SUPPLEMENTARY APPENDIX

Table S1. Diagnoses, Procedures and the Associated ICD-9 CM Codes

Diagnosis or Procedure	ICD-9 CM code
Antepartum hemorrhage	641.1x – 641.9x
Blood transfusion	99.03, 99.04
Chronic anemia	280.x; 281.x; 282.x; 285.2x; 285.3; 285.8; 285.9
Diabetes, pre-existing or gestational	250.x; 648.0x; 648.8x
Obesity	278.0x
Hereditary or acquired coagulation disorder	286.x
Grand multiparity	659.4x; V23.3x
Thrombocytopenia	287.5
Pre-eclampsia or eclampsia	642.4x – 642.7x
Labor or induction of labor	649.8; 652.1x; 653.x; 656.3x; 659.0-659.1x; 660-663.x; 665.1x; 73.01; 73.1; 73.4
Postpartum hemorrhage	666.0x; 666.1x; 666.2x

Table S2. Proportions with Severe Postpartum Anemia According to Each Characteristic and Adjusted Odds Ratios in the Final Multivariable Model.

Patient Characteristics	Proportion with Severe Postpartum Anemia (%)	Adjusted OR (95% CI)*
Maternal age (y):		
<20	13.6	Reference
20-34	7.3	0.72 (0.61 – 0.85)
≥35	6.7	0.72 (0.6 – 0.85)
Race/ethnicity:		
White	5.6	Reference
Black	8.4	1.16 (1.02 – 1.31)
Hispanic	8.3	1.4 (1.29 – 1.52)
Asian	8.6	1.57 (1.44 – 1.71)
Other	6.7	1.12 (0.92 – 1.38)
Unknown	5.6	0.88 (0.61 – 1.28)
Prepartum Hb level (g/dl):		
≥11 g/dl	5.3	Reference
10 – 10.9 g/dl	20.8	5.38 (4.89 – 5.91)
<10 g/dl	54.5	30.6 (27.1 – 34.6)
Hb missing	5.5	1.54 (1.42 – 1.67)
Hereditary or acquired coagulation disorder†	50.5	8.52 (6.0 – 12.1)
Gestational age at delivery:		
<37 weeks	7.9	Reference
37-41 weeks	7.1	1.49 (1.18 – 1.88)
>41 weeks	10	1.81 (1.39 – 2.35)
Grand multiparity†	16.4	1.74 (1.1 – 2.73)
Number of prior CSs:		
0	7.5	Reference
1	5.7	0.88 (0.8 – 0.98)
≥2	7.1	1.16 (0.86 – 1.56)
Obesity†	6.4	0.79 (0.72 – 0.87)
Thrombocytopenia†	11.5	1.6 (1.33 – 1.93)
Preeclampsia†	11.9	1.49 (1.32 – 1.67)
Labor†	9.3	1.73 (1.61 – 1.85)
Placenta previa†	13.3	1.41 (1.15 – 1.73)
Antepartum hemorrhage †	16.5	1.9 (1.58 – 2.27)
Postpartum hemorrhage †	31.8	8.45 (7.8 – 9.16)
RBC transfusion†	79.5	-

Row percentages are presented, where appropriate.

*adjusted for year of birth.

Table S3. Associations between Severe Postpartum Anemia with Postpartum Hemorrhage and Predelivery Hemoglobin Level Stratified by Receipt and Non-Receipt of Transfusion.

	Received RBC Transfusion			Did Not Receive RBC Transfusion		
	No Severe Postpartum Anemia (n=364)	Severe Postpartum Anemia (n=1,183)	aOR (95% CI)[a]	No Severe Postpartum Anemia (n=65,432)	Severe Postpartum Anemia (n=3,960)	aOR (95% CI)[b]
PPH*	256 (70.3%)	672 (56.8%)	0.64 (0.49 – 0.84)	2,888 (4.4%)	794 (20.1%)	6.03 (5.48 – 6.65)
Predelivery Hb level (g/dl):						
> 11	220 (60.4%)	605 (51.2%)	Reference	40,377 (61.7%)	1,659 (41.9%)	Reference
10 -10.9	34 (9.3%)	166 (14%)	2.12 (1.37 – 3.26)	3,233 (4.9%)	691 (17.5%)	5.78 (5.22 – 6.4)
< 10	29 (8%)	148 (12.5%)	1.77 (1.11 – 2.81)	632 (1%)	645 (16.3%)	33.14 (29.12 – 37.72)
Missing Hb	81 (22.3%)	264 (22.3%)	1.45 (1.03 – 2.04)	21,190 (32.4%)	965 (24.4%)	1.59 (1.45 – 1.74)

PPH = Postpartum Hemorrhage; RBC = Red Blood Cells

*PPH was identified using *International Classification of Diseases, 9th Revision, Clinical Modification* Codes.

[a] Adjusted odds ratio calculated from multivariate logistic regression, adjusting for year of birth, maternal age, race/ethnicity, grand multiparity, hereditary or acquired coagulation disorders, gestational age at delivery, number of prior cesarean deliveries, obesity, thrombocytopenia, pre-eclampsia, labor, placenta previa, antepartum hemorrhage, and transfusion as fixed effects, and individual hospital as a random effect.

[b] Adjusted odds ratio calculated from multivariate logistic regression, adjusting for year of birth, maternal age, race/ethnicity, grand multiparity, hereditary or acquired coagulation disorders, gestational age at delivery, number of prior cesarean deliveries, obesity, thrombocytopenia, pre-eclampsia, labor, placenta previa, and antepartum hemorrhage as fixed effects, and individual hospital as a random effect.

aOR = adjusted odds ratio; CI = confidence interval

Table S4. Sensitivity Analyses Examining the Associations between Severe Postpartum Anemia with Predelivery Hemoglobin Levels and Estimated Blood Loss for Women undergoing Cesarean Section between 2010 and 2013.

	aOR (95% CI) [a]
Estimated Blood Loss (ml):	
< 1000	Reference
1000 - 1499	3.85 (3.44 – 4.32)
≥ 1500	13.45 (11.57 – 15.63)
Predelivery Hb level (g/dl):	
> 11	Reference
10 - 10.9	5.58 (4.83 – 6.45)
< 10	34.6 (28.52 – 41.92)
Missing Hb	1.61 (1.42 – 1.83)

[a] Adjusted odds ratio calculated from multivariate logistic regression, adjusting for year of birth, maternal age, race/ethnicity, grand multiparity, hereditary or acquired coagulation disorders, gestational age at delivery, number of prior cesarean deliveries, obesity, thrombocytopenia, pre-eclampsia, labor, placenta previa, antepartum hemorrhage as fixed effects, and individual hospital as a random effect.

aOR = adjusted odds ratio; CI = confidence interval; PPH = postpartum hemorrhage

Table S5. Patient Characteristics of 13,086 Women who did not undergo Postpartum Hemoglobin Testing after Cesarean Section between 2005 and 2013*

Patient Characteristics	Postpartum Hb not measured (n=13,086)	Adjusted Odds Ratio (95% CI)
Maternal Age (y)		
<20	320 (2.4%)	0.89 (0.69 – 1.14)
20-34	7978 (61%)	Reference
≥35	4788 (36.6%)	1.37 (1.28 – 1.48)
Race/Ethnicity		
White	5175 (39.5%)	Reference
Black	1361 (10.4%)	0.98 (0.86 – 1.12)
Hispanic	2923 (22.3%)	0.81 (0.74 – 0.89)
Asian	2952 (22.6%)	0.83 (0.76 – 0.92)
Other	377 (2.9%)	0.89 (0.72 – 1.10)
Unknown	298 (2.3%)	3.87 (3.02 – 4.96)
Prepartum Hb level (g/dl)		
≥11 g/dl	1486 (11.4%)	Reference
10 – 10.9 g/dl	180 (1.4%)	0.86 (0.70 – 1.04)
<10 g/dl	95 (0.7%)	1.54 (1.18 – 2.00)
Hb missing	11,325 (86.5%)	3.67 (3.39 – 3.98)
Hereditary or acquired coagulation disorder†	67 (0.5%)	0.78 (0.41 – 1.48)
Gestational age at delivery:		
<37 weeks	10662 (81.5%)	156.9 (142.99 – 169.97)
37-41 weeks	2382 (18.2%)	Reference
>41 weeks	42 (0.3%)	0.35 (0.26 – 0.49)
Grand multiparity†	60 (0.5%)	1.15 (0.68 – 1.95)
Number of prior CSs		
0	12,358 (94.4%)	Reference
1	689 (5.3%)	0.15 (0.13 – 0.17)
≥2	39 (0.3%)	0.07 (0.04 – 0.10)
Obesity†	1866 (14.4%)	0.88 (0.80 – 0.98)
Thrombocytopenia†	505 (3.9%)	1.96 (1.56 – 2.46)
Preeclampsia†	3195 (24.4%)	1.39 (1.24 – 1.56)
Labor†	4098 (31.3%)	0.81 (075 – 0.87)
Placenta Previa†	757 (5.8%)	0.61 (0.50 – 0.74)
Antepartum hemorrhage†	1218 (9.3%)	0.92 (0.77 – 1.10)
Coagulopathy†	145 (1.1%)	0.57 (0.37 – 0.88)
PPH†	1196 (9.1%)	1.49 (1.30 – 1.71)
Blood transfusion†	796 (6.1%)	1.71 (1.41 – 2.09)

* Denominator consists of 70,939 patients (Figure 1); dependent variable is absence of postpartum

hemoglobin testing (N = 13,086)

† Data for these variables were identified using *International Classification of Diseases, 9th Revision, Clinical Modification* Diagnosis and Procedure Codes.

Adjusted odds ratios and 95% confidence intervals are presented to show the risk of not undergoing postpartum hemoglobin testing for each characteristic. All characteristics were included in a multivariate logistic model, in addition to year of birth as a fixed effect and individual hospital as a random effect.

Data presented as n (%). Column percentages are presented, where appropriate.

aOR = adjusted odds ratio from hierarchical logistic regression; CI = confidence intervals; CS = Cesarean section; Hb = hemoglobin.

Model discrimination was assessed by calculating the area under the receiver operating characteristics curve (AUROC); AUROC = 0.933; 95% CI=0.929 – 0.935

Table S6. Characteristics of 5,843 Women with Missing Postpartum Hemoglobin Values who underwent Cesarean Section between 2010 and 2013.

	Patients with Missing Hb at Discharge[a]	
	N	**%**
No Predelivery Anemia		
No PPH:		
Not Transfused	306	5.24
Transfused	5	0.09
PPH:		
Not Transfused	150	2.57
Transfused	7	0.12
Severe PPH:		
Not Transfused	35	0.6
Transfused	20	0.34
No Documented EBL:		
Not Transfused	83	1.42
Transfused	3	0.05
Mild Predelivery Anemia		
No PPH:		
Not Transfused	35	0.6
Transfused	0	0
PPH:		
Not Transfused	23	0.39
Transfused	3	0.05
Severe PPH:		
Not Transfused	3	0.05
Transfused	2	0.03
No Documented EBL:		
Not Transfused	7	0.12
Transfused	0	0
Severe Predelivery Anemia		
No PPH:		
Not Transfused	17	0.29
Transfused	0	0
PPH:		
Not Transfused	7	0.12
Transfused	4	0.07
Severe PPH:		
Not Transfused	2	0.03
Transfused	1	0.02
No Documented EBL:		
Not Transfused	5	0.09

Transfused	1	0.02
No Predelivery Hb		
No PPH:		
Not Transfused	3,313	56.7
Transfused	117	2
PPH:		
Not Transfused	923	15.8
Transfused	85	1.45
Severe PPH:		
Not Transfused	195	3.34
Transfused	123	2.11
No Documented EBL:		
Not Transfused	337	5.77
Transfused	31	0.53

[a] This cohort consists of 5,843 women among the 38,086 women who underwent cesarean section

between 2010 and 2013; this subset did not have a recorded postpartum hemoglobin value.

Column percentages are presented, where appropriate.

EBL = estimated blood loss; Hb = hemoglobin; PPH = postpartum hemorrhage