

Appendix 1. Maternal Characteristics of Linked and Unlinked Stillbirth and Live Birth Delivery Hospitalizations				
	Stillbirth (n = 32,857)		Live Birth	
	Linked (N = 25,997)	Unlinked (N = 6,860)	Linked (N = 6,424,390)	Unlinked (N = 166,673)
	n (%)	n (%)	n (%)	n (%)
Race/Ethnicity				
Non-Hispanic White	6,752 (25.97)	1,991 (29.02)	1,869,313 (29.05)	83,513 (50.01)
Non-Hispanic Black	3,059 (11.77)	834 (12.16)	368,088 (5.72)	13,622 (8.16)
Hispanic	13,112 (50.44)	3,164 (46.12)	3,293,139 (51.18)	45,196 (27.07)
Asian/Pacific Islander	2,727 (10.49)	723 (10.54)	798,834 (12.42)	16,353 (9.79)
Other	122 (0.47)	37 (0.54)	31,060 (0.48)	1,751 (1.05)
Missing	225 (0.87)	111 (1.62)	73,411 (1.14)	6,552 (3.92)
Age at Delivery (years)				
< 20	2,828 (10.88)	891 (12.99)	610,861 (9.49)	11,625 (6.96)
20-34	17,561 (67.55)	4,449 (64.85)	4,719,842 (73.36)	129,349 (77.49)
≥ 35	5,608 (21.47)	1,520 (22.16)	1,103,142 (17.15)	26,013 (15.58)
Payment Type at Delivery				
Medi-Cal	11,915 (45.83)	2,605 (37.97)	2,928,036 (45.51)	26,426 (15.83)
Private	11,376 (43.76)	3,053 (44.50)	3,238,687 (50.34)	33,377 (19.99)
Other/Missing	2,706 (10.41)	1,202 (17.52)	267,122 (4.15)	107,184 (64.19)
Education Level				
High School or Less	14,932 (57.44)	3,665 (53.43)	3,459,881 (53.78)	73,301 (43.90)
Some College	5,735 (22.06)	1,574 (22.94)	1,323,335 (20.57)	44,736 (26.79)
Completed College	3,920 (15.08)	1,172 (17.08)	1,489,893 (23.16)	40,756 (24.41)
Missing	1,410 (5.42)	449 (6.55)	160,736 (2.50)	8,194 (4.91)
Gestational Age (weeks)				
20-23	4,682 (18.01)	3,161 (46.08)	7,741 (0.21)	656 (0.39)
24-37	12,351 (47.51)	1,740 (25.36)	507,426 (7.89)	15,711 (9.41)
≥ 38	8,964 (34.48)	1,959 (28.56)	5,918,678 (91.99)	150,620 (90.20)

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Appendix 2. Severe Maternal Morbidity Indicators and Corresponding ICD-9-CM Codes During Delivery Hospitalizations

Severe Maternal Morbidity Indicator	Diagnosis (DX) or Procedure (PR)	ICD-9-CM
Acute myocardial infarction/Aneurysm	DX	410.xx, 441.xx
Acute renal failure	DX	584.5, 584.6, 584.7, 584.8, 584.9
Adult respiratory distress syndrome	DX	518.5, 518.81, 518.82, 518.84, 799.1
Amniotic fluid embolism	DX	673.1x
Cardiac arrest/Ventricular Fibrillation	DX	427.41, 427.42, 427.5
Conversion of cardiac rhythm	PR	99.6x
Disseminated intravascular coagulation	DX	997.1, 669.4x
Eclampsia	DX	642.6x
Heart failure/arrest during surgery or procedure	DX	997.1, 669.4x
Puerperal cerebrovascular disorders	DX	430, 431, 432.x, 433.xx, 434.xx, 436, 437.x, 325.xx, 671.5x, 674.0x, 999.2, 999.02
Pulmonary edema/acute heart failure	DX	428.1, 518.4
Severe anesthesia complications	DX	668.0x, 668.1x, 668.2x
Sepsis	DX	038.xx, 995.91, 995.92, 670.2x
Shock	DX	669.1x, 785.5x, 995.0, 995.4, 998.0x
Sickle cell anemia with crises	DX	282.62, 282.64, 282.69
Air and thrombotic embolism	DX	415.1x, 673.0x, 673.2x, 673.3x, 673.8x
Blood transfusion	PR	99.0x
Hysterectomy	PR	68.3x-68.9x
Ventilation/temporary tracheostomy	PR	93.90, 96.01, 96.02, 96.03, 96.04, 96.05, 96.7, 31.1

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Appendix 3. Maternal Preexisting and Gestational Medical Conditions and Corresponding ICD-9-CM Codes

Condition	ICD-9-CM Diagnosis Codes
Pre-existing Diabetes	250.x,
Pre-existing Hypertension	401.x, 402.x, 403.x, 404.x, 405.x, 642.0, 642.1, 642.2, 642.7
Pre-eclampsia	642.4, 642.5, 642.7
Gestational Diabetes	648.8, 648.0
Gestational Hypertension	642.3

NOTE: These conditions are defined using ICD-9-CM codes augmented with reports of specific conditions from birth certificates

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Appendix 4. Cause of Fetal Death and Corresponding ICD-10 Code	
Cause of Fetal Death	ICD-10 Codes
Not Otherwise Specified	P95
Umbilical cord anomalies	P02.4-P02.6, P50.0, P50.1, Q27.0
Obstetric complications	P01.0, P01.1, P01.2, P01.4, P01.7, P03.0, P03.1, P03.8, P03.9, P07.2, P07.3, P24.0, P55.0
Placental conditions	P02.0-P02.3, P02.8, P02.9
Fetal major structural malformations and/or genetic abnormalities	D82.1, P29.8, Q00.0-Q01.2, Q01.8, Q01.9, Q02, Q03.1, Q03.9, Q04.2, Q04.3, Q04.8, Q04.9, Q05.9, Q06.8, Q06.9, Q07.0, Q07.9, Q18.9, Q20.1, Q20.3, Q21.0, Q21.1, Q21.2, Q21.3, Q22.5, Q22.6, Q23.1, Q23.4, Q24.3, Q24.8-Q25.3, Q28.3, Q34.8, Q41.0, Q43.2, Q43.9, Q55.9, Q60.1, Q60.2, Q60.5, Q60.6, Q61.1, Q61.3, Q61.4, Q62.0, Q63.9, Q64.3, Q64.8, Q66.8, Q67.8, Q68.5, Q71.3, Q73.0, Q74.3, Q74.9, Q75.9, Q76.4, Q77.1, Q77.2, Q78.0, Q78.9, Q79.0, Q79.2, Q79.3, Q79.8, Q79.9, Q87.0, Q87.2, Q87.8, Q89.0, Q89.7, Q89.8, Q89.9, Q90.9, Q91.1, Q91.3, Q91.7, Q92.7, Q92.8, Q92.9, Q93.8, Q96.0, Q96.9, Q99.2, Q99.8, Q99.9
Hypertensive disorders	P00.0
Infections	A50.2, B34.3, P00.2, P02.7, P23.9, P35.1, P35.2, P35.9, P36.0, P36.5, P36.9, P37.1, P39.8, P39.9, R75
Maternal medical conditions	P00.1, P00.3, P00.9, P00.4, P00.8, P01.8, P04.8, P70.0, P70.1, P50.4
Other	D18.1, D33.0, D48.0, D56.0, D58.2, D68.2, D68.9, E83.3, E74.3, G71.1, N04.9, P00.5, P00.6, P00.7, P01.3, P01.6, P04.1, P04.4, P05.0, P05.1, P05.9, P08.0, P08.1, P20.0, P20.1, P20.9, P28.0, P28.5, P28.8, P29.0, P29.1, P29.4, P29.9, P50.9, P52.3, P52.4, P52.9, P55.1, P55.8, P55.9, P56.0, P70.2, P74.1, P76.9, P77, P83.2, Q33.6, P96.8, P96.9, W74

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Appendix 5. Sensitivity Analysis - Relative Risk of Severe Maternal Morbidity (SMM) and its Specific Indicators per 10,000 Delivery Hospitalization (reference = Live Birth), adjusting for mode of delivery: California 1999-2011 (n = 6,459,842)

SMM	Excluding Mode of Delivery	Including Mode of Delivery
	Adjusted [†] Relative Risk (95% CI)	Adjusted [‡] Relative Risk (95% CI)
All	4.94 (4.69, 5.20)	6.12 (5.81, 6.44)
Specific SMM Indicator		
Blood transfusion	5.38 (5.06, 5.72)	6.78 (6.37, 7.21)
Disseminated intravascular coagulation	8.78 (7.93, 9.72)	10.61 (9.58, 11.74)
Acute renal failure	13.22 (11.20, 15.62)	20.49 (17.34, 24.23)
Adult respiratory distress syndrome	8.68 (7.29, 10.33)	13.94 (11.71, 16.59)
Sepsis	14.15 (11.81, 16.95)	19.60 (16.35, 23.49)
Shock	14.65 (11.99, 17.90)	20.49 (16.76, 25.04)
Hysterectomy	3.29 (2.64-4.10)	4.85 (3.89-6.05)
Pulmonary edema/acute heart failure	4.16 (3.28, 5.27)	6.40 (5.05, 8.11)
Eclampsia	2.11 (1.60, 2.77)	2.88 (2.18, 3.79)
Conversion of cardiac rhythm	10.17 (6.91, 14.97)	15.57 (10.58, 22.93)
Puerperal cerebrovascular disorders	3.36 (2.31, 4.87)	4.38 (3.02, 6.35)
Cardiac arrest/Ventricular Fibrillation	10.44 (6.75, 16.14)	16.57 (10.71, 25.62)
Ventilation/temporary tracheostomy	6.78 (4.27, 10.77)	11.17 (7.03, 17.75)
All, excluding 'Blood Transfusion Only' cases	5.48 (5.11, 5.88)	7.45 (6.94, 7.99)

[†]Adjusted for maternal race/ethnicity, age at delivery, parity, payment type at delivery, education level, pre-existing diabetes, pre-existing hypertension, pre-eclampsia, gestational diabetes, gestational hypertension.

[‡]Adjusted for maternal race/ethnicity, age at delivery, parity, payment type at delivery, education level, pre-existing diabetes, pre-existing hypertension, pre-eclampsia, gestational diabetes, gestational hypertension, mode of delivery.

Appendix 6. Sensitivity Analysis - One delivery per Woman: Prevalence and Relative Risk of Severe Maternal Morbidity (SMM) and its Specific Indicators per 10,000 Delivery Hospitalization, Among Women with Stillbirth and Live Birth Deliveries: California 1999-2011 (n = 4,758,060)

SMM	Stillbirth (n = 17,645)	Live Birth (n = 4,740,415)	Relative Risk (95% CI)	Adjusted [†] Relative Risk (95% CI)	Adjusted [‡] Relative Risk (95% CI)
	SMM Cases (Prevalence*)	SMM Cases (Prevalence*)			
All	1,030 (584)	49,426 (104)	6.73 (6.21, 7.30)	5.54 (5.10, 6.02)	5.37 (4.94, 5.83)
Specific SMM Indicator					
Blood transfusion	730 (414)	31,638 (67)	6.20 (5.77, 6.66)	5.40 (5.02, 5.82)	5.21 (4.84, 5.62)
Disseminated intravascular coagulation	284 (161)	7,742 (16)	9.86 (8.76, 11.08)	9.08 (8.06, 10.24)	8.59 (7.61, 9.68)
Acute renal failure	125 (71)	1,499 (3)	22.40 (18.68, 26.87)	14.75 (12.19, 17.83)	13.40 (11.08, 16.21)
Adult respiratory distress syndrome	104 (59)	2,266 (5)	12.33 (10.14, 15.00)	8.88 (7.25, 10.86)	8.51 (6.95, 10.42)
Sepsis	96 (54)	1,509 (3)	17.09 (13.91, 21.00)	13.74 (11.11, 17.00)	13.64 (11.02, 16.88)
Shock	74 (42)	1,178 (2)	16.88 (13.35, 21.33)	14.23 (11.19, 18.10)	13.83 (10.87, 17.60)
Hysterectomy	59 (33)	4,097 (9)	3.87 (2.99, 5.00)	3.23 (2.49, 4.18)	3.20 (2.47, 4.15)
Pulmonary edema/acute heart failure	57 (32)	2,230 (5)	6.87 (5.28, 8.93)	4.63 (3.54, 6.05)	4.43 (3.39, 5.79)
Eclampsia	38 (22)	4086 (9)	2.50 (1.82, 3.44)	2.15 (1.56, 2.96)	2.14 (1.55, 2.95)
Conversion of cardiac rhythm	23 (13)	428 (1)	14.44 (9.49, 21.96)	10.67 (6.91, 16.48)	10.44 (6.76, 16.13)
Puerperal cerebrovascular disorders	20 (11)	1300 (3)	4.13 (2.66, 6.43)	3.33 (2.13, 5.21)	3.14 (2.01, 4.91)
Cardiac arrest/Ventricular Fibrillation	20 (11)	309 (1)	17.39 (11.07, 27.32)	12.23 (7.62, 19.63)	11.98 (7.46, 19.25)
Ventilation/temporary tracheostomy	16 (9)	355 (1)	12.11 (7.34, 19.98)	7.51 (4.48, 12.60)	7.34 (4.37, 12.34)
All, excluding 'Blood Transfusion Only' cases	589 (334)	23,504 (50)	6.77 (6.25-7.34)	5.46 (5.03, 5.93)	5.20 (4.78, 5.65)

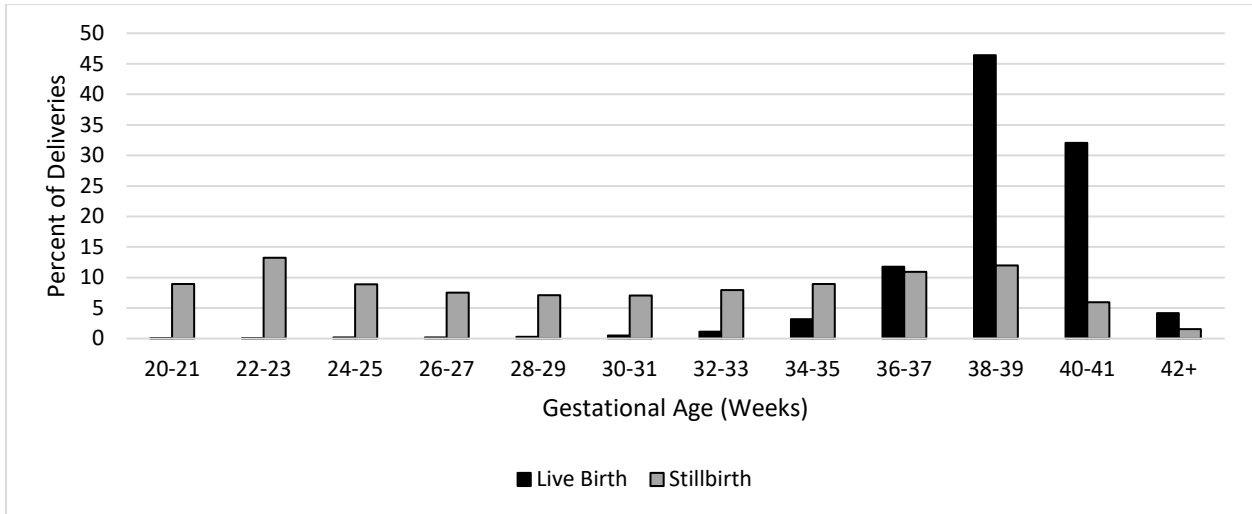
NOTE: Six of the nineteen SMM indicators included in the index – acute myocardial infarction/aneurysm, amniotic fluid embolism, heart failure/arrest during surgery or procedure, severe anesthesia complications, sickle cell anemia with crises, and air and thrombotic embolism - had fewer than 15 cases among live births and/or stillbirths; information for these specific indicators are not presented

*Per 10,000 Delivery Hospitalizations

[†] Adjusted for maternal race/ethnicity, age at delivery, parity, payment type at delivery, education level, pre-existing diabetes, pre-existing hypertension

[‡] Adjusted for maternal race/ethnicity, age at delivery, parity, payment type at delivery, education level, pre-existing diabetes, pre-existing hypertension, pre-eclampsia, gestational diabetes, gestational hypertension

Appendix 7. Distribution of deliveries by gestational age: California, 1999-2011.



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Appendix 8. Prevalence and Relative Risk of Severe Maternal Morbidity per 10,000 Delivery Hospitalization, Among Women with Stillbirth and Live Birth Deliveries, by Gestational Age: California 1999-2011 (n = 6,459,842)

Gestational Age	Number of Births	SMM Cases (Prevalence*)	Relative Risk (95% CI)	Adjusted[†] Relative Risk (95% CI)	Adjusted[‡] Relative Risk (95% CI)
< 30 weeks					
Live Births	49,622	2870 (578)	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Stillbirths	11,670	599 (513)	0.89 (0.81, 0.97)	0.88 (0.81, 0.97)	0.97 (0.88, 1.06)
≥ 30 weeks					
Live Births	6,384,223	60,949 (95)	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Stillbirths	14,327	904 (631)	6.61 (6.20, 7.04)	5.71 (5.35, 6.10)	5.36 (5.02, 5.73)

*per 10,000 deliveries

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