

Real-Time Risk Prediction of Postpartum Hemorrhage: An Online Tool for the Labor & Delivery Time



Mahesh Challapalli, B.S.,² Andrew Warburton, M.D.,¹ Daniel Katz, M.D.¹

¹ Icahn School of Medicine at Mount Sinai. ²University of Arizona School of Medicine.

- Labor & delivery is a dynamic environment where PPH risk shifts hour-to-hour and is difficult to capture at any single moment
- Existing tools (CMQCC, AWHONN) stratify risk once at admission using static variables
- A substantial portion of PPH occurs in patients classified as low-risk by these tools

Goal: Develop a web-based tool that updates PPH risk in real time as labor progresses, using time-varying clinical data.

Methods

Study Design & Population

- Retrospective cohort from **MIMIC-IV (2008–2019)**
- Pregnant patients identified via admission to Labor & Delivery unit
- L&D window restricted to 0–72 hours
- 1,489 total patients: 1,347 No PPH, 142 PPH (9.5%)
- **Outcome:** PPH by ICD-10 O72.x / ICD-9 666.x

Statistical Analysis

- 40 irregularly sampled features: CBC + Coag + medications (oxytocin, magnesium, misoprostol, labetalol + top 20) + Baseline Features
- **Model:** Raindrop graph neural network for irregular multivariate time series
- Patient-level train/test split; AUROC, AUPRC, Brier score with bootstrap 95% CIs

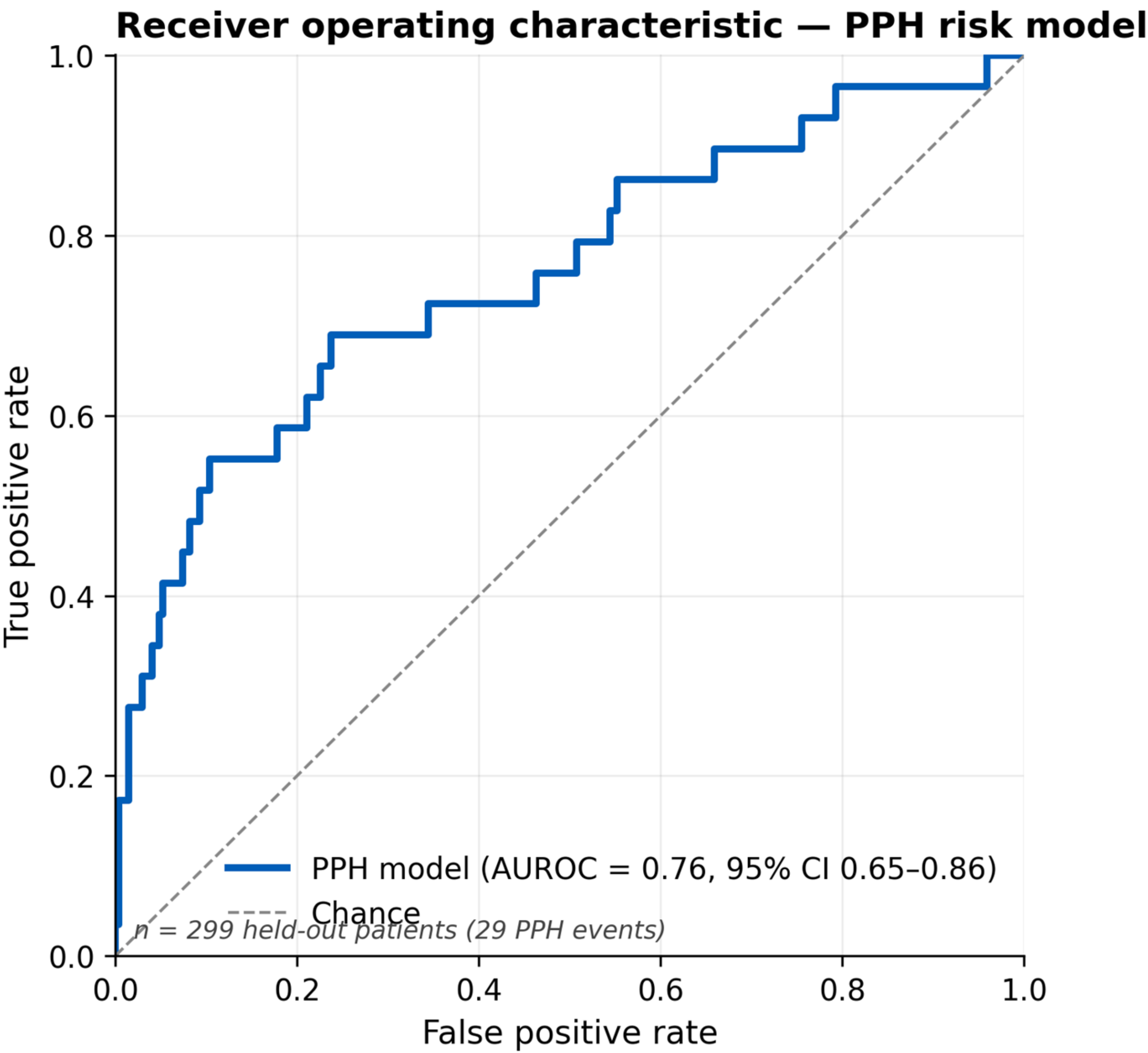
Table 1 | Baseline characteristics of the MIMIC-IV labor and delivery cohort

Patients used to train and evaluate the Raindrop postpartum hemorrhage model.

Characteristic	Overall (n = 1,489)	No PPH (n = 1,347)	PPH (n = 142)
Postpartum hemorrhage, n (%)	142 (9.5%)	0 (0.0%)	142 (100.0%)
Age, years — mean (SD)	30.4 (5.8)	30.3 (5.8)	31.3 (5.7)
BMI, kg/m ² — mean (SD)	29.6 (7.0)	29.4 (6.9)	31.1 (8.1)
Weight, kg — mean (SD)	144.0 (30.0)	143.8 (30.0)	146.2 (30.9)
Height, cm — mean (SD)	162.4 (8.3)	162.4 (8.5)	162.5 (7.2)
Prior cesarean, n (%)	2 (0.1%)	2 (0.1%)	0 (0.0%)
Prior PPH, n (%)	171 (11.5%)	29 (2.2%)	142 (100.0%)
Observation duration, h — median [IQR]	281 [0-1477]	199 [0-1405]	1271 [488-2138]
Medication exposure			
Oxytocin, n (%)	449 (30.2%)	388 (28.8%)	61 (43.0%)
Magnesium sulfate, n (%)	39 (2.6%)	29 (2.2%)	10 (7.0%)
Misoprostol, n (%)	131 (8.8%)	102 (7.6%)	29 (20.4%)
Labetalol, n (%)	16 (1.1%)	11 (0.8%)	5 (3.5%)
Laboratory measured during stay			
Hemoglobin measured, n (%)	1129 (75.8%)	1006 (74.7%)	123 (86.6%)
Hemoglobin Δ (last – first), g/dL — mean (SD)	-1.3 (1.7)	-0.9 (1.4)	-2.3 (2.0)

Values are mean (SD), median [IQR], or n (%). PPH, postpartum hemorrhage. Hemoglobin Δ is computed as the difference between the last and first non-missing in-encounter value, restricted to patients with ≥2 measurements (overall n=228; No PPH n=165; PPH n=63). Cohort derived from MIMIC-IV; the prediction window ends prior to delivery.

Results



PPH Risk Predictor

[Tool](#)[About](#)

Patient Information

Load Example Patient

-- Custom Entry --

Demographics

Age

37

BMI

37

Weight (kg)

70

Height (cm)

165

☐ Prior C-Section

☒ Prior PPH

Clear All

Clinical Data Entry

Labs

Platelet Count

60

Normal: 150.0-400.0 K/uL

Time (min)

120

Add Lab

Hemoglobin

9

30m

Hemoglobin

7

45m

Platelet Count

60

120m

Medications

Misoprostol

Time (min)

180

Click 'Add Medication' to record administration

Add Medication

Med

Type

Val

Time

Oxytocin

event

1.00

30m

Oxytocin

dose

10.00

30m

Oxytocin

event

1.00

30m

Risk Assessment

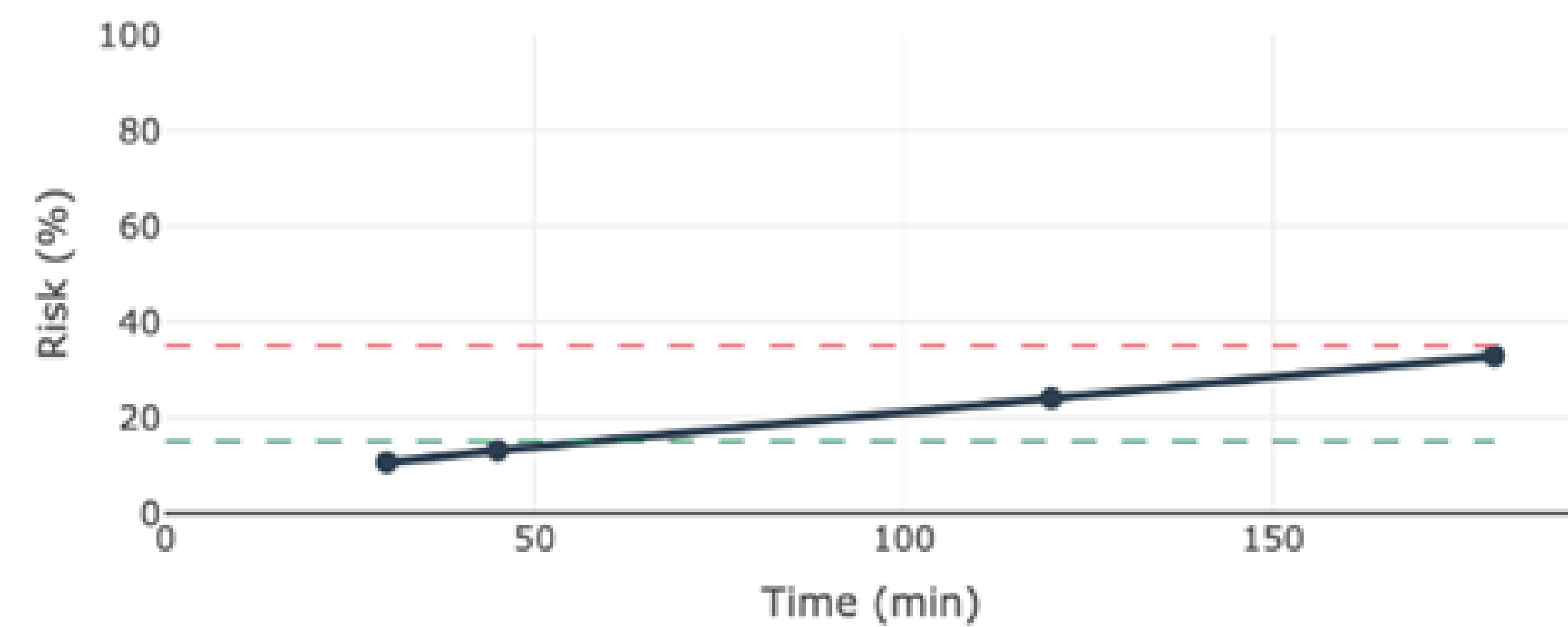
Calculate Risk

32.9%

MODERATE RISK

Based on 9 observations

Risk Trajectory



Loaded Data Summary

Time span: 180 min

Labs (3): Hemoglobin, Platelet Count

Meds (6): Oxytocin, Misoprostol

Discussion

- Postpartum hemorrhage is still the leading cause of preventable maternal death, and many cases occur in women without classic risk factors at admission.
- Current risk tools (CMQCC, AWHONN) are scored once on admission. They miss the patient whose risk develops during labor.
- Our model watches the same labs and medications you're already ordering: hemoglobin, platelets, coagulation studies, oxytocin, magnesium. It updates the risk estimate continuously through labor.
- Next steps before this touches a patient: external validation outside MIMIC-IV, prospective evaluation against current admission-scored tools.