**Supplemental Digital Content**

**Supplemental Statistical Appendix**

**Methodology for calculating inverse probability of treatment weights to estimate the average treatment effect on the treated**

To account for variability between time periods (post- versus pre-implementation) and delivery types (vaginal versus cesarean delivery [CD]) with respect to the distribution of mother characteristics, baby characteristics, and delivering clinicians that could be associated with postdelivery outcomes, all regression models were weighted by inverse probability of treatment weights to estimate the average treatment effect on the treated (IPTW-ATT).23,24 IPTW-ATT were used to estimate the average effect of device implementation on deliveries with the distribution of characteristics observed in patients who delivered vaginally prior to the transition period (i.e., the “treated”). For immediate postdelivery blood loss outcome analyses, multilevel multinomial logistic regression was used to estimate the probability of each patient being in group 1 (vaginal delivery pre-implementation), group 2 (vaginal delivery postimplementation), group 3 (CD pre-implementation), or group 4 (CD postimplementation) conditional upon mother characteristics (age, body mass index, pre-delivery hematocrit, parity, race), baby characteristics (gestational age, birth weight), and delivering clinician. Mother and baby characteristics were included in the model as fixed effects and delivering clinician was included as a random effect with a compound symmetric covariance structure. For postdelivery intervention and hematocrit-based outcomes, multilevel binary logistic regression was used to estimate the probability of each delivery being in group 1 or 2 conditional upon the aforementioned list of covariates. If ek(Xi) is the probability of a delivery i being in group k (where k=1, 2, 3, or 4 for immediate postdelivery blood loss outcomes and 1 or 2 for postdelivery intervention and hematocrit-based outcomes) given a set of observed characteristics X, and g is the group the delivery i actually belonged to, then the IPTW-ATT weight w for each delivery i was calculated as follows23:

Therefore, deliveries in group 1 were assigned a weight of 1, while all other deliveries were assigned weights based on the similarity of their characteristics to deliveries in group 1.

**Supplemental Table 1.** Weighteda Mother, Baby, and Delivery characteristics for VD (Intervention Series) and CD (Control Series) Before and After Transition From Visual to Quantitative Blood Loss Estimation for Vaginal Births

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **VD** | |  | **CD** | | **All Groups** | **VD tBL After**  **vs.**  **VD vBL Before** | **CD vBL After vs.**  **CD vBL Before** |
|  | **vBL Before** | **tBL After** |  | **vBL Before** | **vBL After** | ***P***c | ***P***c | ***P***c |
|  | **n = 967 (967)**b | **n = 645 (939)**b |  | **n = 456 (901)**b | **n = 418 (841)**b |  |  |  |
| Age (years), mean (SD) | 31.6 (4.9) | 31.7 (6.0) |  | 31.8 (7.0) | 32.1 (6.7) | .456 | .902 | .386 |
| Race, n (%) |  |  |  |  |  | .851 | .999 | .183 |
| Asian | 108 (11.2) | 107 (11.4) |  | 89 (9.8) | 101 (12.0) |  |  |  |
| African American | 117 (12.1) | 111 (11.9) |  | 94 (10.5) | 106 (12.6) |  |  |  |
| Hispanic | 62 (6.4) | 58 (6.2) |  | 52 (5.8) | 47 (5.6) |  |  |  |
| White | 573 (59.3) | 558 (59.5) |  | 569 (63.1) | 501 (59.6) |  |  |  |
| Other | 89 (9.2) | 86 (9.2) |  | 84 (9.3) | 66 (7.8) |  |  |  |
| Unknown | 18 (1.9) | 18 (1.9) |  | 14 (1.5) | 21 (2.4) |  |  |  |
| Delivery BMI (kg/m2), mean (SD) | 26.6 (5.9) | 26.6 (7.1) |  | 26.3 (7.7) | 26.8 (8.1) | .569 | .986 | .214 |
| Spontaneous vaginal delivery, n (%) | 883 (91.3) | 879 (93.7) |  | … | … | … | .048 | … |
| Manual removal of placenta, n (%) | 16 (1.7) | 12 (1.3) |  | … | … | … | .536 | … |
| Gestational age (weeks), mean (SD) | 38.9 (1.6) | 38.9 (2.0) |  | 38.9 (2.0) | 38.8 (2.0) | .855 | .899 | .551 |
| Birth weight (g), mean (SD) | 3292.8 (481.6) | 3291.0 (607) |  | 3276.5 (714.5) | 3266.2 (734.8) | .764 | .942 | .766 |
| Predelivery HCT (%), mean (SD) | 35.9 (3.1) | 35.9 (3.8) |  | 36.1 (4.6) | 36 (4.5) | .642 | .886 | .495 |
| Predelivery HCT < 30%, n (%) | 29 (3) | 27 (2.8) |  | 24 (2.7) | 30 (3.6) | .684 | .846 | .256 |
| Multiparous, n (%) | 495 (51.2) | 486 (51.8) |  | 475 (52.7) | 406 (48.3) | .281 | .793 | .063 |
| Anesthesia type, n (%) |  |  |  |  |  | N/Ad | N/Ad | N/Ad |
| CSE | 16 (1.7) | 2 (0.2) |  | 53 (5.8) | 48 (5.7) |  |  |  |
| Spinal | 5 (0.5) | 4 (0.4) |  | 487 (54.1) | 429 (51.0) |  |  |  |
| Epidural | 809 (83.7) | 814 (86.7) |  | 359 (39.8) | 339 (40.3) |  |  |  |
| General | … | … |  | 1 (0.1) | 11 (1.3) |  |  |  |
| Local | 53 (5.5) | 41 (4.4) |  | … | … |  |  |  |
| Other | 3 (0.3) | 5 (0.5) |  | 1 (0.2) | 14 (1.7) |  |  |  |
| None | 81 (8.4) | 73 (7.8) |  | … | … |  |  |  |
| Oxytocin administration, n (%) | 964 (99.7) | 937.3 (99.9) |  | … | … | … | N/Ad | … |
| Abbreviations: BMI, body mass index; CD, cesarean deliveries (the control series); CSE, combined spinal and epidural anesthesia; HCT, Hematocrit; SD, standard deviation; tBL, gravimetric and volumetric estimation of blood loss; vBL, visual estimation of blood loss; VD, vaginal deliveries (the intervention series).  aDeliveries weighted based on similarity to vaginal deliveries pretransition using inverse probability of treatment weights. | | | | | | | | |
| *b*Sum of weights.  c*P* values correspond to weighted analysis of variance and weighted 2-sample *t*-tests for continuous variables and weighted χ2 tests for categorical variables. | | | | | | | | |
| dFisher exact tests could not be performed with non-integer counts. | | | | | | | | |

**Supplemental Table 2.** Sensitivity Analyses for Changes in Outcome Levels for VD (Intervention Series) and CD (Control Series) Immediately After Completion of Transition From Visual to Quantitative Blood Loss Estimation for Vaginal Births, Ac

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Outcome** | **VD** | | | | **CD** | | | | **VD Versus CD** | | |
|  | **vBL Before** | **tBL After** | **Effect Size**  **(95% CI)** | ***P*** | **vBL Before** | **vBL After** | **Effect size**  **(95% CI)** | ***P*** | **Effect size**  **(95% CI)** | ***P*** | |
| **Immediate Postdelivery Blood Loss (sensitivity analysis 1)** | **n = 967** | **n = 947** | **n = 456** | **n = 418** |
| PPH, n (%) | 111 (11.5) | 222 (23.4) | 2.24 (1.13-4.44)a | .021 | 91 (20.0) | 85 (20.3) | 1.55 (0.78-3.08)a | .213 | 1.45 (0.55-3.82)a | .455 | |
| >1000 mL blood loss, n (%) | 20 (2.1) | 52 (5.5) | 1.13 (0.28-4.52)a | .867 | 91 (20.0) | 85 (20.3) | 1.55 (0.78-3.08)a | .213 | 0.73 (0.15-3.43)a | | .687 |
| Blood loss (mL), geometric mean (SE) | 307 (4) | 292 (8) | 1.03 (0.90-1.17)b | .690 | 767 (10) | 793 (11) | 1.10 (1.00-1.22)b | .059 | 0.93 (0.79-1.10)b | .391 | |
| **Postdelivery Interventions (sensitivity analysis 1)** | **n = 967** | **n = 947** |  |  |  |  |  |  |  |  | |
| Secondary uterotonic use, n (%) | 90 (9.3) | 88 (9.3) | 0.91 (0.41-2.01)c | .818 | … | … | … | … | … | … | |
| PPH management interventionsb, n (%) | 20 (2.1) | 20 (2.1) | 0.69 (0.14-3.26)c | .635 | … | … | … | … | … | … | |
| Blood transfusion, n (%) | 13 (1.3) | 11 (1.2) | … | … | … | … | … | … | … | … | |
| Vasopressor administration, n (%) | 6 (0.6) | 7 (0.7) | … | … | … | … | … | … | … | … | |
| Surgical management, n (%) | 13 (1.3) | 10 (1.1) | … | … | … | … | … | … | … | … | |
| **Hematocrit-Based Outcomes (sensitivity analysis 1)** | **n = 160** | **n = 189** |  |  | … | … | … | … | … | … | |
| Hematocrit nadir (%), mean (SD) | 28.5 (4.8) | 29.4 (4.3) | 0.3 (-2.2 to 2.8)d | .821 | … | … | … | … | … | … | |
| Hematocrit drop, ≥10%, n (%) | 50 (31.3) | 38 (20.1) | 0.82 (0.22-3.02)c | .769 | … | … | … | … | … | … | |
| Difference between vBL or tBL and cBL (mL), mean (SD) | -600 (596) | -318 (502) | 270 (-32 to 573)d | .080 | … | … | … | … | … | … | |
| **Hematocrit-Based Outcomes (sensitivity analysis 2)** | **n = 147** | **n = 120** |  |  | … | … | … | … | … | … | |
| Hematocrit nadir (%), mean (SD) | 29 (4.5) | 30.4 (3.9) | 0.9 (-1.7 to 3.4)d | .510 | … | … | … | … | … | … | |
| Hematocrit drop, ≥10%, n (%) | 38 (25.9) | 20 (16.7) | 0.68 (0.15-3.00)c | .609 | … | … | … | … | … | … | |
| Difference between vBL or tBL and cBL (mL), mean (SD) | -568 (548) | -186 (483) | 322 (6-638)d | .046 | … | … | … | … | … | … | |
| PPH management interventions: transfusion, vasopressor administration, and/or surgical procedures. Abbreviations: cBL, calculated blood loss; CD, cesarean deliveries (the control series); CI, confidence interval; IPTW-ATT, inverse probability of treatment weights to estimate the average treatment effect on the treated; PPH, postpartum hemorrhage defined as blood loss ≥500 mL for vaginal deliveries and ≥1000 mL for cesarean deliveries; SD, standard deviation; SE, standard error; tBL, gravimetric and volumetric estimation of blood loss; vBL, visual estimation of blood loss; VD, vaginal deliveries (the treatment series). | | | | | | | | | | | |
| Sensitivity analysis 1 includes vaginal deliveries after device implementation with no evidence of quantitative blood loss device use.  Sensitivity analysis 2 excludes vaginal deliveries from the primary analysis who received a blood transfusion.  aWeighted odds ratios and 95% CIs obtained using the combination of β2 and β6 for VD, β2 for CD, and β6 for VD versus CD from corresponding IPTW-ATT-weighted segmented logistic regression models.  bWeighted ratios of geometric means and 95% CIs obtained using the combination of β2 and β6 for VD, β2 for CD, and β6 for VD versus CD from corresponding IPTW-ATT–weighted segmented linear regression models. cWeighted odds ratios and 95% CIs obtained using β2 from corresponding IPTW-ATT–weighted segmented logistic regression models. dWeighted differences in means and 95% CIs obtained using β2 from corresponding IPTW-ATT–weighted segmented linear regression models. | | | | | | | | | | | |