WEB MATERIAL

Severe Maternal Morbidity: A Comparison of Definitions and Data Sources

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Web Table 1. Severe Maternal Morbidity Indicators and Corresponding ICD-9-CM Codes, as Defined by the CDC SMM Definition[1] and the SMM Definition Proposed by Bateman et al.[2]

Yellow – Bateman only
Green – both CDC and Bateman
Blue – CDC only

Severe Maternal Morbidity Indicator (CDC)	Diagnosis (DX) or Procedure (PR)	ICD-9-CM - CDC Exact List	Bateman (End-Organ Injury List): Show Codes Listed Differently Than in CDC (e.g., #.x) or Not in CDC
Acute congestive heart failure or pulmonary edema	DX	518.4, 428.1, 428.0, 428.21, 428.23, 428.31, 428.33, 428.41, 428.43	514.xx ('pulm edema'), 415.0x, 428.9x, 669.4x ('acute heart failure')
Acute myocardial infarction/Aneurysm	DX	410.xx, 441.xx	
Acute renal failure	DX	584.5, 584.6, 584.7, 584.8, 584.9, 669.3x	
Adult respiratory distress syndrome	DX	518.5, 518.81 518.82 518.84, 799.1	518.7x
Air and thrombotic embolism	DX	415.1x, 673.0x, 673.2x, 673.3x, 673.8x	'673.x' ('pulm embolism')
Amniotic fluid embolism	DX	673.1x	673.x
Cardiac arrest, ventricular fibrillation/ Conversion of cardiac rhythm	DX; PR	427.41, 427.42, 427.5; 99.6x	(427.5x = 'acute heart failure)
Disseminated intravascular coagulation	DX	286.6, 286.9, 666.3	286.7x, 287.4
Eclampsia	DX	642.6x	
Heart failure or arrest during surgery or procedure	DX	997.1	see 'acute heart failure'
Puerperal cerebrovascular disorders	DX	430.xx, 431.xx, 432.xx, 433.xx, 434.xx, 436.xx, 437.xx, 671.5x, 674.0x, 997.02	997.01, 325, 348.1, 348.3x,348.5x, 346.6x
Sepsis	DX	038.xx, 995.91, 995.92, 670.2x	112.5x, 659.3x, 785.52
Severe anesthesia complications	DX	668.0x, 668.1x, 668.2x	
Shock	DX	669.1x, 785.5x, 995.0, 995.4, 998.0x	995.94, 999.4x
Sickle cell disease with crisis	DX	282.42, 282.62, 282.64, 282.69	
Blood transfusion	PR	99.0x	
Hysterectomy	PR	68.3x-68.9x	
Ventilation/Temporary tracheostomy	PR	93.90, 96.01, 96.02, 96.03, 96.05, 31.1	
Acute liver disease			570, 646.7x
Coma (Bateman)			780.01, 780.03, 572.2x, 250.2x, 250.3x, 251.0x
Delirium			293.x
Status asthmaticus (Bateman)			493.01,493.11, 493.21, 493.91
Status epilepticus (Bateman)			345.3x

Web Table 2. Agreement Between SMM Definitions, as Defined by Multiple Metrics, Among 3,049,774 Women Giving Birth in California From 2007 to 2012[a]

	CDC (Without Blood Transfusion) Prevalence = 0.55% (*n* = 16,662)	CDC Prevalence = 1.30% (*n* = 39,753)	CDC (LOS Restriction) Prevalence = 1.13% (*n* = 34,413)	CDC (Bateman Modification) Prevalence = 0.97% (*n* = 29,733)	Birth Certificate, CDC Analog Prevalence = 0.47% (*n* = 14,329)	Birth Certificate, CDC Augmented Prevalence = 0.60% (*n* = 18,329)	Bateman Index Prevalence = 0.83% (*n* = 25,275)
CDC (Without Blood Transfusion)	1						
CDC	$\kappa = 0.588$ Sens=100 Spec=99.2 PPV=41.9 NPV=100 Accur=99.2	1					
CDC (LOS Restriction)	$\kappa = 0.439$ Sens=68.0 Spec=99.2 PPV=32.9 NPV=99.8 Accur=99.1	$\kappa = 0.927$ Sens=86.6 Spec=100 PPV=100 NPV=99.8 Accur=99.8	1				
CDC (Bateman Modification)	$\kappa = 0.716$ Sens=100 Spec=99.6 PPV=56.0 NPV=100 Accur=99.6	$\kappa = 0.492$ Sens=43.5 Spec=99.6 PPV=58.1 NPV=99.3 Accur=98.9	$\kappa = 0.366$ Sens=34.7 Spec=99.4 PPV=40.2 NPV=99.3 Accur=98.7	1			
CDC, BC Analog	$\kappa = 0.086$ Sens=8.42 Spec=99.6 PPV=9.8	$\kappa = 0.109$ Sens=7.8 Spec=99.6 PPV=21.8	$\kappa = 0.119$ Sens=8.9 Spec=99.6 PPV=21.3	$\kappa = 0.067$ Sens=5.4 Spec=99.6 PPV=11.3	1		

	NPV=99.5 Accur=99.1	NPV=98.8 Accur=98.4	NPV=99.0 Accur=98.6	NPV=99.1 Accur=98.7			
CDC, BC Augmented	κ = 0.132 Sens=14.3 Spec=99.5 PPV=13.0 NPV=99.5 Accur=99.5	κ = 0.146 Sens=11.2 Spec=99.5 PPV=24.3 NPV=98.8 Accur=98.8	κ = 0.154 Sens=12.3 Spec=99.5 PPV=23.2 NPV=99.0 Accur=95.5	κ = 0.105 Sens=9.0 Spec=99.5 PPV=14.7 NPV=99.1 Accur=98.6	κ = 0.877 Sens=100 Spec=99.9 PPV=78.2 NPV=100 Accur=99.9	1	
Bateman	κ = 0.579 Sens=73.2 Spec=99.6 PPV=48.3 NPV=99.9 Accur=99.4	κ = 0.388 Sens=32.3 Spec=99.6 PPV=50.7 NPV=99.1 Accur=98.7	κ = 0.280 Sens=24.9 Spec=99.5 PPV=33.9 NPV=99.2 Accur=98.6	κ = 0.918 Sens=85.0 Spec=100 PPV=100 NPV=99.9 Accur=99.9	κ = 0.050 Sens=7.7 Spec=99.2 PPV=4.3 NPV=99.6 Accur=98.8	κ = 0.084 Sens=10.8 Spec=99.2 PPV=7.8 NPV=99.5 Accur=98.7	1

Abbreviations: Accur, accuracy; BC, birth certificate; CDC, Centers for Disease Control and Prevention; LOS, length of stay; NPV, negative predictive value; PPV, positive predictive value; Sens, sensitivity; SMM, severe maternal morbidity; Spec, specificity.

[a] The SMM definition in the column is treated as the "truth" and the definition in the row is treated as the "test" for sensitivity, specificity, PPV, and NPV.

Web References

1. Centers for Disease Control and Prevention. Severe maternal morbidity indicators and corresponding ICD-9-CM codes during delivery hospitalizations. https://www.cdc.gov/reproductivehealth/maternalinfanthealth/smm/severe-morbidity-ICD.htm. Published 2019. Accessed December 17, 2019.

2. Bateman BT, Mhyre JM, Hernandez-Diaz S, et al. Development of a comorbidity index for use in obstetric patients. *Obstetr Gynecol.* 2013;122(5):957–965.