

## Supplemental Digital Content (SDC)

**Table 1a.** Diagnostic codes used to define Severe Maternal Morbidity.

**Table 1b.** Diagnostic codes used to define Severe Newborn Morbidity.

**Table 2.** Data source for maternal risk factors and infant congenital anomalies.

**Table 3.** Severe Maternal Morbidity risk adjustment model.

**Table 4.** Severe Newborn Morbidity risk adjustment model.

**Table 5.** Maternal outcomes.

**Table 6.** Newborn outcomes.

**Table 7.** Agreement on classification of hospital performance as a function of SMM, SNM, and composite morbidity.

**Figure 1a.** Flow diagram for 2011 delivery cohort.

**Figure 1b.** Flow diagram for 2012 delivery cohort.

**Figure 2.** Calibration graphs for Severe Maternal Morbidity risk-adjustment model.

**Figure 3.** Calibration graphs for Severe Newborn Morbidity risk-adjustment model.

**Table 1a.** Diagnostic codes used to define Severe Maternal Morbidity.

CDC Algorithm	ICD9-CM diagnosis codes	ICD-9-CM procedure codes
Acute myocardial infarction	410.xx	
Acute renal failure	584.x, 669.3x	
Adult respiratory distress syndrome	518.5, 518.81, 518.82, 518.84, 799.1	
Amniotic fluid embolism	673.1x	
Aneurysm	441.xx	
Cardiac arrest/ventricular fibrillation	427.41, 427.42, 427.5	
Disseminated intravascular coagulation	286.6, 286.9, 666.3x	
Eclampsia	642.6x	
Heart failure during procedure or surgery	669.4x, 997.1	
Internal injuries of thorax, abdomen, and pelvis	860.xx—869.xx	
Intracranial injuries	800.xx, 801.xx, 803.xx, 804.xx, 851.xx-854.xx	
Puerperal cerebrovascular disorders	430, 431, 432.x, 433.xx, 434.xx, 436, 437.x, 671.5x, 674.0x, 997.2, 999.2	
Pulmonary edema	428.1, 518.4	
Severe anesthesia complications	668.0x, 668.1x, 668.2x	
Sepsis	038.xx, 995.91, 995.92	
Shock	669.1x, 785.5x, 995.0, 995.4, 998.0	
Sickle cell anemia with crisis	282.62, 282.64, 282.69	
Thrombotic embolism	415.1x, 673.0x, 673.2x, 673.3x, 673.8x	
Blood transfusion		99.0x
Cardio monitoring		89.6x
Hysterectomy		68.3x-68.9
Operations on heart and pericardium		35.xx, 36.xx, 37.xx, 39.xx
Temporary tracheostomy		31.1
Ventilation		93.90, 96.01-96.05, 96.7x
<b>Birth Certificate Data</b>		
Ruptured uterus	x	
Unplanned hysterectomy	x	
ICU admission	x	
Unplanned return to OR	x	
Death	x	

**Appendix Table 1b.** Severe newborn morbidity.

	ICD-9-CM diagnosis codes	ICD-9-CM procedure codes	Birth Certificate Data	Administrative data
<b>California Maternal Quality Care Collaborative NQF-approved composite measure</b>				
<b>Severe Birth Trauma</b>				
Subdural and cerebral hemorrhage	767			
Epicranial subaponeurotic hemorrhage (massive)	767.11			
Other injuries to skeleton due to birth trauma	767.3			
Injury to spine and spinal cord due to birth trauma	767.4			
Injury to brachial plexus due to birth trauma	767.6			
Other cranial and peripheral nerve injuries due to birth trauma	767.7			
<b>Severe Hypoxia Asphyxia</b>				
Severe birth asphyxia	768.5			
Mild or moderate birth asphyxia	768.6			
Hypoxic-ischemic encephalopathy, unspecified	768.7			
Mild hypoxic-ischemic encephalopathy	768.71			
Moderate hypoxic-ischemic encephalopathy	768.72			
Severe hypoxic-ischemic encephalopathy	768.73			
Unspecified severity of birth asphyxia in liveborn infant	768.9			
Congenital diplegia	343			
Congenital hemiplegia	343.1			
Congenital quadriplegia	343.2			
Congenital monoplegia	343.3			
Infantile hemiplegia	343.4			
Other specified infantile cerebral palsy	343.8			
Infantile cerebral palsy, unspecified	343.9			
<b>Severe Shock and Resuscitation</b>				
Disseminated intravascular coagulation in newborn	776.2			
Necrotizing enterocolitis in newborn, unspecified	777.5			
Stage I necrotizing enterocolitis in newborn	777.51			
Stage II necrotizing enterocolitis in newborn	777.52			
Stage III necrotizing enterocolitis in newborn	777.53			
Shock, unspecified	785.5			
Cardiogenic shock	785.51			
Septic shock	785.52			
Other shock without mention of trauma	785.59			

Acute kidney failure with lesion of tubular necrosis	584.5
<b>Severe Respiratory Complications</b>	
Persistent fetal circulation	747.83
Meconium aspiration with respiratory symptoms	770.12
Pulmonary hemorrhage	770.3
<b>Severe Infection</b>	
Congenital pneumonia	770
Bacteremia of newborn	771.83
Severe sepsis	995.92
<b>Severe Neurological Complication</b>	
Intraventricular hemorrhage unspecified grade	772.1
Intraventricular hemorrhage, grade I	772.11
Intraventricular hemorrhage, grade II	772.12
Intraventricular hemorrhage, grade III	772.13
Intraventricular hemorrhage, grade IV	772.14
Subarachnoid hemorrhage of fetus or newborn	772.2
Convulsions in newborn	779
Grand mal status	345.3
Cerebral depression, coma, and other abnormal cerebral signs in fetus or newborn	779.2
Periventricular leukomalacia	779.7
Cardiac arrest of newborn	779.85
Cardiac arrest	427.5
Encephalopathy, unspecified	348.3
Metabolic encephalopathy	348.31
Other encephalopathy	348.39
Cerebral edema	348.5
<b>Severe Shock/Resuscitation</b>	
Arterial catheterization	38.91
Cardiopulmonary resuscitation, not otherwise specified	99.6
<b>Severe Respiratory</b>	
Continuous invasive mechanical ventilation of unspecified duration	96.7
Continuous invasive mechanical ventilation for less than 96 consecutive hours	96.71
Continuous invasive mechanical ventilation for 96 consecutive hours or more	96.72
Administration of inhaled nitric oxide	0.12
Insertion of intercostal catheter for drainage	34.04
<b>Severe Neurological</b>	
Electroencephalogram	89.14
Gastrostomy	43.1
<b>Severe Septicemia</b>	
Septicemia [sepsis] of newborn	771.81

---

**Birth Certificate Data**

---

Birth injury	x
Seizure of serious neurologic dysfunction	x
Assisted ventilation required for more than 6 hours	x
Apgar score at 5 minutes < 4	x

---

**Other**

---

death	x
-------	---

**Appendix Table 2 .** Data source for maternal risk factors and infant congenital anomalies.

	ICD-9-CM diagnostic codes	Administrative data	Birth Certificate
Age			x
Race		X	
Ethnicity		X	
Education			x
Prenatal care			x
Weight at delivery			x
Parity			x
Gestational age			x
Intrauterine growth restriction			x
Prior Cesarean Section			x
Multiple gestation			x
Fetal presentation at delivery (i.e. vertex)			x
<b>Hypertension</b>			
gestational hypertension	642.3x		
pre-existing hypertension	401.x-405.x, 642.0x-642.2x, 642.7x		x
mild pre-eclampsia	642.4x, 642.7x		
severe pre-eclampsia	642.5x		
<b>Placental abnormality</b>			
Placenta Previa	641.0x, 641.1x		
Abruptio	641.2		x
Accreta	667		
Premature rupture of membranes (>12 hrs)			x
<b>Hematologic abnormality</b>			
Anticoagulant/NSAID use	V58.61, V58.63		
Coagulopathy	286.xx		
Platelet defect	287.1, 287.3x		
<b>Comorbidities</b>			
gestational diabetes	648.8x		x
Diabetes, pre-pregnancy	250.x, 648.0x		x
Valvular heart disease	394.x-397.x, 424.x		
Congestive heart failure	428.22, 428.23, 428.32, 428.33, 428.42, 428.43		
Pulmonary hypertension	416.0x, 416.8x, 416.9x		
Ischemic heart disease	412.x-414.x		
Asthma	493.x		

Sickle cell disease	282.4x, 282.6x	
SLE	710.0x	
Uterine fibroma		x
HIV	042.x, V08.x	
Drug abuse	304.x, 305.2x-305.9x, 648.3x	
Alcohol abuse	291.xx, 303.xx, 305.0x	
Chronic kidney disease	581.x-583.x, 585.x, 587.x, 588.x, 646.2x	
Sleep apnea	327.2x, 780.51, 780.53, 780.57	
<hr/>		
Infant congenital anomalies		
<hr/>		
congenital anomalies	740-749	*

**Appendix Table 3. Severe Maternal Morbidity Model (based on 2011 data)**

<b>Patient Risk</b>				
	<b>AOR</b>	<b>95% CI</b>		<b>P</b>
<b>Age</b>				
<=15	0.80	0.51	1.24	0.314
16-20	1.09	0.99	1.20	0.085
21-25	reference			
26-30	0.98	0.91	1.07	0.702
31-35	1.08	0.99	1.17	0.082
36-40	1.20	1.09	1.32	0.000
41-45	1.46	1.26	1.69	0.000
46-	1.90	1.26	2.88	0.002
<b>Race</b>				
White	reference			
Black	1.43	1.29	1.58	0.000
Native American	1.01	0.69	1.46	0.978
Asian	1.30	1.19	1.41	0.000
Other	1.06	0.99	1.13	0.085
Unknown	1.03	0.78	1.37	0.819
<b>Ethnicity</b>				
Non-Hispanic	reference			
Hispanic	1.18	1.10	1.26	0.000
Unknown	0.76	0.56	1.03	0.082
<b>Education</b>				
up to 12th grade	1.03	0.96	1.12	0.373
high school graduate	reference			
some college credit to college graduate	0.94	0.87	1.01	0.073
graduate degree	0.92	0.82	1.03	0.148
unknown	1.08	0.94	1.25	0.270
<b>Insurance</b>				
Medicare	1.56	1.11	2.18	0.010
Medicaid	1.03	0.97	1.10	0.323
Private	reference			
Other	0.90	0.78	1.04	0.149
<b>Prenatal care</b>				
none	reference			
1st trimester	0.44	0.33	0.58	0.000
2nd trimester	0.49	0.37	0.65	0.000
3rd trimester	0.64	0.47	0.87	0.005
unknown	0.57	0.40	0.81	0.002
<b>Parity at delivery</b>				
1	reference			



2	0.60	0.56	0.65	0.000
3	0.71	0.65	0.78	0.000
4	0.76	0.67	0.85	0.000
5	0.78	0.67	0.91	0.002
6 or more	0.94	0.80	1.11	0.452
Gestational age				
28-31	2.11	1.80	2.46	0.000
32-36	1.34	1.23	1.46	0.000
37-38	1.00	0.94	1.07	0.880
39-40	reference			
41	1.27	1.16	1.39	0.000
42-43	1.16	1.01	1.33	0.037
Prior Cesarean Section				
0	reference			
1	1.94	1.78	2.10	0.000
2	2.37	2.12	2.65	0.000
3	2.96	2.46	3.56	0.000
4	4.25	3.23	5.60	0.000
unknown	2.24	1.07	4.69	0.033
Multiple gestation				
singleton	reference			
Twin	2.81	2.49	3.17	0.000
Triplet or higher	2.96	1.62	5.42	0.000
Fetal presentation at delivery				
Vertex	reference			
Breech	1.15	1.02	1.31	0.027
Other	1.24	1.09	1.42	0.001
Unknown	1.27	1.15	1.40	0.000
Hypertension				
gestational hypertension	1.62	1.40	1.86	0.000
pre-existing hypertension	1.48	1.24	1.75	0.000
mild pre-eclampsia	2.26	2.01	2.53	0.000
severe pre-eclampsia	5.67	5.08	6.32	0.000
Placental abnormality				
Placenta Previa	7.40	6.53	8.39	0.000
Abruption	3.39	2.94	3.91	0.000
Accreta	8.00	4.33	14.76	0.000
chorioamnionitis	2.66	2.32	3.05	0.000
placental insufficiency	1.40	0.84	2.36	0.200
Premature rupture of membranes (>12 hrs)	1.19	1.01	1.39	0.035
Hematologic abnormality				
Anticoagulant use (before admission)	2.73	1.61	4.64	0.000

Coagulopathy (before admission)	6.00	4.05	8.87	0.000
Platelet defect (before admission)	8.76	6.38	12.04	0.000
<b>Comorbidities</b>				
Valvular heart disease	3.19	2.22	4.56	0.000
Pulmonary hypertension	9.54	4.56	19.94	0.000
Ischemic heart disease	3.31	0.72	15.24	0.124
Congenital heart disease	5.84	1.60	21.33	0.008
Asthma	1.32	1.19	1.48	0.000
Sickle cell disease	2.72	1.98	3.72	0.000
SLE	1.72	1.11	2.67	0.016
Uterine fibroma	1.54	1.04	2.30	0.033
HIV	2.98	0.70	12.70	0.140
Drug abuse	1.41	1.17	1.69	0.000
Chronic kidney disease	3.30	2.52	4.31	0.000
Sleep apnea	3.65	2.24	5.95	0.000
<b>C statistic</b>				
training set	0.71 (95% CI:0.700 - 0.714)			
validation set	0.69 (95% CI: 0.687 - 0.700)			
<b>Hosmer-Lemeshow statistic</b>				
training set	5.42 (p = 0.71)			
validation set	92.0 (p <0.001)			

**Appendix Table 4.** Severe Newborn Morbidity Model (based on 2011 data)

	AOR	95% CI		P
<b>Maternal risk factors</b>				
<b>Race</b>				
White	reference			
Black	1.01	0.94	1.08	0.858
Native American	0.73	0.56	0.94	0.016
Asian	0.88	0.83	0.94	0.000
Other	1.00	0.96	1.05	0.929
Unknown	1.08	0.92	1.27	0.352
<b>Ethnicity</b>				
Non-Hispanic	reference			
Hispanic	0.91	0.88	0.96	0.000
Unknown	1.32	1.14	1.54	0.000
<b>Education</b>				
up to 12th grade	0.97	0.93	1.02	0.299
high school graduate	reference			
some college credit to college graduate	0.93	0.89	0.97	0.001
graduate degree	0.84	0.78	0.91	0.000
unknown	1.36	1.25	1.49	0.000
<b>Insurance</b>				
Medicare	1.40	1.09	1.80	0.008
Medicaid	1.21	1.16	1.26	0.000
Private	reference			
Other	1.19	1.09	1.30	0.000
<b>Prenatal care</b>				
none	reference			
1st trimester	0.75	0.61	0.93	0.008
2nd trimester	0.71	0.58	0.88	0.002
3rd trimester	0.70	0.56	0.89	0.003
unknown	0.68	0.53	0.89	0.005
<b>Weight at delivery</b>				
underweight (BMI < 18.5)	1.45	0.89	2.39	0.138
normal (BMI >= 18.5 & < 25)	reference			
overweight (BMI >= 25 & < 30)	0.95	0.90	1.00	0.064
obesity (BMI >= 30 & < 40)	1.04	0.98	1.10	0.185
morbid obesity (BMI >= 40 & < 50)	1.18	1.10	1.28	0.000
super obesity (BMI >= 50)	1.44	1.24	1.67	0.000
<b>Parity</b>				
1	reference			
2	0.61	0.58	0.64	0.000

3	0.62	0.59	0.66	0.000
4	0.63	0.58	0.67	0.000
5	0.69	0.62	0.76	0.000
6 or more	0.68	0.60	0.77	0.000
<b>Gestational age</b>				
28-31	35.27	32.67	38.09	0.000
32-36	4.58	4.37	4.80	0.000
37-38	1.13	1.08	1.18	0.000
39-40	reference			
41	1.19	1.12	1.27	0.000
42-43	1.21	1.10	1.33	0.000
<b>Intrauterine growth restriction</b>				
	2.17	1.84	2.55	0.000
<b>Prior Cesarean Section</b>				
0	reference			
1	1.11	1.04	1.18	0.001
2	1.10	1.00	1.21	0.051
3	1.23	1.04	1.46	0.013
4	1.71	1.32	2.23	0.000
unknown	1.47	0.83	2.61	0.186
<b>Multiple gestation</b>				
singleton	reference			
Twin	1.21	1.11	1.32	0.000
Triplet or higher	2.08	1.43	3.04	0.000
<b>Fetal presentation at delivery</b>				
Vertex	reference			
Breech	1.34	1.23	1.45	0.000
Other	1.36	1.24	1.49	0.000
other	1.16	1.08	1.24	0.000
<b>Hypertension</b>				
gestational hypertension	1.10	1.00	1.22	0.057
pre-existing hypertension	1.12	0.99	1.27	0.066
mild pre-eclampsia	1.27	1.16	1.38	0.000
severe pre-eclampsia	1.93	1.77	2.11	0.000
<b>Placental abnormality</b>				
Placenta Previa	1.59	1.39	1.82	0.000
Abruption	2.93	2.65	3.24	0.000
Accreta	1.74	0.81	3.72	0.152
chorioamnionitis	3.53	3.25	3.84	0.000
placental insufficiency	1.84	1.25	2.72	0.002
<b>Premature rupture of membranes (&gt;12 hrs)</b>				
	1.60	1.47	1.74	0.000
<b>Precipitous labor</b>				
	1.23	1.08	1.41	0.002
<b>Hematologic abnormality</b>				

Anticoagulant use (before admission)	1.73	1.12	2.68	0.014
<b>Comorbidities</b>				
Valvular heart disease	1.78	1.28	2.48	0.001
Pulmonary hypertension	2.40	1.01	5.70	0.047
gestational diabetes	1.22	1.16	1.29	0.000
Diabetes, pre-pregnancy	2.14	1.93	2.37	0.000
Drug abuse	1.35	1.19	1.52	0.000
Alcohol abuse	1.50	1.05	2.12	0.025
Chronic kidney disease	1.43	1.11	1.83	0.005
<b>C statistic</b>				
training set	0.74 (95% CI: 0.731 - 0.740)			
validation set	0.74 (95% CI: 0.735 - 0.743)			
<b>Hosmer-Lemeshow statistic</b>				
training set	7.24 (p = 0.51)			
validation set	11.7 (p=0.31)			

**Appendix Table 5. Maternal Outcomes**

	All patients		2011		2012	
	Number	%, 95% CI	Number	%, 95% CI	Number	%, 95% CI
Severe maternal morbidity	13,475	1.53 (1.50, 1.55)	6,386	1.45 (1.41, 1.48)	7,089	1.60 (1.57, 1.64)
Acute myocardial infarction	14	0.0016 (0.0009, 0.0027)	7	0.0016 (0.0006, 0.0033)	7	0.0016 (0.0006, 0.0033)
Acute renal failure	304	0.034 (0.031, 0.039)	155	0.035 (0.030, 0.041)	149	0.034 (0.029, 0.040)
Adult respiratory distress syndrome	435	0.049 (0.045, 0.054)	219	0.050 (0.043, 0.057)	216	0.049 (0.043, 0.056)
Amniotic fluid embolism	25	0.0028 (0.0018, 0.0042)	12	0.0027 (0.0014, 0.0048)	13	0.0029 (0.0016, 0.0050)
Aneurysm	1	0.0001 (0, 0.0006)	1	0.0002 (0, 0.0013)	0	0 (0, 0.0008)
Cardiac arrest/ventricular fibrillation	39	0.0044 (0.0031, 0.0060)	24	0.0054 (0.0035, 0.0081)	15	0.0034 (0.0019, 0.0056)
Disseminated intravascular coagulation	1,998	0.23 (0.22, 0.24)	912	0.21 (0.19, 0.22)	1,086	0.25 (0.23, 0.26)
Eclampsia	78	0.0088 (0.0070, 0.0110)	35	0.0079 (0.0055, 0.0110)	43	0.0097 (0.0070, 0.0131)
Heart failure during procedure or surgery	1180	0.13 (0.13, 0.14)	611	0.14 (0.13, 0.15)	569	0.13 (0.12, 0.14)
Internal injuries of thorax, abdomen, and pelvis	29	0.0033 (0.0022, 0.0047)	14	0.0032 (0.0017, 0.0053)	15	0.0034 (0.0019, 0.0056)
Intracranial injuries	0	0 (0, 0.0004)	0	0 (0, 0.0008)	0	0 (0, 0.0008)
Puerperal cerebrovascular disorders	74	0.0084 (0.0066, 0.0105)	37	0.0084 (0.0059, 0.0116)	37	0.0084 (0.0059, 0.0115)
Pulmonary edema	103	0.012 (0.010, 0.014)	51	0.012 (0.009, 0.015)	52	0.012 (0.009, 0.015)
Severe anesthesia complications	77	0.0087 (0.0069, 0.0109)	44	0.0100 (0.0073, 0.0134)	33	0.0075 (0.0051, 0.0105)
Sepsis	111	0.013 (0.010, 0.015)	46	0.010 (0.008, 0.014)	65	0.015 (0.011, 0.019)
Shock	267	0.030 (0.027, 0.034)	133	0.030 (0.025, 0.036)	134	0.030 (0.025, 0.036)
Sickle cell anemia with crisis	2	0.0002 (0, 0.0008)	1	0.0002 (0, 0.0013)	1	0.0002 (0, 0.0013)
Thrombotic embolism	44	0.0050 (0.0036, 0.0067)	27	0.0061 (0.0040, 0.0089)	17	0.0038 (0.0022, 0.0062)
Blood transfusion	8,524	0.97 (0.94, 0.99)	4,161	0.94 (0.92, 0.97)	4,363	0.99 (0.96, 1.02)
Cardio monitoring	376	0.043 (0.038, 0.047)	11	0.0025 (0.0012, 0.0045)	365	0.083 (0.074, 0.091)
Conversion of cardiac rhythm	67	0.0076 (0.0059, 0.0096)	41	0.0093 (0.0067, 0.0126)	26	0.0059 (0.0038, 0.0086)
Hysterectomy	808	0.091 (0.085, 0.098)	408	0.093 (0.084, 0.102)	400	0.090 (0.082, 0.100)
Operations on heart and pericardium	569	0.064 (0.059, 0.070)	263	0.060 (0.053, 0.067)	306	0.069 (0.062, 0.077)

Temporary tracheostomy	4	0.0005 (0.0001, 0.0012)	2	0.0005 (0.0001, 0.0016)	2	0.0005 (0.0001, 0.0016)
Ventilation	339	0.038 (0.034, 0.043)	183	0.042 (0.036, 0.048)	156	0.035 (0.030, 0.041)
Ruptured uterus	107	0.012 (0.010, 0.015)	46	0.010 (0.008, 0.014)	61	0.014 (0.011, 0.018)
ICU admission	779	0.088 (0.082, 0.095)	383	0.087 (0.078, 0.096)	396	0.090 (0.081, 0.099)
Unplanned return to OR	786	0.089 (0.083, 0.095)	384	0.087 (0.079, 0.096)	402	0.091 (0.082, 0.100)
Death	20	0.0023 (0.0014, 0.0035)	11	0.0025 (0.0012, 0.0045)	9	0.0020 (0.0009, 0.0039)

**Appendix Table 6. Severe Newborn Outcomes**

	All patients		2011		2012	
	Number	%, 95% CI	Number	%, 95% CI	Number	%, 95% CI
Severe newborn morbidity	32,430	3.67 (3.63, 3.71)	16,160	3.67 (3.61, 3.72)	16,270	3.68 (3.62, 3.73)
Severe birth trauma	1,568	0.18 (0.17, 0.19)	772	0.18 (0.16, 0.19)	796	0.18 (0.17, 0.19)
Severe hypoxia asphyxia	485	0.055 (0.050, 0.060)	230	0.052 (0.046, 0.059)	255	0.058 (0.051, 0.065)
Severe shock and resuscitation	8,080	0.91 (0.90, 0.94)	4,129	0.94 (0.91, 0.97)	3,951	0.89 (0.87, 0.92)
Severe respiratory complications	10,408	1.18 (1.16, 1.20)	5,272	1.20 (1.16, 1.23)	5,136	1.16 (1.13, 1.19)
Severe infection	1,955	0.22 (0.21, 0.23)	1,045	0.24 (0.22, 0.25)	910	0.21 (0.19, 0.22)
Severe sepsis	16,769	1.90 (1.87, 1.93)	8,436	1.91 (1.87, 1.95)	8,333	1.88 (1.84, 1.92)
Severe neurological complication	2,621	0.30 (0.29, 0.31)	1,341	0.30 (0.29, 0.32)	1,280	0.29 (0.27, 0.31)
Assisted ventilation > 6 hours	2,957	0.33 (0.32, 0.35)	1,417	0.32 (0.30, 0.34)	1,540	0.35 (0.33, 0.37)
Apgar score at 5 minutes < 4	1,280	0.14 (0.14, 0.15)	610	0.14 (0.13, 0.15)	670	0.15 (0.14, 0.16)
Death	653	0.074 (0.068, 0.080)	331	0.075 (0.067, 0.084)	322	0.073 (0.065, 0.081)



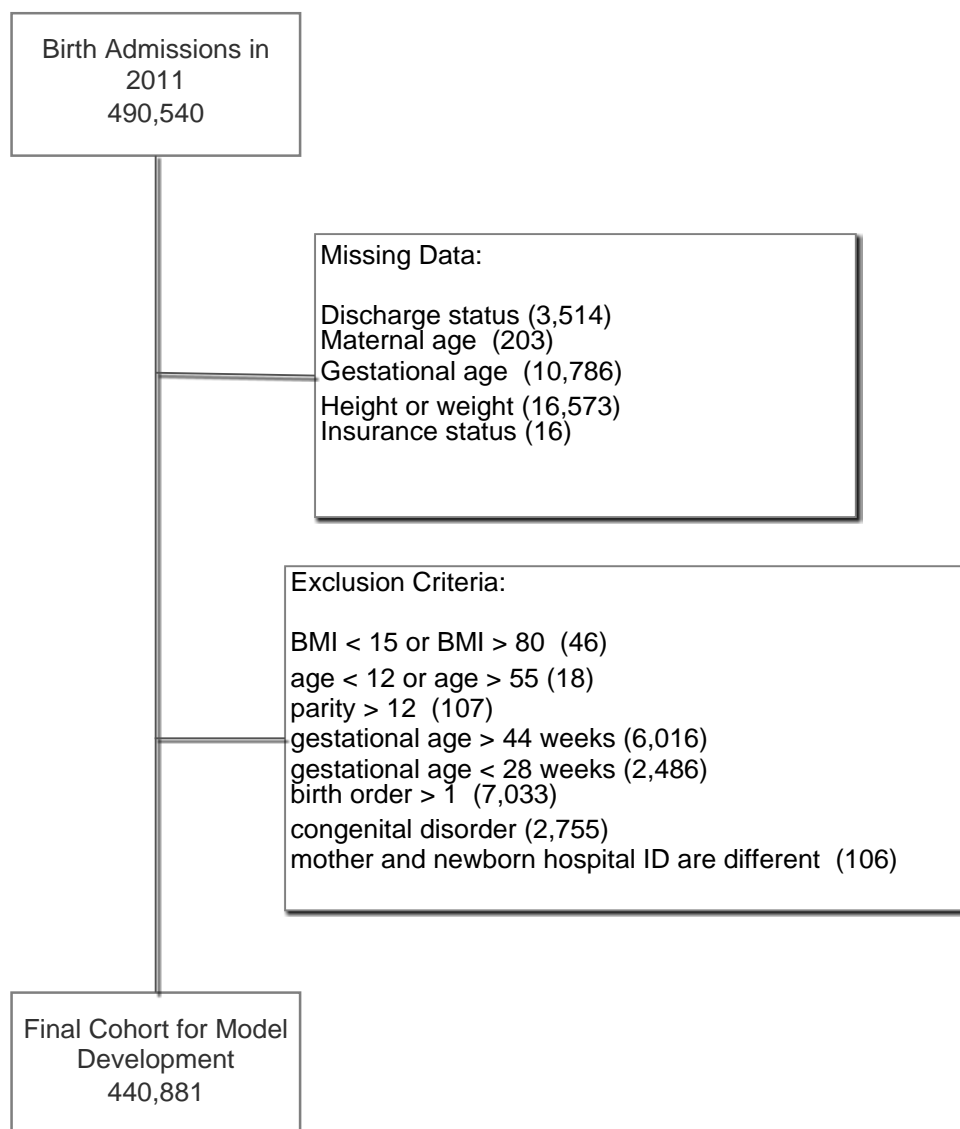


**Appendix Table 7.** Agreement on classification of hospital performance as a function of SMM, SNM, and composite morbidity

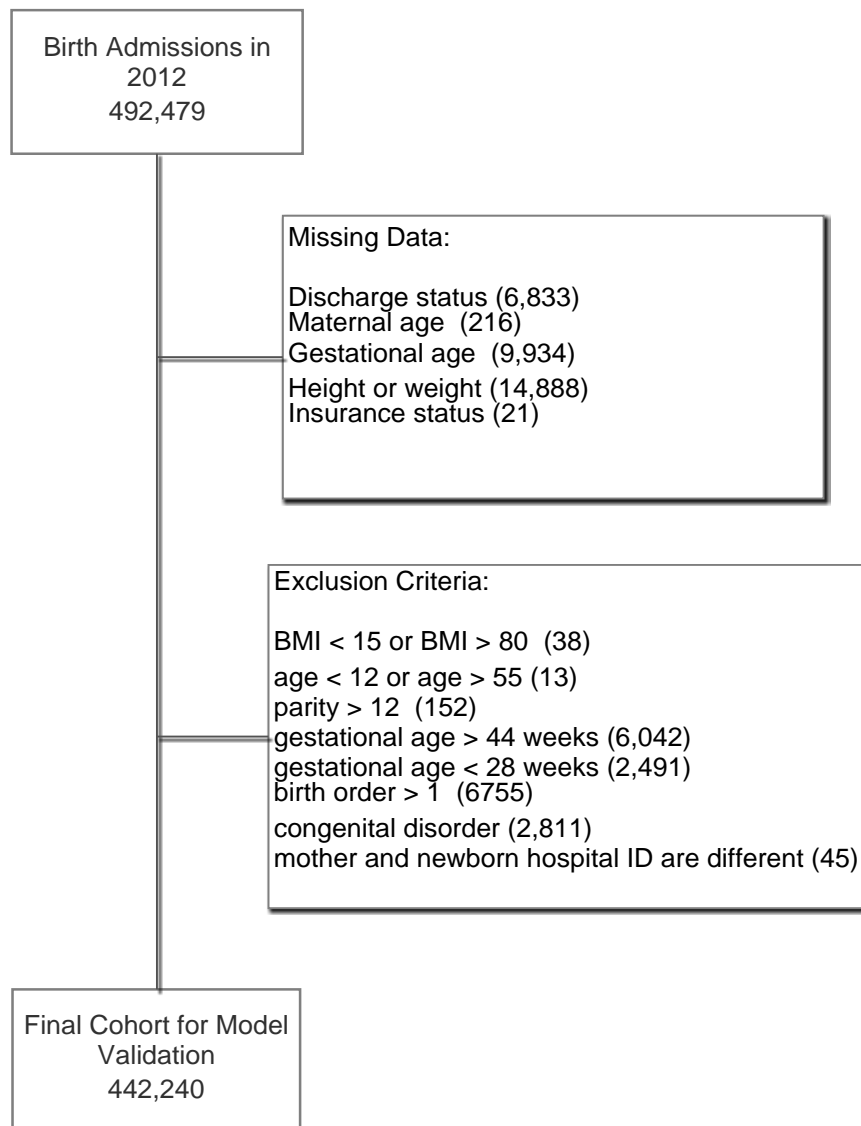
<b>Table 1a</b>		<b>Hospital Maternal Outcomes</b>		
		low-performance	average-performance	high-performance
<b>Hospital Newborn Outcomes</b>	low-performance	16	43	9
	average-performance	17	73	13
	high-performance	14	41	17

<b>Table 1b</b>		<b>Hospital Composite Outcomes</b>		
		low-performance	average-performance	high-performance
<b>Hospital Newborn Outcomes</b>	low-performance	44	24	0
	average-performance	15	78	10
	high-performance	4	19	49

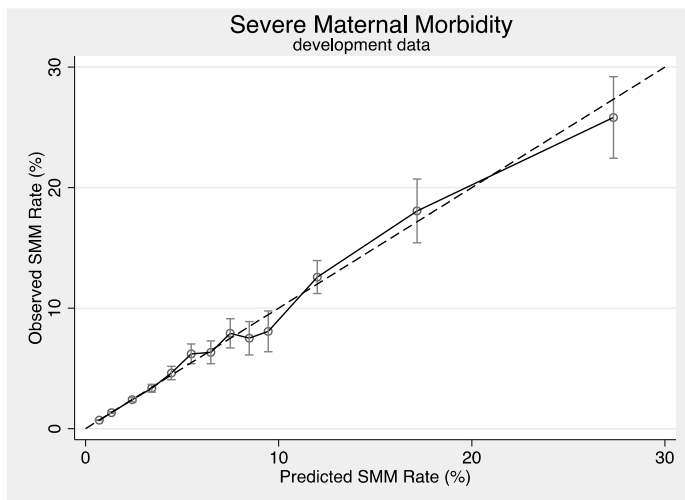
<b>Table 1c</b>		<b>Hospital Composite Outcomes</b>		
		low-performance	average-performance	high-performance
<b>Hospital Maternal Outcomes</b>	low-performance	32	12	3
	average-performance	30	96	31
	high-performance	1	13	25



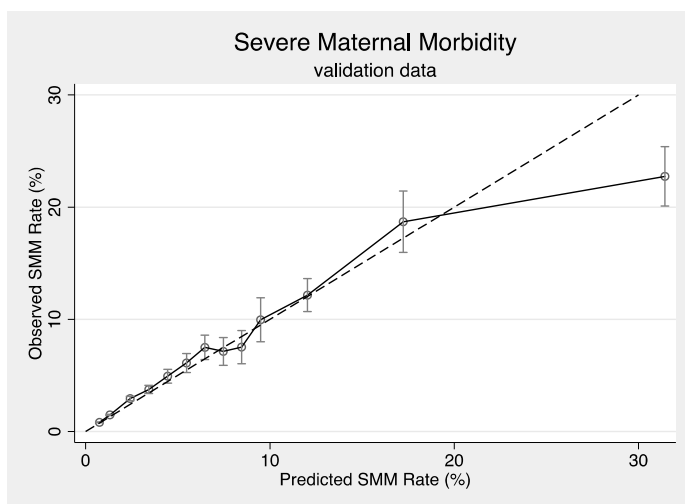
**Appendix Figure 1a.** Flow diagram for 2011 delivery cohort used to derive risk-adjustment models for severe maternal morbidity and severe newborn morbidity. Each case in the final cohort includes a mother and her newborn.



**Appendix Figure 1b.** Flow diagram for 2012 delivery cohort used to validate risk-adjustment models for severe maternal morbidity and severe newborn morbidity. Each case in the final cohort includes a mother and her newborn.

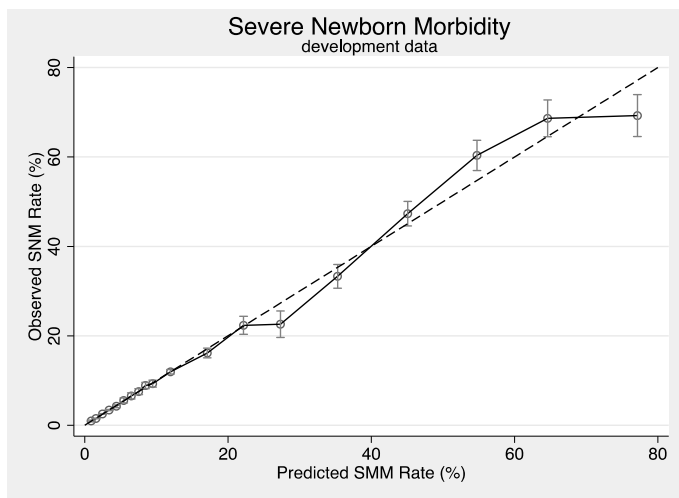


a

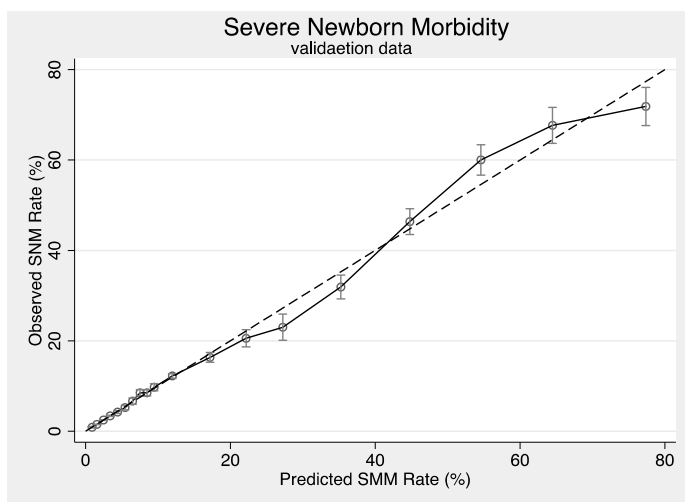


b

**Appendix Figure 2.** Calibration graphs for the Severe Maternal Morbidity risk-adjustment model in the development data set (Appendix figure 2a) and in the validation data set (Appendix figure 2b). Model fit in the validation data set was assessed using the model coefficients estimated in the 2011 data (development data set). The dashed line represents perfect calibration. Error bars are 95% confidence intervals.



a



b

**Appendix Figure 3.** Calibration graph for the Severe Newborn Morbidity risk-adjustment model in the development data set (appendix figure 3a) and in the validation data set (appendix figure 3b). Model fit in the validation data set was assessed using the model coefficients estimated in the 2011 data (development data set). The dashed line represents perfect calibration. Error bars are 95% confidence intervals.