

Appendix 1. Diagnostic and Procedure Codes

Delivery Hospitalizations

Code Description	Code Type	Codes
<i>Level I</i>		
Outcome of Delivery (live or still born; singleton or multiple births)		
	ICD-9-CM	V27.x
	ICD-10-CM	Z37.x
<i>Level II</i>		
Normal Delivery	ICD-9-CM	650
	ICD-10-CM	O80
<i>Level III</i>		
Complicated Cesarean Section	DRG	370, 765
Uncomplicated Cesarean Section	DRG	371, 766
Complicated Vaginal Delivery	DRG	372, 774
Uncomplicated Vaginal Delivery	DRG	373, 775
Uncomplicated vaginal delivery with sterilization and/or dilatation & curettage	DRG	374, 767
Vaginal delivery with operation room procedure except sterilization and/or dilatation & curettage	DRG	375, 768
<i>Level IV: Selected Delivery-Related Procedures</i>		
Forceps	ICD-9-PCS	720, 721, 7221, 7229, 7231, 7239, 724, 726
	ICD-10-PCS	10D07Z3, 0W8NXZZ, 10D07Z4, 10D07Z5, 10S07ZZ
Breech Extraction	ICD-9-PCS	7251, 7252, 7253, 7254
	ICD-10-PCS	10D07Z3, 10D07Z4, 10D07Z5, 10D07Z6
Vacuum Extraction	ICD-9-PCS	7271, 7279

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Code Description	Code Type	Codes
	ICD-10-PCS	0W8NXZZ, 10D07Z6
Other specified and unspecified delivery	ICD-9-PCS	728, 729
	ICD-10-PCS	10D07Z8
Internal and combined version and extraction	ICD-9-PCS	7322
	ICD-10-PCS	10D07Z7
Other manually assisted deliveries	ICD-9-PCS	7359
	ICD-10-PCS	10E0XZZ
Episiotomy	ICD-9-PCS	736
	ICD-10-PCS	0W8NXZZ
Cesarean Section	ICD-9-PCS	740, 741, 742, 744, 7499
	ICD-10-PCS	10D00Z0, 10D00Z1, 10D00Z2
<i>Exclusions</i>		
Hydatidiform Mole	ICD-9-CM	630
	ICD-10-CM	O01*, O08*
Abnormal Products of Conception	ICD-9-CM	631
	ICD-10-CM	O02*, O07*, O08*
Ectopic Pregnancy	ICD-9-CM	633
	ICD-10-CM	O00*, O03*, O08*
Abortion	ICD-9-CM	632, 634, 635, 636, 637, 638, 639, 6901, 6951, 7491, 750
	ICD-10-CM	Z332, O04*, O07*, 10A07ZZ, 10A08ZZ, 10A00ZZ, 10A03ZZ, 10A04ZZ, 10A07ZX
Stillbirths	ICD-9-CM	V271, V274, V277
	ICD-10-CM	Z371, Z374, Z377

Data from Kuklina EV, Whiteman MK, Hillis SD, Jamieson DJ, Meikle SF, Posner SF, Marchbanks PA. An enhanced method for identifying obstetric deliveries: implications for estimating maternal morbidity. *Matern Child Health J* 2008;12:469–77. doi: 10.1007/s10995-007-0256-6

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Appendix 2. Centers for Disease Control and Prevention: 21 Severe Maternal Morbidity Indicator Codes

Code Description	Code Type	Codes
<i>SMM Indicator</i>		
1. Acute myocardial infarction	ICD-9-CM	410.xx
	ICD-10-CM	I21.xx, I22.x
2. Aneurysm	ICD-9-CM	441.xx
	ICD-10-CM	I71.xx, I79.0*
3. Acute renal failure	ICD-9-CM	584.x, 669.3x
	ICD-10-CM	N17.x, O90.4
4. Adult respiratory distress syndrome	ICD-9-CM	518.5, 518.81, 518.82, 518.84, 799.1
	ICD-10-CM	J80, J95.1, J95.2, J95.3, J95.82x, J96.0x, J96.2x, R09.2
5. Amniotic fluid embolism	ICD-9-CM	673.1x
	ICD-10-CM	O88.1x
6. Cardiac arrest/ventricular fibrillation	ICD-9-CM	427.41, 427.42, 427.5
	ICD-10-CM	I46.x, I49.0x
7. Conversion of cardiac rhythm	ICD-9-PCS	99.6x
	ICD-10-PCS	5A2204Z, 5A12012
8. Disseminated intravascular coagulation	ICD-9-CM	286.6, 286.9, 666.3x
	ICD-10-CM	D65, D68.8, D68.9, O72.3
9. Eclampsia	ICD-9-CM	642.6x
	ICD-10-CM	O15.x
10. Heart failure/arrest during surgery or procedure	ICD-9-CM	997.1
	ICD-10-CM	I97.12x, I97.13x, I97.710, I97.711
11. Puerperal cerebrovascular disorders	ICD-9-CM	430.xx, 431.xx, 432.xx, 433.xx, 434.xx, 436.xx, 437.xx, 671.5x, 674.0x, 997.02
	ICD-10-CM	I60.xx-I68.xx, I22.51, O22.52, O22.53, I97.81x, I97.82x, O87.3

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Code Description	Code Type	Codes
12. Pulmonary edema/ Acute heart failure	ICD-9-CM	518.4, 428.0, 428.1, 428.21, 428.23, 428.31, 428.33, 428.41, 428.43
	ICD-10-CM	J81.0, I50.1, I50.20, I50.21, I50.23, I50.30, I50.31, I50.33, I50.40, I40.41, I50.43, I50.9
13. Severe anesthesia complications	ICD-9-CM	668.0x, 668.1x, 668.2x
	ICD-10-CM	O74.0, O74.1, O74.2, O74.3, O89.0x, O89.1, O89.2
14. Sepsis	ICD-9-CM	038xx, 995.91, 995.92, 670.2x (post October 1, 2009)
	ICD-10-CM	O85, O86.04, T80.211A, T81.4AAA, R65.20, A40.x, A41.x, A32.7
15. Shock	ICD-9-CM	669.1x, 785.5x, 995.0, 995.4, 998.0x
	ICD-10-CM	O75.1, R57.x, R65.21, T78.2XXA, T88.2XXA, T88.6ZZA, T81.10XA, T81.11XA, T81.19XA
16. Sickle cell anemia with crisis	ICD-9-CM	282.42, 282.62, 282.64, 282.69
	ICD-10-CM	D57.0x, D57.21x, D57.41x, D57.81x
17. Air and thrombotic embolism	ICD-9-CM	415.1x 673.0x, 673.2x, 673.3x, 673.8x
	ICD-10-CM	I26.x, O88.0x, O88.2x, O88.3x, O88.8x
18. Blood products transfusion	ICD-9-PCS	99.0x
	ICD-10-PCS	30233.x1 30240.x1 30243.x1 (120 codes total identifies this indicator; 3 example code groups provided)
19. Hysterectomy	ICD-9-PCS	68.3x-68.9x

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Code Description	Code Type	Codes
	ICD-10-PCS	0UT90ZZ, 0UT94ZZ, 0UT97ZZ, 0UT98ZZ, 0UT9FZZ
20. Temporary tracheostomy	ICD-9-PCS	31.1
	ICD-10-PCS	0B110Z, 0B110F, 0B113, 0B114
21. Ventilation	ICD-9-PCS	93.90, 96.01, 96.02, 96.03, 96.05
	ICD-10-PCS	5A1935Z, 5A1945Z, 5A1955Z

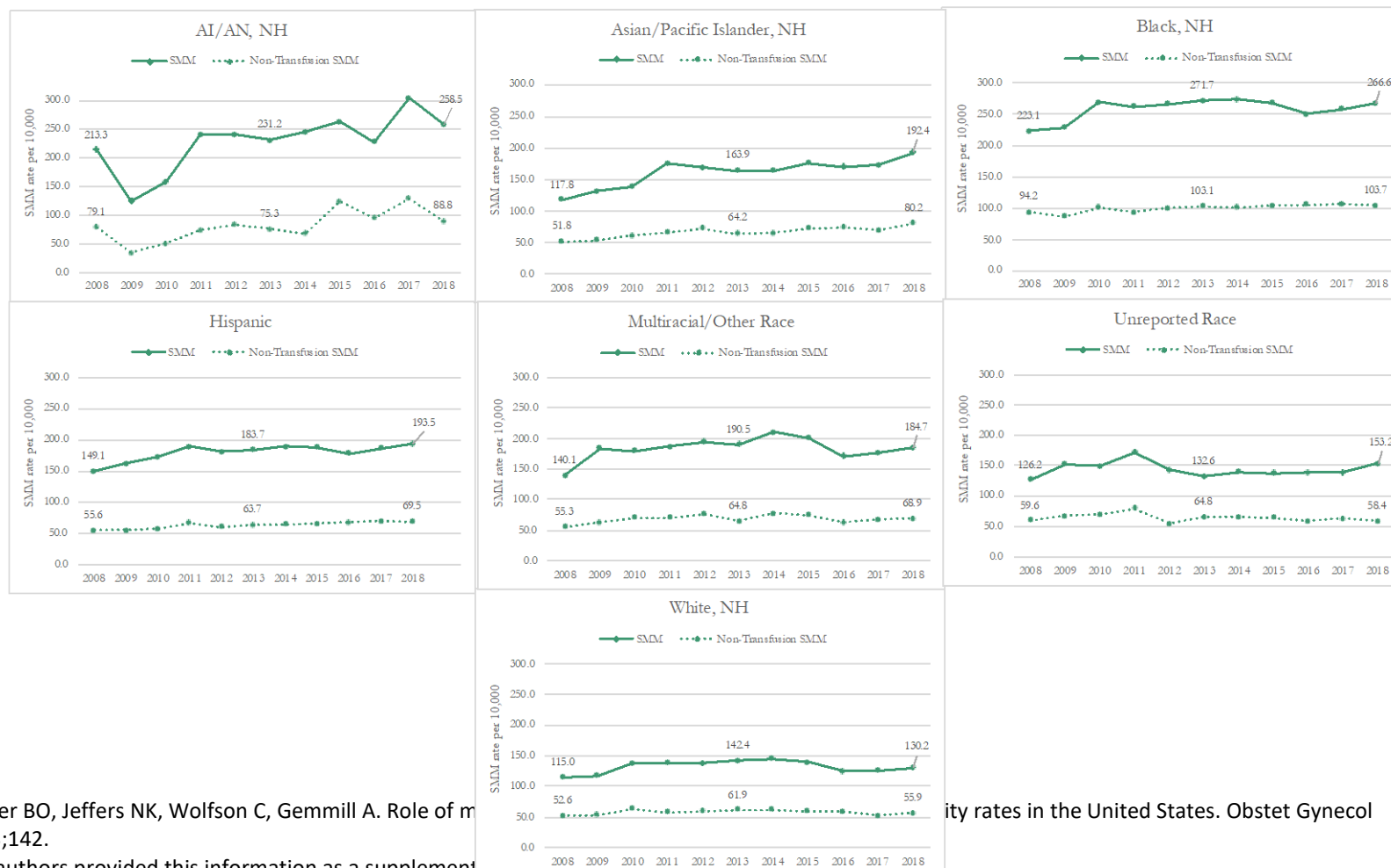
Data from Centers for Disease Control and Prevention. How does the CDC Identify Severe Maternal Morbidity? Accessed April 18, 2023. <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/smm/severe-morbidity-ICD.htm>

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Appendix 3. Yearly trends in severe maternal morbidity (SMM) and nontransfusion SMM rates per 10,000 delivery hospitalizations by race and ethnicity (2008–2018), United States. All trends significant ($P<.001$) based on Cochran-Armitage test for trends except nontransfusion SMM among White non-Hispanic people and those with unreported race. AI/AN: American Indian/Alaskan Native; NH: Non-Hispanic. Note: “Multiracial/Other Race” includes non-missing race on the discharge record, marked “multiracial” or “other race” and non-Hispanic ethnicity, and grouped in HCUP as a single category



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ity rates in the United States. Obstet Gynecol

Appendix 4. Rates (SE) per 10,000 of Severe Maternal Morbidity Indicators Among Delivery Hospitalizations by Time Period and Maternal Age, United States

SMM Indicator	Maternal Age (years)															
	Total		<20		20-24		25-29		30-34		35-39		40-44		45+	
	2008-2009	2017-2018	2008-2009	2017-2018	2008-2009	2017-2018	2008-2009	2017-2018	2008-2009	2017-2018	2008-2009	2017-2018	2008-2009	2017-2018	2008-2009	2017-2018
Blood transfusion	96.13 (3.41)	113.36 (2.36)	121.43 (5.08)	168.89 (6.65)	101.64 (3.70)	123.03 (3.34)	82.31 (3.10)	101.44 (2.45)	85.38 (3.71)	97.50 (2.40)	106.07 (4.93)	121.89 (3.45)	140.03 (7.82)	169.37 (6.94)	224.85 (36.30)	274.02 (32.68)
Disseminated intravascular coagulation	24.07 (1.00)	16.66 (0.47)	17.19 (1.30)	11.75 (1.33)	17.74 (0.97)	12.13 (0.69)	23.54 (1.26)	15.35 (0.72)	27.53 (1.39)	17.49 (0.73)	33.89 (1.86)	22.31 (1.09)	38.86 (3.61)	28.94 (2.68)	34.72 (11.60)	50.39 (14.28)
Hysterectomy	8.37 (0.32)	9.04 (0.30)	1.19 (0.26)	1.49 (0.45)	3.34 (0.33)	2.52 (0.30)	5.80 (0.41)	6.05 (0.40)	10.92 (0.71)	10.53 (0.55)	19.94 (1.09)	18.04 (0.96)	32.67 (2.92)	29.39 (2.64)	44.97 (12.47)	85.04 (18.01)
Eclampsia	7.80 (0.32)	7.35 (0.25)	20.10 (1.19)	22.97 (1.78)	9.00 (0.53)	9.54 (0.61)	5.60 (0.42)	5.74 (0.38)	5.34 (0.44)	5.14 (0.37)	5.45 (0.55)	6.09 (0.56)	5.47 (1.23)	9.65 (1.48)	14.07 (7.43)	6.30 (5.05)
Adult respiratory distress syndrome	6.53 (0.28)	8.46 (0.26)	6.89 (0.63)	7.30 (0.99)	5.24 (0.38)	7.51 (0.51)	5.40 (0.42)	6.70 (0.41)	6.28 (0.46)	7.97 (0.47)	9.92 (0.77)	12.55 (0.79)	15.64 (2.04)	16.82 (1.98)	13.75 (7.19)	28.35 (10.60)
Acute renal failure	4.96 (0.22)	11.88 (0.37)	3.54 (0.48)	9.59 (1.21)	4.20 (0.34)	9.78 (0.61)	4.12 (0.31)	9.72 (0.52)	5.29 (0.41)	11.53 (0.57)	7.70 (0.65)	17.53 (0.94)	9.69 (1.40)	21.98 (2.38)	28.97 (11.52)	66.14 (16.07)
Pulmonary edema/Acute heart failure	4.62 (0.24)	6.10 (0.23)	3.41 (0.48)	4.86 (0.81)	3.29 (0.32)	3.91 (0.38)	3.68 (0.34)	4.94 (0.35)	5.08 (0.39)	5.96 (0.39)	7.17 (0.67)	10.18 (0.74)	13.97 (1.94)	14.36 (1.82)	38.00 (13.09)	12.60 (7.15)
Sepsis	3.38 (0.16)	9.89 (0.39)	4.08 (0.49)	14.73 (1.40)	3.42 (0.29)	10.34 (0.64)	3.26 (0.28)	8.81 (0.54)	2.88 (0.28)	8.97 (0.60)	3.29 (0.41)	10.83 (0.75)	5.82 (1.23)	12.34 (1.89)	14.06 (7.36)	22.05 (9.45)
Shock	3.27 (0.16)	7.13 (0.24)	1.77 (0.35)	4.46 (0.78)	2.42 (0.26)	4.30 (0.39)	2.51 (0.24)	5.62 (0.37)	3.90 (0.35)	8.04 (0.46)	5.56 (0.57)	10.74 (0.72)	8.64 (1.45)	15.93 (1.92)	13.02 (6.76)	37.80 (11.80)
Puerperal cerebrovascular disorders	2.83 (0.14)	0.25 (0.04)	2.24 (0.37)	—	2.12 (0.24)	—	2.35 (0.24)	0.28 (0.08)	3.66 (0.31)	—	3.93 (0.47)	—	4.34 (0.97)	—	6.36 (4.55)	—
Air thrombotic embolism	1.91 (0.13)	3.29 (0.16)	1.38 (0.30)	2.57 (0.59)	1.94 (0.25)	2.90 (0.32)	1.72 (0.21)	2.93 (0.27)	2.01 (0.24)	3.28 (0.30)	2.33 (0.36)	4.32 (0.45)	2.70 (0.78)	5.16 (1.09)	3.33 (3.49)	9.45 (6.20)
Severe anesthesia complications	1.43 (0.11)	0.59 (0.06)	1.37 (0.30)	—	1.27 (0.19)	0.59 (0.15)	1.27 (0.18)	0.63 (0.12)	1.57 (0.22)	0.60 (0.12)	1.74 (0.36)	—	—	—	2.47 (2.59)	—
Heart failure/arrest during surgery/procedure	1.27 (0.12)	0.10 (0.03)	1.67 (0.31)	—	1.21 (0.20)	—	1.12 (0.17)	—	1.03 (0.17)	—	1.62 (0.30)	—	2.52 (0.76)	—	—	—
Ventilation	0.74 (0.08)	4.97 (0.19)	0.66 (0.23)	4.86 (0.82)	0.65 (0.13)	4.19 (0.40)	0.60 (0.12)	3.75 (0.30)	0.72 (0.14)	4.52 (0.34)	1.23 (0.25)	7.95 (0.61)	—	10.09 (1.51)	—	—
Sickle cell disease with crisis	0.74 (0.08)	1.30 (0.11)	0.91 (0.24)	—	1.12 (0.19)	1.75 (0.26)	0.77 (0.15)	1.69 (0.23)	0.47 (0.11)	0.96 (0.15)	—	0.84 (0.21)	—	—	—	—
Conversion of cardiac rhythm	0.72 (0.07)	0.89 (0.08)	0.63 (0.21)	—	0.46 (0.11)	0.70 (0.16)	0.88 (0.14)	0.68 (0.13)	0.64 (0.14)	0.69 (0.13)	0.77 (0.20)	1.53 (0.27)	—	—	17.58 (8.32)	9.45 (6.19)
Cardiac arrest/ventricular fibrillation	0.69 (0.06)	1.01 (0.09)	—	—	0.39 (0.09)	1.01 (0.19)	0.53 (0.12)	0.82 (0.14)	1.02 (0.18)	0.74 (0.14)	1.08 (0.23)	1.44 (0.27)	—	3.59 (0.91)	3.22 (3.37)	9.45 (6.18)
Amniotic fluid embolism	0.42 (0.05)	0.58 (0.06)	—	—	—	0.42 (0.12)	0.30 (0.09)	0.49 (0.11)	0.53 (0.11)	0.55 (0.11)	0.90 (0.21)	0.79 (0.19)	—	—	6.44 (4.77)	—
Temporary tracheostomy	0.26 (0.04)	0.20 (0.04)	—	—	0.34 (0.09)	—	0.29 (0.08)	—	—	—	—	—	—	—	—	—
Acute myocardial infarction	0.21 (0.04)	0.32 (0.05)	—	—	—	—	—	0.26 (0.08)	0.28 (0.09)	0.38 (0.10)	—	—	—	—	—	—
Aneurysm	0.13 (0.03)	0.37 (0.05)	—	—	—	—	—	0.30 (0.09)	—	0.45 (0.10)	—	0.56 (0.16)	—	—	—	3.15 (3.58)

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Based on N=1,687,748 unweighted delivery hospitalizations in 2008-2009, and N=1,467,786 unweighted delivery hospitalizations in 2017-2018. Rates shown reflect weighted estimates. Cells suppressed for n<11. Bold indicates statistically significant ($p<0.05$) difference between rates based on tests for equality of weighted proportions. SMM= severe maternal morbidity.

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