

## Supplementary Online Content

Asch DA, Nicholson S, Srinivas S, Herrin J, Epstein AJ. Evaluating obstetrical residency programs using patient outcomes. *JAMA*. 2009;302(12):1277-1283.

**eTable 1.** Complication Codes by Delivery Mode

**eAppendix.** Statistical Appendix

**eTable 2.** Comparison of Deliveries Included in and Excluded From Analysis

**eTable 3.** Hierarchical Generalized Linear Model Output for 3 Composite Maternal Complication Outcomes

**eTable 4.** Hierarchical Generalized Linear Model Output for 3 Maternal Complications Conditional on Vaginal Delivery

**eTable 5.** Hierarchical Generalized Linear Model Output for 3 Maternal Complications Conditional on Cesarean Deliver

**eTable 6.** Patient Characteristics by Quintile Ranking of Residency Programs for Any Major Complication Among All Deliveries

This supplementary material has been provided by the authors to give readers additional information about their work.

**eTable 1. Complication Codes by Delivery Mode**

	ICD-9 Diagnosis Codes
Vaginal delivery	<p><b>Hemorrhage:</b> 287.4, 648.22, 649.32, 666.02, 666.04, , 666.10, 666.12, 666.14, 666.20, 666.22, 666.24, 666.32, 667.02, 667.12, 998.11</p> <p><b>Laceration:</b> 664.21, 664.31, 664.41, 664.51, 664.61 ,664.81, 664.91, 665.31, 665.41, 674.22</p> <p><b>Infection:</b> 646.62, 670.02, 672.02, 996.60, 996.62, 999.3</p> <p><b>Thrombotic and other:</b> 512.0, 512.1, 512.8, 518.4, 518.81, 584.5, 584.8, 584.9, 665.51, 669.12, 669.22,669.42, 669.82, , 671.42, 671.52, , 673.12,673.22, 674.32,674.52, 674.92, 785.50, 785.51, 785.59, 996.31, 998.4, 998.7, 999.2, , 999.4, 999.5, 999.6, 999.7, 999.8, 999.9</p>
Cesarean delivery	<p><b>Hemorrhage:</b> 287.4, 648.22, 649.32, 666.02, 666.04, 666.10, 666.12, 666.14, 666.20, 666.22, 666.24, 666.32, 667.02, 667.12, 998.11</p> <p><b>Infection:</b> 646.62, 670.02, 672.02, , 674.12, 674.32, 998.59, 999.3</p> <p><b>Operative:</b> 669.42, 998.20, 998.4, 999.83</p> <p><b>Thrombotic and Other:</b> 512.0, 512.1, 512.8, 518.4, 518.81, 584.5, 584.8, 584.9, 669.12, 669.22, 669.82, 671.42, 671.52, 673.12, 673.22, 674.52, 674.92, 785.50, 785.51, 785.59, 996.31, 996.60, 996.62, 998.60, 998.7, 999.2, 999.4, 999.5, 999.6, 999.7, 999.8, 999.9</p>

Maternal comorbidities were based on ICD-9 codes developed by Gregory, et al.<sup>7</sup>

## eAppendix. Statistical Appendix

Denoting  $y_{ijk}$  as one of the patient outcomes for the  $i^{\text{th}}$  patient treated by the  $j^{\text{th}}$  physician who completed the  $k^{\text{th}}$  residency program, the model we estimated can be expressed as:

$$\begin{aligned}\text{logit}(\text{Pr}(y_{ijk}=1)) &= \beta_{0jk} + \beta^*X_{ijk} \\ \beta_{0jk} &= \alpha_{0k} + \alpha^*Z_{jk} + u_{jk} \\ \alpha_{0k} &= \gamma_0 + v_k\end{aligned}$$

where  $X_{ijk}$  is a vector of patient characteristics,  $Z_{jk}$  is a vector of physician characteristics, and  $u_{jk} \sim N(0, \sigma^2)$ ;  $v_k \sim N(0, \tau^2)$  are normally distributed error terms.

Risk-standardized maternal complication rates were calculated from the results of the HGLMs for each residency program for each of the 6 individual and 3 composite complication outcome variables. For a given patient, the predicted outcome

$$P_{ijk} = \text{logit}^{-1}(\gamma_0 + u_{jk} + v_k + \beta^*X_{ijk} + \alpha^*Z_{jk})$$

is what the model predicts for patients with the same characteristics as that patient, treated by physicians with the same characteristics as the physician treating that patient, from the same OB Residency program as the physician treating that patient. The expected outcome

$$E_{ijk} = \text{logit}^{-1}(\gamma_0 + u_{jk} + \beta^*X_{ijk} + \alpha^*Z_{jk})$$

is what the model predicts for a patient with the same characteristics as that patient, treated by physicians with the same characteristics as the physician treating the patient, from a “mean” residency program. The risk standardized complication rate for program  $k$  is then

$$R_k = \text{sum}(P_{ijk}) / \text{sum}(E_{ijk}) \times \text{mean}(y_{ijk})$$

where the sums are over all patients treated by physicians trained at the  $k^{\text{th}}$  program.

We estimated the adjusted rate of each outcome for each residency program using the same models as above. Using the estimated coefficients, we calculated

$$\text{Prob}(y_{ijk}) = \text{logit}^{-1}(\gamma_0 + v_k + \beta^*\text{mean}(X_{ijk}) + \alpha^*\text{mean}(Z_{jk}))$$

where the means are over all patients or physicians in the study. Then we averaged for each residency program

$\text{Prob}_k = \text{mean}(\text{Prob}(y_{ijk}))$  to get the adjusted rate of the outcome for an average patient treated by an average physician if that physician had attended the  $k^{\text{th}}$  residency program.

**eTable 2. Comparison of Deliveries Included in and Excluded From Analysis**

<b>Variable</b>	<b>Included Deliveries (%)</b>	<b>Excluded Deliveries (%)</b>	<b>Abs Diff</b>	<b>95% CI</b>
Any Major Complication	12.5	13.5	1.0	(0.9, 1.1)
Cesarean Delivery	28.2	25.6	2.6	(2.5, 2.7)
<b>Maternal Demographics</b>				
State is New York	61.9	43.4	18.6	(18.5, 18.7)
Patient Age (Years) (Mean, SD)	28.1 (6.2)	27.1 (6.2)	1.0	(1.0, 1.0)
Admitted on Saturday or Sunday	0.2	0.2	0.0	(0.0, 0.0)
Patient is Not Non-Hispanic White	44.6	43.3	1.4	(1.3, 1.5)
Patient with Medicaid Insurance or Uninsured	42.5	50.6	8.1	(8.0, 8.2)
<b>Maternal Comorbidities</b>				
Previous C-Section	13.6	12.2	1.4	(1.3, 1.5)
Fetal Malpresentation	6.2	5.9	0.3	(0.3, 0.3)
Antepartum Bleeding	1.7	1.8	0.1	(0.1, 0.1)
Herpes	1.2	1.4	0.1	(0.1, 0.1)
Eclampsia or Severe Pre-eclampsia	1.0	1.1	0.1	(0.1, 0.1)
Uterine Scar Unrelated to C-section	0.2	0.1	0.0	(0.0, 0.0)
Multiple Gestation	1.3	1.1	0.2	(0.2, 0.2)
Macrosomia	2.4	2.5	0.1	(0.1, 0.1)
Unengaged Fetal Head	1.5	1.4	0.2	(0.2, 0.2)
Maternal Soft Tissue Disorder	2.8	2.5	0.3	(0.3, 0.3)
Mild Pre-eclampsia or Non-eclampsia Hypertension	5.9	6.7	0.8	(0.8, 0.8)
Preterm Gestation	6.9	7.2	0.4	(0.4, 0.4)
Congenital Fetal CNS Anomaly or Chromosomal Abnormality	0.1	0.1	0.0	(0.0, 0.0)
Cerebral Hemorrhage	0.0	0.0	0.0	(0.0, 0.0)
Asthma	1.7	1.7	0.0	(0.0, 0.0)
Maternal Renal Abnormality	0.1	0.1	0.0	(0.0, 0.0)
Maternal Liver Abnormality	0.1	0.1	0.0	(0.0, 0.0)
Diabetes or Abnormal Glucose Tolerance	0.6	0.7	0.1	(0.1, 0.1)
Maternal Thyroid Abnormality	1.3	1.1	0.2	(0.2, 0.2)
Maternal Substance Abuse	0.3	0.3	0.0	(0.0, 0.0)
Maternal Mental Disorder	1.9	2.6	0.7	(0.7, 0.7)
Maternal Congenital and Other Heart Disease	1.5	1.2	0.3	(0.3, 0.3)
Isoimmunization	1.8	1.8	0.0	(0.0, 0.0)
Intrauterine Fetal Demise	0.1	0.1	0.0	(0.0, 0.0)
Intrauterine Growth Restriction	1.3	1.6	0.3	(0.3, 0.3)
Oligohydramnios	0.6	0.6	0.1	(0.1, 0.1)
Polyhydramnios	3.1	3.1	0.1	(0.1, 0.1)
Ruptured Membrane > 24 hrs	1.6	1.8	0.1	(0.1, 0.1)
Chorioamnionitis	1.8	2.0	0.2	(0.2, 0.2)
Maternal Pyrexia or Septicemia	1.0	1.0	0.0	(0.0, 0.0)
Uterine Rupture	0.1	0.1	0.0	(0.0, 0.0)
Maternal Hypotension or Obstetrical Shock	0.1	0.1	0.0	(0.0, 0.0)
Pulmonary Embolism	0.0	0.0	0.0	(0.0, 0.0)
Obesity	0.5	0.7	0.2	(0.2, 0.2)
N	4,906,169	2,224,188		

**eTable 3. Hierarchical Generalized Linear Model Output for 3 Composite Maternal Complication Outcomes**

Variable	Major Complication					
	Any Delivery Mode		Vaginal Delivery		Cesarean Delivery	
	OR	CI	OR	CI	OR	CI
Intercept	0.14	(0.13, 0.14)	0.14	(0.14, 0.15)	0.12	(0.12, 0.12)
<b>Physician</b>						
NY State	1.019	(0.978, 1.062)	0.916	(0.876, 0.958)	1.376	(1.299, 1.458)
Female	1.180	(1.144, 1.217)	1.195	(1.156, 1.236)	1.132	(1.083, 1.183)
Experience as of 2007 (quintiles)						
Q1: 1 to 12 yrs	ref		ref		ref	
Q2: 13 to 17 yrs	1.036	(0.993, 1.081)	1.031	(0.985, 1.079)	1.057	(0.995, 1.123)
Q3: 18 to 23 yrs	0.987	(0.943, 1.033)	0.990	(0.942, 1.040)	0.974	(0.913, 1.039)
Q4: 23 to 28 yrs	0.922	(0.881, 0.964)	0.932	(0.888, 0.979)	0.880	(0.825, 0.939)
Q5: 29 to 61 yrs	0.880	(0.843, 0.920)	0.869	(0.829, 0.911)	0.894	(0.839, 0.951)
<b>Patient Demographics</b>						
<i>Age</i>						
18-21	ref		ref		ref	
22-25	0.847	(0.839, 0.854)	0.853	(0.845, 0.861)	0.809	(0.794, 0.824)
26-31	0.808	(0.801, 0.815)	0.825	(0.817, 0.833)	0.741	(0.727, 0.755)
31-41	0.723	(0.717, 0.730)	0.711	(0.704, 0.719)	0.735	(0.721, 0.749)
>41	0.707	(0.687, 0.728)	0.658	(0.633, 0.685)	0.758	(0.725, 0.791)
Weekend	1.047	(1.040, 1.054)	1.026	(1.018, 1.034)	1.094	(1.078, 1.110)
<i>Race/Ethnicity</i>						
White	ref		ref		ref	
Minority	1.083	(1.075, 1.091)	0.993	(0.985, 1.002)	1.337	(1.318, 1.356)
Minority missing	1.082	(1.065, 1.099)	1.059	(1.040, 1.078)	1.158	(1.122, 1.194)
Medicaid or uninsured	0.963	(0.956, 0.970)	0.909	(0.901, 0.917)	1.135	(1.118, 1.151)
<i>Year</i>						
1992	ref		ref		ref	
1993	1.209	(1.193, 1.225)	1.137	(1.119, 1.155)	1.389	(1.354, 1.425)
1994	1.166	(1.151, 1.182)	1.104	(1.087, 1.122)	1.348	(1.312, 1.384)
1995	1.139	(1.124, 1.155)	1.097	(1.080, 1.115)	1.234	(1.201, 1.268)
1996	1.119	(1.104, 1.135)	1.087	(1.070, 1.105)	1.174	(1.142, 1.207)
1997	1.063	(1.048, 1.077)	1.053	(1.036, 1.070)	1.056	(1.027, 1.086)
1998	1.036	(1.022, 1.050)	1.047	(1.030, 1.064)	0.963	(0.936, 0.990)
1999	0.999	(0.985, 1.013)	1.021	(1.004, 1.037)	0.911	(0.887, 0.937)
2000	0.939	(0.926, 0.952)	0.978	(0.962, 0.994)	0.810	(0.788, 0.833)
2001	0.874	(0.862, 0.886)	0.941	(0.926, 0.957)	0.703	(0.683, 0.723)
2002	0.865	(0.853, 0.878)	0.927	(0.911, 0.943)	0.728	(0.708, 0.749)
2003	0.869	(0.857, 0.881)	0.927	(0.911, 0.942)	0.751	(0.731, 0.771)
2004	0.853	(0.841, 0.865)	0.909	(0.894, 0.925)	0.745	(0.726, 0.765)
2005	0.810	(0.799, 0.822)	0.867	(0.853, 0.883)	0.713	(0.694, 0.731)
2006	0.795	(0.784, 0.807)	0.844	(0.829, 0.859)	0.718	(0.699, 0.736)
<b>Previous C-section</b>	0.994	(0.985, 1.004)	1.419	(1.398, 1.441)	0.804	(0.794, 0.814)
<b>Patient Comorbidities</b>						
Fetal Malpresentation	1.037	(1.024, 1.049)	1.257	(1.229, 1.285)	0.877	(0.863, 0.890)
Antepartum Bleeding	1.827	(1.794, 1.861)	1.344	(1.298, 1.391)	1.881	(1.838, 1.924)
Herpes	0.983	(0.960, 1.008)	1.018	(0.985, 1.052)	0.901	(0.867, 0.937)
Severe Hypertension	1.959	(1.914, 2.005)	2.062	(1.982, 2.146)	1.632	(1.584, 1.682)
Uterine Scar Unrelated to C-section	1.151	(1.081, 1.224)	1.234	(1.030, 1.477)	1.107	(1.034, 1.184)
Multiple Gestation	1.418	(1.386, 1.451)	1.349	(1.297, 1.403)	1.398	(1.357, 1.440)
Macrosomia	1.189	(1.168, 1.210)	1.418	(1.383, 1.453)	1.032	(1.006, 1.059)
Unengaged Fetal Head	1.221	(1.195, 1.249)	2.763	(2.556, 2.987)	1.197	(1.169, 1.226)
Maternal Soft Tissue Disorder	1.282	(1.262, 1.303)	1.281	(1.247, 1.317)	1.281	(1.255, 1.307)

Other Types of Hypertension	1.344	(1.330, 1.359)	1.373	(1.354, 1.392)	1.210	(1.188, 1.232)
Preterm Gestation	0.872	(0.862, 0.882)	0.737	(0.726, 0.748)	1.104	(1.084, 1.125)
Congenital Fetal CNS Anomaly or Chromosomal Abnormality	1.007	(0.919, 1.103)	0.752	(0.646, 0.874)	1.141	(1.012, 1.286)
Cerebral Hemorrhage	3.716	(2.709, 5.097)	5.065	(2.891, 8.872)	3.168	(2.131, 4.709)
Asthma	1.013	(0.992, 1.034)	0.965	(0.941, 0.991)	1.087	(1.050, 1.125)
Maternal Renal Abnormality	1.415	(1.319, 1.518)	1.220	(1.109, 1.341)	1.646	(1.473, 1.840)
Maternal Liver Abnormality	1.341	(1.238, 1.453)	1.322	(1.195, 1.462)	1.424	(1.237, 1.640)
Diabetes or Abnormal Glucose Tolerance	1.239	(1.200, 1.280)	1.289	(1.237, 1.343)	1.158	(1.095, 1.225)
Maternal Thyroid Abnormality	0.963	(0.940, 0.987)	0.978	(0.949, 1.007)	0.962	(0.923, 1.004)
Maternal Substance Abuse	0.930	(0.886, 0.976)	0.810	(0.760, 0.864)	1.123	(1.034, 1.220)
Maternal Mental Disorder	1.007	(0.987, 1.027)	0.961	(0.938, 0.984)	1.129	(1.090, 1.169)
Maternal Congenital and Other Heart Disease	1.130	(1.107, 1.155)	1.073	(1.045, 1.101)	1.257	(1.211, 1.306)
Isoimmunization	1.039	(1.019, 1.061)	1.036	(1.012, 1.061)	1.048	(1.007, 1.092)
Intrauterine Fetal Demise	1.252	(1.130, 1.386)	1.046	(0.923, 1.186)	2.274	(1.839, 2.811)
Intrauterine Growth Restriction	0.814	(0.793, 0.834)	0.800	(0.773, 0.828)	0.796	(0.766, 0.828)
Oligohydramnios	1.083	(1.046, 1.122)	1.059	(1.006, 1.116)	1.101	(1.048, 1.157)
Polyhydramnios	1.031	(1.015, 1.048)	1.058	(1.036, 1.079)	0.912	(0.889, 0.935)
Ruptured Membrane > 24 hrs	1.229	(1.205, 1.254)	1.200	(1.170, 1.230)	1.216	(1.177, 1.258)
Chorioamnionitis	1.792	(1.762, 1.822)	1.579	(1.539, 1.620)	1.581	(1.543, 1.620)
Other Maternal Infection	1.430	(1.397, 1.464)	1.611	(1.567, 1.656)	1.075	(1.028, 1.124)
Uterine Rupture	3.467	(3.213, 3.741)	5.533	(4.530, 6.758)	3.256	(2.989, 3.547)
Maternal Hypotension or Obstetrical Shock	10.309	(9.723, 10.930)	10.321	(9.571, 11.129)	11.102	(10.086, 12.221)
Pulmonary Embolism	10.878	(8.534, 13.866)	7.668	(4.779, 12.302)	11.241	(8.413, 15.021)
Obesity	1.000	(0.965, 1.036)	0.973	(0.920, 1.030)	1.053	(1.004, 1.105)
<b>Hospital</b>						
Has NRMP residency	1.102	(1.086, 1.119)	1.043	(1.025, 1.062)	1.228	(1.195, 1.262)
Hosts NRMP residency rotations	0.879	(0.853, 0.905)	0.947	(0.915, 0.980)	0.726	(0.687, 0.768)
<b>C-section</b>	0.829	(0.823, 0.836)				
<b>Variance Components</b>	$\sigma^2$	$\chi^2$	$\sigma^2$	$\chi^2$	$\sigma^2$	$\chi^2$
Physician	0.179	86100.8	0.202	67547.8	0.336	46937.1
Residency Program	0.019	564.5	0.028	645.3	0.024	372.5
<b>C-statistic</b>	0.646		0.648		0.719	
<b>Proportion of Variance Explained by Model</b>	0.073		0.079		0.160	

**eTable 4. Hierarchical Generalized Linear Model Output for 3 Maternal Complications Conditional on Vaginal Delivery**

Variable	Vaginal Delivery					
	Laceration		Hemorrhage		Other	
	OR	CI	OR	CI	OR	CI
Intercept	0.07	(0.06, 0.07)	0.03	(0.03, 0.04)	0.03	(0.03, 0.03)
<b>Physician</b>						
NY State	0.881	(0.836, 0.929)	1.041	(0.978, 1.109)	0.839	(0.791, 0.891)
Female	1.203	(1.156, 1.251)	1.135	(1.081, 1.191)	1.173	(1.123, 1.226)
Experience as of 2007 (quintiles)						
Q1: 1 to 12 yrs	ref		ref		ref	
Q2: 13 to 17 yrs	1.015	(0.961, 1.072)	1.045	(0.977, 1.117)	1.029	(0.969, 1.093)
Q3: 18 to 23 yrs	1.002	(0.945, 1.062)	0.915	(0.852, 0.983)	1.013	(0.949, 1.080)
Q4: 23 to 28 yrs	0.947	(0.894, 1.004)	0.880	(0.819, 0.945)	0.927	(0.869, 0.988)
Q5: 29 to 61 yrs	0.839	(0.793, 0.888)	0.903	(0.843, 0.968)	0.870	(0.816, 0.927)
<b>Patient Demographics</b>						
<i>Age</i>						
18-21	ref		ref		ref	
22-25	0.811	(0.800, 0.822)	0.902	(0.888, 0.917)	0.857	(0.842, 0.871)
26-31	0.831	(0.820, 0.842)	0.850	(0.835, 0.864)	0.757	(0.744, 0.770)
31-41	0.669	(0.660, 0.679)	0.813	(0.798, 0.827)	0.704	(0.691, 0.717)
>41	0.545	(0.515, 0.577)	0.894	(0.839, 0.952)	0.709	(0.662, 0.759)
Weekend	1.041	(1.031, 1.052)	0.990	(0.977, 1.003)	1.024	(1.010, 1.038)
<i>Race/Ethnicity</i>						
White	ref		ref		ref	
Minority	0.930	(0.920, 0.941)	1.149	(1.132, 1.166)	1.037	(1.021, 1.052)
Minority missing	1.066	(1.041, 1.092)	1.140	(1.105, 1.176)	0.991	(0.959, 1.024)
Medicaid or uninsured	0.772	(0.763, 0.781)	1.069	(1.053, 1.085)	1.064	(1.047, 1.080)
<i>Year</i>						
1992	ref		ref		ref	
1993	1.191	(1.166, 1.217)	1.100	(1.071, 1.130)	1.107	(1.075, 1.140)
1994	1.172	(1.147, 1.197)	1.065	(1.036, 1.094)	1.033	(1.003, 1.064)
1995	1.179	(1.154, 1.204)	0.980	(0.953, 1.007)	1.077	(1.046, 1.109)
1996	1.154	(1.130, 1.179)	0.954	(0.927, 0.981)	1.106	(1.074, 1.139)
1997	1.120	(1.097, 1.144)	0.894	(0.869, 0.920)	1.079	(1.048, 1.110)
1998	1.085	(1.063, 1.109)	0.900	(0.875, 0.926)	1.083	(1.052, 1.115)
1999	1.036	(1.014, 1.058)	0.900	(0.875, 0.925)	1.065	(1.035, 1.097)
2000	0.998	(0.976, 1.019)	0.829	(0.806, 0.854)	1.059	(1.029, 1.090)
2001	0.938	(0.917, 0.959)	0.811	(0.788, 0.835)	1.040	(1.010, 1.071)
2002	0.904	(0.884, 0.925)	0.828	(0.804, 0.852)	1.050	(1.019, 1.082)
2003	0.887	(0.867, 0.907)	0.874	(0.849, 0.900)	1.028	(0.997, 1.059)
2004	0.857	(0.837, 0.877)	0.895	(0.870, 0.921)	0.999	(0.970, 1.030)
2005	0.808	(0.789, 0.828)	0.851	(0.826, 0.876)	0.991	(0.962, 1.021)
2006	0.762	(0.743, 0.780)	0.844	(0.819, 0.869)	0.979	(0.949, 1.009)
<b>Previous C-section</b>	1.493	(1.464, 1.522)	1.373	(1.338, 1.409)	1.275	(1.240, 1.310)
<b>Patient Comorbidities</b>						
Fetal Malpresentation	1.345	(1.306, 1.385)	1.161	(1.119, 1.205)	1.129	(1.086, 1.175)
Antepartum Bleeding	1.007	(0.954, 1.062)	2.117	(2.021, 2.219)	1.093	(1.030, 1.160)
Herpes	0.978	(0.934, 1.024)	1.039	(0.984, 1.098)	1.128	(1.070, 1.190)
Severe Hypertension	1.422	(1.337, 1.513)	3.284	(3.119, 3.458)	1.886	(1.772, 2.007)
Uterine Scar Unrelated to C-section	1.402	(1.114, 1.766)	1.145	(0.834, 1.571)	1.135	(0.841, 1.531)
Multiple Gestation	0.842	(0.789, 0.898)	2.571	(2.444, 2.704)	1.099	(1.027, 1.176)
Macrosomia	1.537	(1.490, 1.586)	1.659	(1.595, 1.726)	0.894	(0.849, 0.942)
Unengaged Fetal Head	3.921	(3.601, 4.268)	1.820	(1.582, 2.094)	1.071	(0.906, 1.266)
Maternal Soft Tissue Disorder	1.128	(1.085, 1.174)	1.469	(1.408, 1.534)	1.308	(1.251, 1.367)
Other Types of	1.220	(1.197, 1.244)	1.842	(1.804, 1.880)	1.201	(1.172, 1.231)

<b>Hypertension</b>						
Preterm Gestation	0.485	(0.473, 0.497)	0.866	(0.846, 0.887)	1.111	(1.086, 1.137)
Congenital Fetal CNS Anomaly or Chromosomal Abnormality	0.611	(0.479, 0.780)	0.853	(0.672, 1.083)	0.977	(0.783, 1.220)
Cerebral Hemorrhage	1.194	(0.425, 3.355)	5.399	(2.819, 10.340)	7.960	(4.237, 14.955)
Asthma	0.842	(0.810, 0.875)	1.053	(1.009, 1.098)	1.084	(1.040, 1.129)
Maternal Renal Abnormality	0.975	(0.847, 1.122)	1.423	(1.231, 1.645)	1.600	(1.388, 1.843)
Maternal Liver Abnormality	1.378	(1.208, 1.573)	1.353	(1.151, 1.590)	1.088	(0.907, 1.305)
Diabetes or Abnormal Glucose Tolerance	1.456	(1.382, 1.533)	1.188	(1.107, 1.276)	1.095	(1.017, 1.180)
Maternal Thyroid Abnormality	0.984	(0.945, 1.024)	0.976	(0.926, 1.030)	0.993	(0.943, 1.046)
Maternal Substance Abuse	0.445	(0.392, 0.505)	1.026	(0.937, 1.125)	1.093	(0.996, 1.199)
Maternal Mental Disorder	0.736	(0.708, 0.765)	1.078	(1.038, 1.119)	1.140	(1.099, 1.182)
Maternal Congenital and Other Heart Disease	1.050	(1.013, 1.087)	1.186	(1.135, 1.241)	1.042	(0.995, 1.091)
Isoimmunization	1.003	(0.972, 1.036)	1.079	(1.035, 1.124)	1.044	(1.002, 1.087)
Intrauterine Fetal Demise	0.352	(0.266, 0.465)	1.365	(1.154, 1.614)	2.081	(1.768, 2.450)
Intrauterine Growth Restriction	0.614	(0.582, 0.649)	0.779	(0.735, 0.826)	1.134	(1.077, 1.194)
Oligohydramnios	0.982	(0.913, 1.055)	1.249	(1.153, 1.354)	1.022	(0.933, 1.120)
Polyhydramnios	1.051	(1.022, 1.081)	1.111	(1.075, 1.149)	1.030	(0.995, 1.067)
Ruptured Membrane >24 hrs	1.134	(1.094, 1.175)	1.321	(1.270, 1.374)	1.235	(1.186, 1.286)
Chorioamnionitis	1.586	(1.533, 1.641)	1.797	(1.731, 1.866)	1.761	(1.693, 1.833)
Other Maternal Infection	1.847	(1.786, 1.909)	1.577	(1.504, 1.653)	1.004	(0.951, 1.060)
Uterine Rupture	2.535	(1.957, 3.284)	13.410	(10.828, 16.607)	4.329	(3.296, 5.685)
Maternal Hypotension or Obstetrical Shock	2.376	(2.149, 2.628)	10.822	(9.967, 11.752)	26.221	(24.319, 28.272)
Pulmonary Embolism	0.806	(0.321, 2.024)	8.177	(4.827, 13.849)	18.582	(11.399, 30.292)
Obesity	0.788	(0.719, 0.863)	1.058	(0.974, 1.149)	1.111	(1.016, 1.215)
<b>Hospital</b>						
Has NRMP residency	1.035	(1.011, 1.059)	0.958	(0.931, 0.986)	1.229	(1.194, 1.265)
Hosts NRMP residency rotations	1.009	(0.966, 1.054)	0.744	(0.702, 0.789)	1.148	(1.082, 1.219)
<b>C-section</b>						
<b>Variance Components</b>	$\sigma^2$	$\chi^2$	$\sigma^2$	$\chi^2$	$\sigma^2$	$\chi^2$
Physician	0.277	56646.7	0.408	69060.9	0.314	45396.7
Residency Program	0.030	526.4	0.029	364.0	0.055	755.0
<b>C-statistic</b>	0.672		0.708		0.690	
<b>Proportion of variance explained by model</b>	0.112		0.132		0.108	



**eTable 5. Hierarchical Generalized Linear Model Output for 3 Maternal Complications Conditional on Cesarean Delivery**

Variable	Cesarean Delivery					
	Hemorrhage		Infection		Other	
	OR	CI	OR	CI	OR	CI
Intercept	0.05	(0.05, 0.05)	0.04	(0.04, 0.04)	0.02	(0.02, 0.02)
<b>Physician</b>						
NY State	1.348	(1.250, 1.454)	1.399	(1.306, 1.498)	1.115	(1.047, 1.188)
Female	1.101	(1.040, 1.167)	1.123	(1.067, 1.182)	1.116	(1.067, 1.167)
<b>Experience as of 2007 (quintiles)</b>						
Q1: 1 to 12 yrs	ref		ref		ref	
Q2: 13 to 17 yrs	1.025	(0.946, 1.109)	1.074	(1.001, 1.152)	1.059	(0.995, 1.127)
Q3: 18 to 23 yrs	0.939	(0.863, 1.022)	1.012	(0.938, 1.091)	0.985	(0.922, 1.053)
Q4: 23 to 28 yrs	0.873	(0.802, 0.950)	0.941	(0.873, 1.014)	0.871	(0.814, 0.931)
Q5: 29 to 61 yrs	0.876	(0.807, 0.951)	0.970	(0.902, 1.044)	0.853	(0.797, 0.913)
<b>Patient Demographics</b>						
<i>Age</i>						
18-21	ref		ref		ref	
22-25	0.933	(0.909, 0.957)	0.689	(0.672, 0.707)	0.923	(0.883, 0.964)
26-31	0.873	(0.851, 0.896)	0.572	(0.557, 0.587)	1.046	(1.003, 1.091)
31-41	0.872	(0.850, 0.895)	0.499	(0.486, 0.512)	1.282	(1.231, 1.337)
>41	0.945	(0.890, 1.002)	0.412	(0.383, 0.444)	1.573	(1.455, 1.700)
Weekend	1.072	(1.051, 1.093)	1.102	(1.079, 1.126)	1.119	(1.086, 1.153)
<i>Race/Ethnicity</i>						
White	ref		ref		ref	
Minority	1.181	(1.159, 1.204)	1.745	(1.708, 1.784)	1.140	(1.109, 1.172)
Minority missing	1.091	(1.046, 1.138)	1.364	(1.300, 1.432)	1.155	(1.088, 1.226)
Medicaid or uninsured	1.109	(1.087, 1.131)	1.186	(1.161, 1.213)	1.125	(1.093, 1.159)
Year						
1992	ref		ref		ref	
1993	1.265	(1.222, 1.309)	1.559	(1.502, 1.618)	1.223	(1.157, 1.293)
1994	1.282	(1.238, 1.328)	1.417	(1.363, 1.474)	1.214	(1.148, 1.284)
1995	1.161	(1.120, 1.204)	1.316	(1.264, 1.369)	1.098	(1.037, 1.163)
1996	1.056	(1.018, 1.096)	1.316	(1.264, 1.370)	1.106	(1.043, 1.171)
1997	0.937	(0.903, 0.973)	1.157	(1.110, 1.206)	1.123	(1.062, 1.187)
1998	0.843	(0.811, 0.876)	1.067	(1.023, 1.113)	1.053	(0.995, 1.114)
1999	0.835	(0.804, 0.866)	0.949	(0.910, 0.990)	1.001	(0.946, 1.058)
2000	0.657	(0.632, 0.683)	0.951	(0.913, 0.991)	0.911	(0.862, 0.964)
2001	0.572	(0.549, 0.595)	0.802	(0.769, 0.837)	0.878	(0.830, 0.928)
2002	0.601	(0.578, 0.625)	0.844	(0.809, 0.880)	0.862	(0.816, 0.911)
2003	0.646	(0.623, 0.670)	0.825	(0.792, 0.859)	0.867	(0.822, 0.914)
2004	0.697	(0.673, 0.722)	0.729	(0.700, 0.760)	0.891	(0.846, 0.938)
2005	0.718	(0.694, 0.743)	0.657	(0.630, 0.685)	0.801	(0.761, 0.844)
2006	0.763	(0.737, 0.789)	0.617	(0.591, 0.643)	0.791	(0.751, 0.833)
<b>Previous C-section</b>	0.834	(0.820, 0.848)	0.618	(0.606, 0.630)	1.203	(1.173, 1.233)
<b>Patient Comorbidities</b>						
Fetal Malpresentation	0.884	(0.866, 0.902)	0.853	(0.834, 0.873)	0.963	(0.933, 0.993)
Antepartum Bleeding	2.797	(2.722, 2.875)	1.032	(0.992, 1.073)	1.545	(1.477, 1.617)
Herpes	0.921	(0.874, 0.971)	0.880	(0.831, 0.933)	0.924	(0.853, 1.001)
Severe Hypertension	1.848	(1.777, 1.921)	1.106	(1.055, 1.160)	2.449	(2.327, 2.576)
Uterine Scar Unrelated to C-section	1.165	(1.064, 1.276)	0.926	(0.828, 1.035)	1.304	(1.154, 1.473)
Multiple Gestation	1.766	(1.701, 1.833)	0.982	(0.935, 1.031)	1.317	(1.244, 1.394)
Macrosomia	1.150	(1.113, 1.189)	0.927	(0.889, 0.966)	0.902	(0.853, 0.954)
Unengaged Fetal Head	1.240	(1.201, 1.280)	1.148	(1.107, 1.190)	1.129	(1.071, 1.190)
Maternal Soft Tissue Disorder	1.275	(1.241, 1.310)	1.198	(1.161, 1.237)	1.453	(1.401, 1.508)
Other Types of	1.185	(1.157, 1.214)	1.192	(1.161, 1.224)	1.347	(1.301, 1.395)

Hypertension						
Preterm Gestation	0.972	(0.947, 0.996)	1.191	(1.159, 1.224)	1.228	(1.186, 1.273)
Congenital Fetal CNS Anomaly or Chromosomal Abnormality	1.089	(0.926, 1.281)	1.162	(0.974, 1.387)	1.135	(0.894, 1.440)
Cerebral Hemorrhage	1.890	(1.125, 3.175)	1.678	(0.902, 3.120)	7.007	(4.472, 10.979)
Asthma	1.042	(0.994, 1.092)	1.022	(0.969, 1.078)	1.245	(1.167, 1.328)
Maternal Renal Abnormality	1.661	(1.438, 1.918)	1.145	(0.956, 1.370)	2.626	(2.222, 3.102)
Maternal Liver Abnormality	1.521	(1.263, 1.832)	1.098	(0.884, 1.364)	2.208	(1.785, 2.733)
Diabetes or Abnormal Glucose Tolerance	1.062	(0.983, 1.147)	1.028	(0.937, 1.127)	1.533	(1.394, 1.687)
Maternal Thyroid Abnormality	0.950	(0.898, 1.005)	0.890	(0.827, 0.958)	1.007	(0.931, 1.089)
Maternal Substance Abuse	1.248	(1.120, 1.390)	0.935	(0.828, 1.057)	1.301	(1.115, 1.518)
Maternal Mental Disorder	1.158	(1.108, 1.211)	0.973	(0.916, 1.034)	1.235	(1.156, 1.318)
Maternal Congenital and Other Heart Disease	1.275	(1.215, 1.339)	1.092	(1.026, 1.162)	1.574	(1.476, 1.680)
Isoimmunization	1.079	(1.022, 1.139)	0.987	(0.924, 1.054)	1.005	(0.927, 1.090)
Intrauterine Fetal Demise	1.666	(1.283, 2.162)	2.401	(1.812, 3.180)	2.869	(2.089, 3.940)
Intrauterine Growth Restriction	0.720	(0.682, 0.760)	0.808	(0.763, 0.856)	0.952	(0.886, 1.024)
Oligohydramnios	1.101	(1.031, 1.176)	1.072	(0.993, 1.157)	1.097	(0.993, 1.211)
Polyhydramnios	0.898	(0.866, 0.931)	0.934	(0.902, 0.969)	0.898	(0.849, 0.948)
Ruptured Membrane > 24 hrs	1.030	(0.982, 1.080)	1.422	(1.361, 1.487)	1.171	(1.093, 1.255)
Chorioamnionitis	1.385	(1.339, 1.433)	1.669	(1.617, 1.722)	1.464	(1.391, 1.540)
Other Maternal Infection	1.403	(1.325, 1.485)	0.734	(0.683, 0.788)	1.122	(1.019, 1.235)
Uterine Rupture	3.266	(2.943, 3.625)	1.740	(1.509, 2.005)	4.349	(3.861, 4.899)
Maternal Hypotension or Obstetrical Shock	6.942	(6.267, 7.688)	2.063	(1.775, 2.398)	34.198	(31.127, 37.572)
Pulmonary Embolism	5.234	(3.874, 7.072)	2.657	(1.840, 3.836)	23.235	(17.470, 30.901)
Obesity	0.956	(0.897, 1.018)	1.090	(1.010, 1.176)	1.240	(1.136, 1.354)
<b>Hospital</b>						
Has NRMP residency	1.034	(0.997, 1.072)	1.616	(1.557, 1.677)	1.236	(1.186, 1.288)
Hosts NRMP residency rotations	0.573	(0.531, 0.619)	0.902	(0.833, 0.976)	1.149	(1.054, 1.253)
<b>C-section</b>						
<b>Variance Components</b>	$\sigma^2$	$\chi^2$	$\sigma^2$	$\chi^2$	$\sigma^2$	$\chi^2$
Physician	0.553	51460.5	0.385	27237.2	0.218	10980.5
Residency Program	0.043	386.9	0.037	397.9	0.044	602.1
<b>C-statistic</b>	0.753		0.775		0.710	
<b>Proportion of variance explained by model</b>	<b>0.185</b>		<b>0.230</b>		<b>0.106</b>	

**eTable 6. Patient Characteristics by Quintile Ranking of Residency Programs for Any Major Complication Among All Deliveries**

Variable	Residency Program Maternal Complication Rate Quintile														
	High			Q4			Q3			Q2			Low		
	All (%)	Vag (%)	Cesar (%)	All (%)	Vag (%)	Cesar (%)	All (%)	Vag (%)	Cesar (%)	All (%)	Vag (%)	Cesar (%)	All (%)	Vag (%)	Cesar (%)
<b><u>Maternal Complications</u></b>															
Any Major Complication	10.6	10.3	11.3	11.7	12.0	11.2	12.4	13.0	10.9	13.1	13.8	11.4	14.9	15.7	12.9
Laceration	--	5.2	0.1	--	6.3	0.1	--	6.4	0.1	--	7.4	0.1	--	7.8	0.1
Hemorrhage	--	3.2	5.3	--	3.5	5.6	--	4.1	5.6	--	3.6	5.1	--	4.4	7.1
Infection	--	0.8	5.3	--	0.7	4.6	--	0.7	4.3	--	0.7	4.8	--	0.7	4.3
Other	--	1.9	1.9	--	2.4	2.2	--	2.8	2.2	--	3.1	2.7	--	4.2	2.8
<b><u>Physician Characteristics</u></b>															
State is New York	82.7	83.2	81.4	68.7	68.8	68.5	37.5	39.1	33.7	68.8	69.1	68.3	50.2	51.0	48.3
Female Doctor	30.6	30.8	30.1	29.4	29.3	29.8	25.5	26.0	24.5	34.1	34.4	33.3	28.4	28.5	28.1
Years of Experience (As of 2007) (mean)	21.2	21.3	21.0	21.2	21.3	20.8	19.8	19.9	19.6	20.2	20.3	20.0	19.5	19.6	19.1
<b><u>Hospital Characteristics</u></b>															
Hospital Has OB Residency	54.2	54.7	52.6	39.6	40.3	37.9	32.8	33.8	30.4	36.9	37.0	36.7	30.9	31.1	30.1
Hospital Hosts OB Residency Rotations	3.7	3.8	3.6	4.3	4.3	4.3	1.8	1.8	1.8	7.4	7.8	6.6	4.1	4.3	3.6
<b><u>Maternal Demographics</u></b>															
Patient Age (Years) (mean)	27.8	27.2	29.2	28.4	27.8	29.9	27.9	27.3	29.3	28.6	28.1	30.0	28.3	27.8	29.5
Admitted on Saturday or Sunday	21.8	24.0	16.2	21.5	23.8	15.6	20.0	22.4	14.3	20.5	22.7	14.7	20.5	22.7	15.0
Patient is Not Non-Hispanic White	56.3	56.7	55.4	46.3	46.4	46.2	50.4	50.2	50.8	33.7	34.1	32.9	31.9	31.9	31.9
Patient with Medicaid Insurance or Uninsured	52.5	54.9	46.3	40.4	42.5	34.7	44.6	46.8	39.5	37.6	39.4	32.7	34.6	35.9	31.0
<b><u>Maternal Comorbidities</u></b>															
Previous C-Section	12.9	3.4	37.7	13.8	4.0	38.9	13.9	3.7	38.4	13.6	4.1	38.1	13.9	4.1	38.9
Fetal Malpresentation	5.8	1.8	16.1	6.1	1.9	17.2	6.2	1.7	16.8	6.5	2.0	18.3	6.6	2.0	18.6
Antepartum Bleeding	1.6	0.6	4.2	1.6	0.6	4.1	1.6	0.7	3.9	1.8	0.8	4.3	1.8	0.9	4.2
Herpes	1.0	0.7	1.8	1.2	0.9	1.9	1.4	0.9	2.3	1.3	0.9	2.2	1.5	1.1	2.4

Eclampsia or Severe Pre-eclampsia	0.9	0.4	2.3	0.9	0.4	2.3	1.1	0.5	2.4	0.9	0.4	2.2	1.1	0.5	2.5
Uterine Scar Unrelated to C-section	0.2	0.0	0.5	0.2	0.0	0.6	0.2	0.0	0.6	0.2	0.0	0.6	0.2	0.0	0.7
Multiple Gestation	1.1	0.5	2.8	1.3	0.6	3.2	1.1	0.5	2.5	1.4	0.7	3.3	1.4	0.7	3.2
Macrosomia	1.6	0.7	3.8	2.2	1.2	4.7	2.9	1.6	6.1	2.7	1.7	5.3	2.8	1.6	5.7
Unengaged Fetal Head	1.4	0.1	4.7	1.5	0.1	5.3	1.5	0.1	5.1	1.6	0.1	5.5	1.7	0.1	5.8
Maternal Soft Tissue Disorder	2.4	0.9	6.3	3.0	1.2	7.4	2.7	1.1	6.5	2.8	1.3	6.9	3.0	1.4	7.0
Mild Pre-eclampsia or Non-eclampsia Hypertension	5.5	4.4	8.6	5.5	4.4	8.5	6.2	5.1	9.0	5.9	4.8	8.7	6.5	5.3	9.5
Preterm Gestation	6.7	5.7	9.3	6.8	5.8	9.5	7.0	6.1	9.4	6.7	5.6	9.3	7.0	6.0	9.7
Congenital Fetal CNS Anomaly or Chromosomal Abnormality	0.1	0.0	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2
Maternal Cerebral Hemorrhage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Asthma	1.4	1.2	1.8	1.6	1.4	2.2	1.6	1.4	2.0	2.0	1.8	2.5	2.0	1.7	2.5
Maternal Renal Abnormality	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2
Maternal Liver Abnormality	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Diabetes or Abnormal Glucose Tolerance	0.5	0.5	0.7	0.6	0.5	0.8	0.6	0.5	0.9	0.7	0.6	1.0	0.7	0.6	1.0
Maternal Thyroid Abnormality	0.9	0.8	1.3	1.4	1.2	1.8	1.3	1.1	1.7	1.6	1.3	2.1	1.6	1.4	2.2
Maternal Substance Abuse	0.5	0.5	0.5	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
Maternal Mental Disorder	1.2	1.1	1.4	1.7	1.6	1.9	1.8	1.7	2.0	2.0	1.9	2.3	3.1	2.9	3.4
Maternal Congenital and Other Heart Disease	1.0	0.9	1.3	1.5	1.4	1.9	1.5	1.4	1.8	1.6	1.4	1.9	1.9	1.8	2.2
Isoimmunization	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.6	2.1	2.1	2.0	2.2	2.2	2.2
Intrauterine Fetal Demise	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intrauterine Growth Restriction	1.0	0.7	1.8	1.2	0.9	2.2	1.5	1.1	2.3	1.4	1.1	2.3	1.5	1.1	2.4
Oligohydramnios	0.5	0.3	1.1	0.5	0.3	1.1	0.6	0.3	1.1	0.6	0.4	1.1	0.7	0.5	1.3
Polyhydramnios	3.5	2.9	5.3	3.2	2.6	4.8	3.1	2.5	4.5	2.9	2.3	4.2	2.9	2.3	4.3
Ruptured Membrane > 24 hrs	1.6	1.4	2.1	1.7	1.5	2.1	1.4	1.3	1.7	1.7	1.6	2.1	1.8	1.7	2.1

Chorioamnionitis	1.6	0.9	3.4	1.6	1.1	3.2	1.8	1.2	3.3	2.1	1.4	4.0	1.9	1.3	3.5
Maternal Pyrexia or Septicemia	0.8	0.7	1.1	1.0	0.9	1.3	1.2	1.1	1.4	1.2	1.1	1.3	1.1	1.1	1.3
Uterine Rupture	0.1	0.0	0.2	0.1	0.0	0.2	0.1	0.0	0.2	0.1	0.0	0.2	0.1	0.0	0.2
Maternal Hypotension or Obstetrical Shock	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2
Pulmonary Embolism	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Obesity	0.3	0.2	0.8	0.4	0.2	1.0	0.6	0.3	1.3	0.6	0.3	1.2	0.8	0.4	1.6
N	12172 47		338784		66976 8		97312 9		28777 7		50876 4		10820 29		30338 7
		878463		93009 1		26032 3		68535 2		70367 3		19490 9		77864 2	