Improving Postpartum Hemorrhage Risk Prediction:
Integration of Time-Based Anesthesia Factors

Introduction

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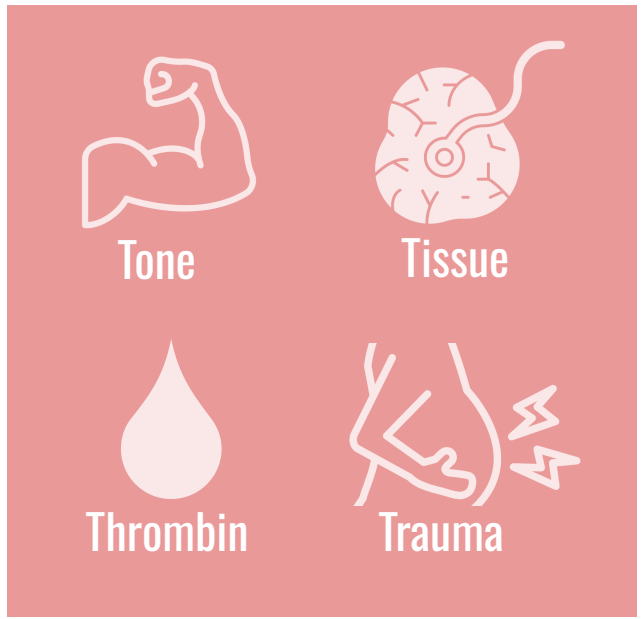
Postpartum Hemorrhage (PPH)

Definition: Blood Loss ≥ 1,000 mL (ACOG)

- Leading cause of maternal morbidity & mortality
- Early risk identification improves outcomes



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Preparation and Prediction

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Preparation

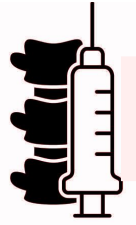
1. **Risk assessment**
2. **Blood bank** orders
3. Additional **personnel**
4. **Transfer** of high-risk patients

PPH risk assessment tools

Stratify patients as low- / medium- / high- risk:

- ACOG Safe Motherhood Initiative
- California Maternal Quality Care Collaborative
- Association of Women's Health, Obstetric and Neonatal Nurses

Is **dysfunctional labor**, which may be indicated by **labor analgesia patterns**, associated with **PPH**?



Hypothesis:

Anesthetic factors can indicate increased PPH risk and enhance risk stratification.

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Methods

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Population

37,287 delivery encounters
from 01/2017 – 05/2024

→ Exclude encounters without labor (7218)

Encounters in which patients labored (30,069)

→ Exclude placental disorders & coagulopathies (1022)

Encounters without placental & bleeding conditions (29,047)

→ Exclude encounters missing outcomes (717)

28,330 delivery encounters

Analysis Pipeline

Database development & enrichment

↓

Univariate analysis & variable screening

↓

Regression analysis

↓

Model evaluation

Variables

Age	Labor stages
Gravidity/Parity	Diabetes
BMI	Breech
Gestational age	Hypertension
Gestation	Preeclampsia
Delivery weight	Eclampsia
Cesarean section	HELLP
Induction	Infection
Augmentation	Polyhydramnios
Platelet count	Vaginal laceration
Heart rate	Fibroids
Hematocrit	History of PPH
...	...

+

Anesthetic factors

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Results

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Descriptive statistics *of laboring population*

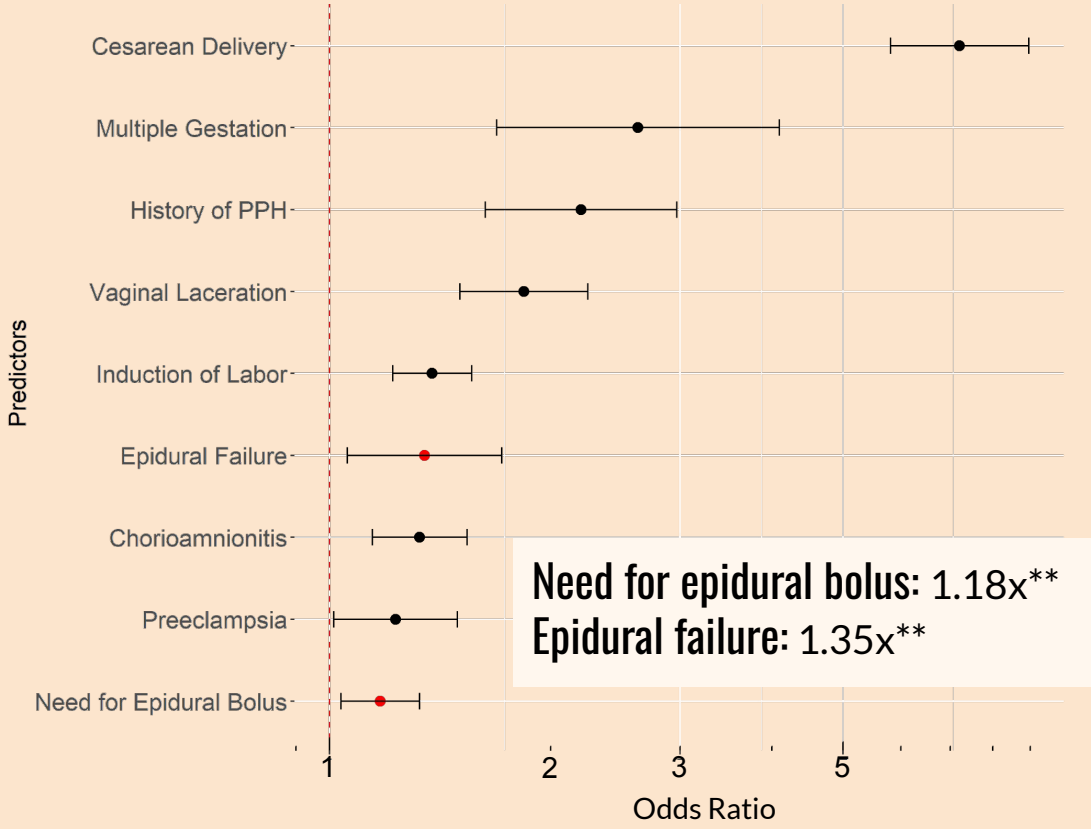
	mean ± SD, or %
Age range	32.9 ± 4.77
BMI	30.5 ± 6.2
Nulliparous	54.5% (15,448 / 28,330)
Multiple gestation	1.4% (393 / 28,330)
CS rate	17% (4,853 / 28,330)
Epidural rate	83% (23,409 / 28,330)
PPH rate	8.1% (2,305 / 28,330)

Multivariate model

Outcome: PPH by EBL ≥ 1,000 mL
Model: Logistic regression
30 variables

Baseline AUC 0.784 → *+ epidural factors* → Augmented AUC 0.786

Odds Ratios



Need for epidural bolus: 1.18x**
Epidural failure: 1.35x**

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Results: Another Model…

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Vanderbilt model (Ende et al., 2024)

Outcome: PPH by EBL, with transfusion

No exclusion criteria
(included placental conditions as predictors)

21 variables

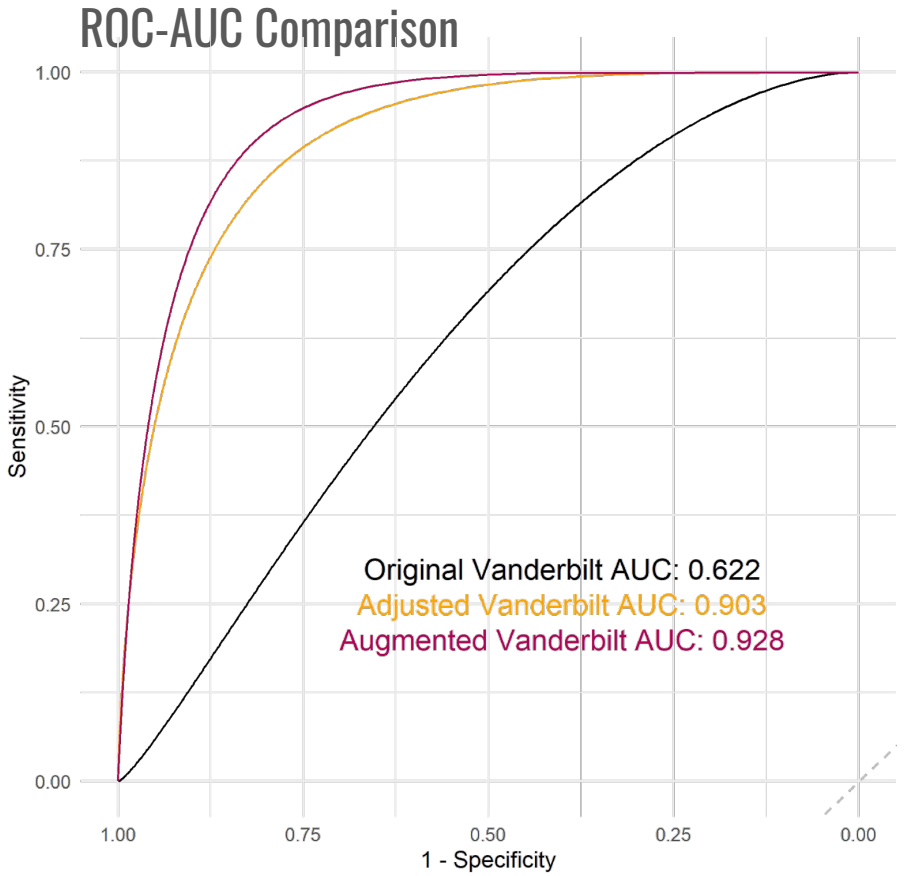
Original VB model: AUC 0.622

↓ *Re-fit variables to our data*

Adjusted VB model: AUC 0.903

↓ *Incorporated anesthetic factors*

Augmented VB model: AUC 0.928



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Conclusions and Future Directions

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Conclusions:

- **PPH risk is a dynamic measure** that changes during labor
- **Epidural failure** and **bolus requirements** are associated with increased PPH risk
- Integration of anesthesia factors can **enhance PPH prediction** in combination with obstetric predictors

Future directions:

- Validate findings externally
- Explore interaction effects
- Investigate mechanism of action

Citations

Ende HB, Domenico HJ, Polic A, Wesoloski A, Zuckerwise LC, Mccoy AB, Woytash AR, Moore RP, Byrne DW. Development and Validation of an Automated, Real-Time Predictive Model for Postpartum Hemorrhage. Obstet Gynecol. 2024 Jul 1;144(1):109-117.
Gallos, I., Devall, A., Martin, J., Middleton, L., Beeson, L., Galadanci, H., Alwy Al-beity, F., & Coomarasamy, A., et al. (2023). Randomized trial of early detection and treatment of postpartum hemorrhage. The New England Journal of Medicine, 389(1), 11–21.
Hess, P. E., Pratt, S. D., Soni, A. K., Sarna, M. C., & Oriol, N. E. (2000). An association between severe labor pain and cesarean delivery. Anesthesia & Analgesia, 90(4), 881–886.