

Appendix 1. Diagnostic and Procedure Codes for Severe Maternal Morbidity and Cause of Death

	International Classification of Diseases 9th revision/ International Classification of Diseases, Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	International Classification of Diseases 10th revision/ Canadian Classification of Health Interventions
Severe maternal morbidity		
Severe preeclampsia or eclampsia	642.5, 642.6	O14 (2006-2011), O14.1-O14.2 (2012-2016), O15
Severe hemorrhage	286, 641.1, 641.2, 641.3, 641.8, 641.9, 666/13.01, 13.02, 13.03, 13.04, 13.08, 13.09, 80.29, 80.39, 80.49, 80.59, 80.69, 81.01, 81.61, 86.42, 87.21	O44.1, O45.0, O46.0, O67, O72/1.LZ.19.HH-U1-A, 1.LZ.19.HH-U1-J, 1.LZ.19.HH-U9-A, 1.LZ.19.HH-U9-J, 1.LZ.19.HM-U1, 1.LZ.19.HM-U9, 1.LZ.35.HH-T7, 1.LZ.35.HA-T7, 1.PL.74, 1.RM.87.LA-GX, 1.RM.89.LA, 1.RS.74, 1.RS.80, 5.MD.60.CB, 5.MD.60.KE, 5.MD.60.RC, 5.MD.60.RD, 5.PC.91.GA, 5.PC.91.GC, 5.PC.91.GD
Cardiac complications	410, 425, 427.4, 427.5, 428, 514, 518.4, 668.1, 674.5/13.63, 13.71, 13.72, 13.73, 13.74, 13.79, 49.91	I21, I22, I42, I43, I46, I49.0, I50, J81, O74.2, O89.1, O90.3/1.HZ.09, 1.HZ.30
Cerebrovascular accident	430-434, 671.5, 674.0	I60-I64, O22.5, O87.3
Acute renal failure or dialysis	584, 586, 669.3/51.27, 51.42, 51.43, 51.95, 66.98	N17, N19, N99.0, O90.4/1.PZ.21
Embolism, shock, disseminated intravascular coagulation	286.6, 669.1, 673, 785.5, 995.0, 999.4	D65, O75.1, O88, R57, T80.5, T88.6
Sepsis	659.3, 670	O75.3, O85
Uterine rupture	665.0, 665.1/13.01, 13.02, 13.03, 13.04, 13.08, 13.09, 80.29, 80.39, 80.49, 80.59, 80.69, 86.42	O71.0, O71.1/1.LZ.19.HH-U1-A, 1.LZ.19.HH-U1-J, 1.LZ.19.HH-U9-A, 1.LZ.19.HH-U9-J, 1.LZ.19.HM-U1, 1.LZ.19.HM-U9, 1.LZ.35.HH-T7, 1.LZ.35.HA-T7, 1.PL.74, 1.RM.87.LA-GX, 1.RM.89.LA, 1.RS.74, 1.RS.80, 5.MD.60.CB, 5.MD.60.KE, 5.MD.60.RC, 5.MD.60.RD
Hysterectomy	80.29, 80.39, 80.49, 80.59, 80.69, 86.42	1.PL.74, 1.RM.87.LA-GX, 1.RM.89.LA, 1.RS.74, 1.RS.80, 5.MD.60.CB, 5.MD.60.KE, 5.MD.60.RC, 5.MD.60.RD
Surgical complication*	669.4/13.01, 13.02, 13.03, 13.04, 13.08, 13.09, 58.79, 66.51, 87.73, 87.81, 87.91	O75.4/1.LZ.19.HH-U1-A, 1.LZ.19.HH-U1-J, 1.LZ.19.HH-U9-A, 1.LZ.19.HH-U9-J, 1.LZ.19.HM-U1, 1.LZ.19.HM-U9, 1.LZ.35.HH-T7, 1.LZ.35.HA-T7, 1.NK.80, 1.NM.80, 5.PC.73.JS, 5.PC.80.JH, 5.PC.80.JM, 5.PC.80.JR
Assisted ventilation	10.04, 10.05, 43.19, 43.21	1.GZ.31.CA-ND, 1.GZ.31.CR-ND
Other†	042, 282.62, 282.64, 282.69, 293.0, 345.2, 345.3, 348.5, 493.01, 493.11, 493.21, 493.91, 518.52, 518.82, 540, 541, 567, 570, 571.8, 572.2, 573.3, 573.4, 614.5, 668.0-668.2, 780.01/13.01, 13.02, 13.03, 13.04, 13.07, 13.08, 13.09, 87.93, 87.94	B20-B24, D57.0, F23, F53.1, G41, G93.6, J45.01, J45.11, J45.81, J45.91, J80, K35, K37, K65, K71, K72, N73.3, N73.5, O26.6, O29.0-O29.2, O74.0-O74.3, O89.0-O89.2, O98.7, R40.2/1.LZ.19.HH-U1-A, 1.LZ.19.HH-U1-J, 1.LZ.19.HH-U2-A, 1.LZ.19.HH-U2-J, 1.LZ.19.HH-U9-A, 1.LZ.19.HH-U9-J, 1.LZ.19.HM-U1, 1.LZ.19.HM-U2, 1.LZ.19.HM-U9, 1.LZ.35.HH-T7, 1.LZ.35.HA-T7, 5.PC.91.HQ, 5.PC.91.HP

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Cause of death	
Obstetric	O00-O99
Cardiovascular	I00-I99
Pulmonary	J00-J99
Neurological	G00-G99, R56
Sepsis, shock, organ failure	A00-B99, M72.6, M86, N39.0, R57, R65, T81.1, T81.4, T83.5, T83.6, T84.5-T84.7, T85.7, T86, T88.0, T88.2, T88.6
Neoplastic	C00-D89
Suicide	X60-X84, Y87.0
Gastrointestinal	K00-K93
Endocrine	E00-E90
Renal	N00-N29, N99.0
Wounds and injury	R09.0, S00-S99, T00-T98 except T codes listed above
Other causes	All other diagnostic codes

*Cardiac arrest, cardiac failure, cerebral anoxia, renal failure or residual ovary syndrome following obstetric surgery

or procedures, evacuation of incisional hematoma with red cell transfusion, repair of small or large intestine, and postpartum surgical repair of obstetric laceration of bladder and urethra, laceration of corpus uteri, or wound dehiscence following cesarean section or hysterectomy

†Acute fatty liver, hepatic failure, cerebral edema or coma, pulmonary, cardiac, and central nervous system complications of anesthesia, status asthmaticus, adult respiratory distress syndrome, acute abdomen, correction of inverted uterus, Sickle cell anemia with crisis, acute psychosis, epilepsy, and HIV disease

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Appendix 2. Number of Deaths and Women at Risk by Time Interval

	43 days-11 months		1-4 years		5-9 years		10-29 years	
	No. deaths	No. women at risk	No. deaths	No. women at risk	No. deaths	No. women at risk	No. deaths	No. women at risk
Severe maternal morbidity								
Any	30	35,969	55	35,939	67	29,283	172	21,652
Severe preeclampsia or eclampsia	<5	10,819	8	10,817	17	8,522	51	5,410
Severe hemorrhage	<5	6,079	7	6,076	8	4,429	28	2,832
Cardiac complications	8	913	11	905	6	668	7	412
Cerebrovascular accident	<5	259	<5	257	<5	227	<5	195
Acute renal failure or dialysis	8	729	<5	721	<5	513	<5	310
Embolism, shock, disseminated intravascular coagulation	5	1,989	<5	1,984	<5	1,574	6	1,127
Sepsis	<5	8,514	15	8,510	9	7,139	36	5,742
Uterine rupture	-	2,395	<5	2,395	<5	1,897	9	1,298
Hysterectomy	<5	1,655	<5	1,653	6	1,302	10	858
Surgical complication	0	6,448	5	6,448	14	5,981	28	5,386
Assisted ventilation	9	630	<5	621	<5	479	<5	289
Intensive care unit admission	20	4,810	12	4,790	15	3,599	22	2,249
Other severe morbidity	9	1,683	8	1,674	<5	1,310	8	937
No	115	1,193,223	823	1,193,108	1,163	976,064	4,994	741,760

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Appendix 3. Partially Adjusted Association of Severe Maternal Morbidity With Mortality After 42 Days

Severe maternal morbidity	Hazard ratio (95% confidence interval)*				
	43 days-11 months	1-4 years	5-9 years	10-29 years	43 days-29 years
Any	6.71 (4.47-10.1)	1.92 (1.46-2.53)	1.79 (1.39-2.28)	1.20 (1.03-1.40)	1.51 (1.35-1.69)
Severe preeclampsia or eclampsia	1.41 (0.35-5.73)	0.91 (0.45-1.83)	1.60 (0.99-2.59)	1.44 (1.09-1.89)	1.39 (1.11-1.73)
Severe hemorrhage	4.01 (1.27-12.6)	1.51 (0.72-3.18)	1.49 (0.74-2.98)	1.75 (1.20-2.53)	1.72 (1.29-2.30)
Cardiac complications	49.7 (24.0-103.2)	12.5 (6.88-22.7)	5.94 (2.66-13.3)	2.65 (1.27-5.55)	6.82 (4.81-9.65)
Cerebrovascular accident	47.4 (11.7-192.8)	12.0 (3.86-37.1)	5.41 (1.35-21.6)	1.81 (0.59-5.59)	4.27 (2.30-7.94)
Acute renal failure or dialysis	60.2 (29.0-124.9)	1.45 (0.20-10.3)	4.20 (1.35-13.1)	1.84 (0.69-4.89)	4.33 (2.65-7.08)
Embolism, shock, disseminated intravascular coagulation	20.1 (8.19-49.4)	0.63 (0.09-4.47)	1.45 (0.47-4.49)	0.74 (0.33-1.65)	1.25 (0.75-2.07)
Sepsis	4.08 (1.51-11.1)	2.33 (1.40-3.88)	0.99 (0.51-1.90)	0.84 (0.61-1.17)	1.08 (0.84-1.38)
Uterine rupture	-	1.67 (0.54-5.19)	0.83 (0.21-3.33)	1.18 (0.61-2.27)	1.16 (0.69-1.95)
Hysterectomy	9.41 (2.32-38.2)	1.44 (0.36-5.77)	3.38 (1.51-7.54)	1.78 (0.96-3.31)	2.22 (1.43-3.44)
Surgical complication	-	1.03 (0.43-2.48)	1.77 (1.04-2.99)	0.88 (0.61-1.28)	1.04 (0.78-1.38)
Assisted ventilation	88.0 (44.1-175.6)	1.67 (0.24-11.9)	1.49 (0.21-10.6)	2.61 (0.98-6.94)	5.16 (3.11-8.56)
Intensive care unit admission	27.6 (17.0-44.8)	2.84 (1.61-5.03)	3.14 (1.88-5.23)	1.86 (1.22-2.83)	3.21 (2.53-4.07)
Other severe morbidity	39.8 (20.1-78.8)	5.93 (2.95-11.9)	1.21 (0.30-4.86)	1.37 (0.68-2.73)	2.99 (2.05-4.36)
No	Reference	Reference	Reference	Reference	Reference

*Hazard ratio for severe maternal morbidity relative to no morbidity, adjusted for age and pre-existing comorbidity

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Appendix 4. Partially Adjusted Association of Severe Maternal Morbidity With Specific Causes of Death*

Cause of death	0-11 months [‡]	Hazard ratio (95% confidence interval) [†]		
		1-4 years	5-29 years	0-29 years
Obstetric	225.8 (116.5-437.9)	-	-	-
Cardiovascular	29.4 (10.1-86.1)	4.98 (1.69-14.6)	4.75 (1.36-16.6)	8.67 (4.77-15.8)
Pulmonary	- [§]	5.87 (1.65-20.8)	1.98 (0.26-15.4)	7.21 (3.09-16.8)
Neurological	39.1 (9.16-166.7)	1.19 (0.16-8.87)	8.74 (1.74-43.8)	6.61 (3.02-14.5)
Sepsis, shock, organ failure	18.1 (3.98-82.2)	1.54 (0.20-11.8)	- [§]	3.35 (1.16-9.64)
Neoplastic	3.03 (0.68-13.5)	1.54 (0.67-3.52)	1.01 (0.37-2.75)	1.40 (0.78-2.51)
Suicide	- [§]	1.12 (0.15-8.27)	1.09 (0.35-3.45)	1.07 (0.40-2.90)
Gastrointestinal	-	-	-	-
Endocrine	-	-	-	-
Renal	-	-	-	-
Injury	-	-	-	-
Other causes	-	-	-	-

*Obstetric and suicide deaths are for 1989-2018. All other causes of death are for 2006-2018.

[†]Hazard ratio for severe maternal morbidity relative to no morbidity, adjusted for age and pre-existing comorbidity

[‡]≤42 days for obstetric deaths

[§]Hazard ratio could not be estimated as there were no deaths in exposed women.

Appendix 5. Comparison of Partially and Fully Adjusted Association of Severe Maternal Morbidity in Previous Pregnancies With Future Mortality

Timing of maternal severe morbidity	Hazard ratio (95% confidence interval)	
	Partially adjusted*	Fully adjusted†
Women with no previous pregnancy (nulliparous)		
Severe maternal morbidity	2.37 (2.09-2.69)	2.29 (2.01-2.60)
No morbidity	1.34 (1.28-1.41)	1.28 (1.22-1.35)
Women with previous pregnancies (multiparous)		
Severe maternal morbidity in last pregnancy only	2.92 (1.99-4.30)	2.88 (1.96-4.24)
Severe maternal morbidity in previous and last pregnancies	2.35 (1.99-2.77)	2.36 (2.00-2.78)
Severe maternal morbidity in previous pregnancies only	1.18 (0.97-1.43)	1.20 (0.99-1.45)
No morbidity	Reference	Reference

*Hazard ratio adjusted for age and pre-existing comorbidity

†Hazard ratio adjusted for age, multiple birth, pre-existing comorbidity, socioeconomic deprivation, and time period

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Appendix 6. Sensitivity Analysis for the Robustness of Association Between Severe Maternal Morbidity and

Long-term Risk of Mortality

Severe maternal morbidity	Hazard ratio (95% confidence interval)*				
	Severe maternal morbidity at last pregnancy	Severe maternal morbidity at first pregnancy	Excluding women with preexisting comorbidity	Excluding women with socioeconomic deprivation	Excluding women with pregnancies after 2010
Any	2.00 (1.81-2.20)	1.65 (1.47-1.84)	1.77 (1.57-1.99)	2.08 (1.85-2.34)	1.96 (1.77-2.16)
Severe preeclampsia or eclampsia	1.57 (1.27-1.93)	1.27 (1.04-1.55)	1.26 (0.96-1.65)	1.57 (1.22-2.03)	1.57 (1.27-1.94)
Severe hemorrhage	2.97 (2.37-3.72)	1.73 (1.26-2.40)	2.98 (2.30-3.85)	3.45 (2.65-4.48)	2.90 (2.30-3.65)
Cardiac complications	22.4 (18.4-27.2)	15.8 (12.1-20.5)	24.6 (19.2-31.6)	24.7 (19.6-31.1)	21.2 (17.2-26.0)
Cerebrovascular accident	11.8 (8.19-17.0)	13.7 (9.28-20.1)	13.7 (8.74-21.5)	12.0 (7.54-19.0)	11.3 (7.82-16.4)
Acute renal failure or dialysis	10.3 (7.51-14.1)	6.08 (4.14-8.94)	8.49 (5.27-13.7)	10.9 (7.43-16.1)	9.68 (6.91-13.6)
Embolism, shock, disseminated intravascular coagulation	5.77 (4.55-7.32)	3.07 (2.21-4.26)	5.80 (4.39-7.67)	6.21 (4.72-8.17)	5.32 (4.15-6.81)
Sepsis	1.23 (0.98-1.54)	1.05 (0.84-1.33)	1.19 (0.92-1.55)	1.21 (0.91-1.60)	1.22 (0.97-1.53)
Uterine rupture	1.21 (0.72-2.05)	1.60 (0.89-2.90)	1.52 (0.90-2.57)	1.36 (0.75-2.45)	1.58 (1.00-2.51)
Hysterectomy	4.40 (3.21-6.03)	4.64 (1.50-14.4)	5.24 (3.76-7.31)	4.36 (2.99-6.37)	4.27 (3.09-5.90)
Surgical complication	1.49 (1.17-1.89)	1.73 (1.09-2.75)	1.49 (1.15-1.95)	1.79 (1.37-2.33)	1.45 (1.14-1.85)
Assisted ventilation	19.4 (14.9-25.2)	30.6 (16.9-55.3)	22.9 (16.4-31.9)	21.4 (15.8-29.0)	18.5 (14.0-24.4)
Intensive care unit admission	5.85 (4.88-7.02)	3.91 (3.08-4.67)	5.53 (4.35-7.03)	5.46 (4.38-6.82)	5.73 (4.76-6.89)
Other severe morbidity	5.25 (3.95-6.97)	4.42 (3.07-6.36)	4.16 (2.85-6.08)	4.23 (2.90-6.17)	5.23 (3.91-6.99)
No	Reference	Reference	Reference	Reference	Reference

*Hazard ratio for severe maternal morbidity relative to no morbidity, adjusted for age, parity, multiple birth, pre-existing comorbidity, socioeconomic deprivation, and time period

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