in pilot signals, lock thresholds from decision-curve analysis, and evaluate outcomes in a prospective, equity-minded trial.