Division of Public Health

Severe Maternal Morbidity Report

2017-2021

July 2024

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Acknowledgments

We would like to acknowledge the women who have experienced a severe maternal morbidity (SMM) event in Nebraska, the loved ones who were affected by them, and those who provided care to them.

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Introduction

Maternal health is a continuum ranging from a healthy pregnancy, delivery, and postpartum period to minor complications, severe maternal morbidity (SMM), and maternal death. Maternal death comprises only a small portion of the burden of negative maternal health outcomes. Between 1998 and 2009, Callaghan et al. (2012) identified that among delivery and postpartum hospitalizations, SMM events occurred nearly 100 times more frequently than in-hospital deaths during delivery and postpartum hospitalizations.

The Nebraska Department of Health and Human Services (DHHS) released a previous SMM report in September 2021 which included events occurring from 2016-2018. This report includes Nebraska SMM data from 2017-2021. SMM cases that occurred in years 2017 and 2018 are included in both reports to allow for a rolling analysis of five years of SMM data.

The American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine define SMM as "unexpected outcomes of labor and delivery that result in significant short- or long-term consequences to a woman's health (American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine, 2016). Using data from the Healthcare Cost and Utilization Project – National (Nationwide) Inpatient Sample (HCUP-NIS), the US Department of Health and Human Services (HHS) reports that severe maternal complications nationwide have been steadily increasing, from 71.5 per 10,000 delivery hospitalizations with severe maternal complications in 2017 to 88.2 per 10,000 delivery hospitalizations with severe maternal complications in 2020 (HHS, 2023). HHS set a Healthy People 2030 (HP2030) objective to "reduce severe maternal complications identified during delivery hospitalizations" with a current target of 64.4 per 10,000 delivery hospitalizations (HHS, 2023).

Methods

The Centers for Disease Control and Prevention (CDC) identifies SMM using a list of 21 indicators (CDC, 2023). Each indicator has corresponding International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes (*Appendix 1*). Due to relatively small numbers of SMM events in Nebraska (count less than 5 in some cases), indicators are also grouped into seven complication groups (*Table 1*). Twenty out of the 21 indicators were considered, excluding blood transfusion indicators which are no longer used (Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau, 2023).

Table 1. Severe maternal morbidity complication groups and indicators.

Severe maternal morbidity complication groups	**Severe maternal morbidity indicator**
Cardiac complications	Acute myocardial infarction Aneurysm Cardiac arrest/ventricular fibrillation Conversion of cardiac rhythm Heart failure/arrest during surgery or procedure Pulmonary edema/acute heart failure
Hemorrhage complications	Disseminated intravascular coagulation Hysterectomy Shock
Renal complications	Acute renal failure
Respiratory complications	Adult respiratory distress syndrome Temporary tracheostomy Ventilation
Sepsis complications	Sepsis
Other obstetric complications	Air and thrombotic embolism Amniotic fluid embolism Eclampsia Severe anesthesia complications
Other medical complications	Puerperal cerebrovascular disorders Sickle cell disease with crisis

Note: Blood transfusion not included
Source: Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau. (2023). Federally Available Data (FAD) Resource Document; Rockville, MD: Health Resources and Services Administration. https://mchb.tvisdata.hrsa.gov/Home/Resources

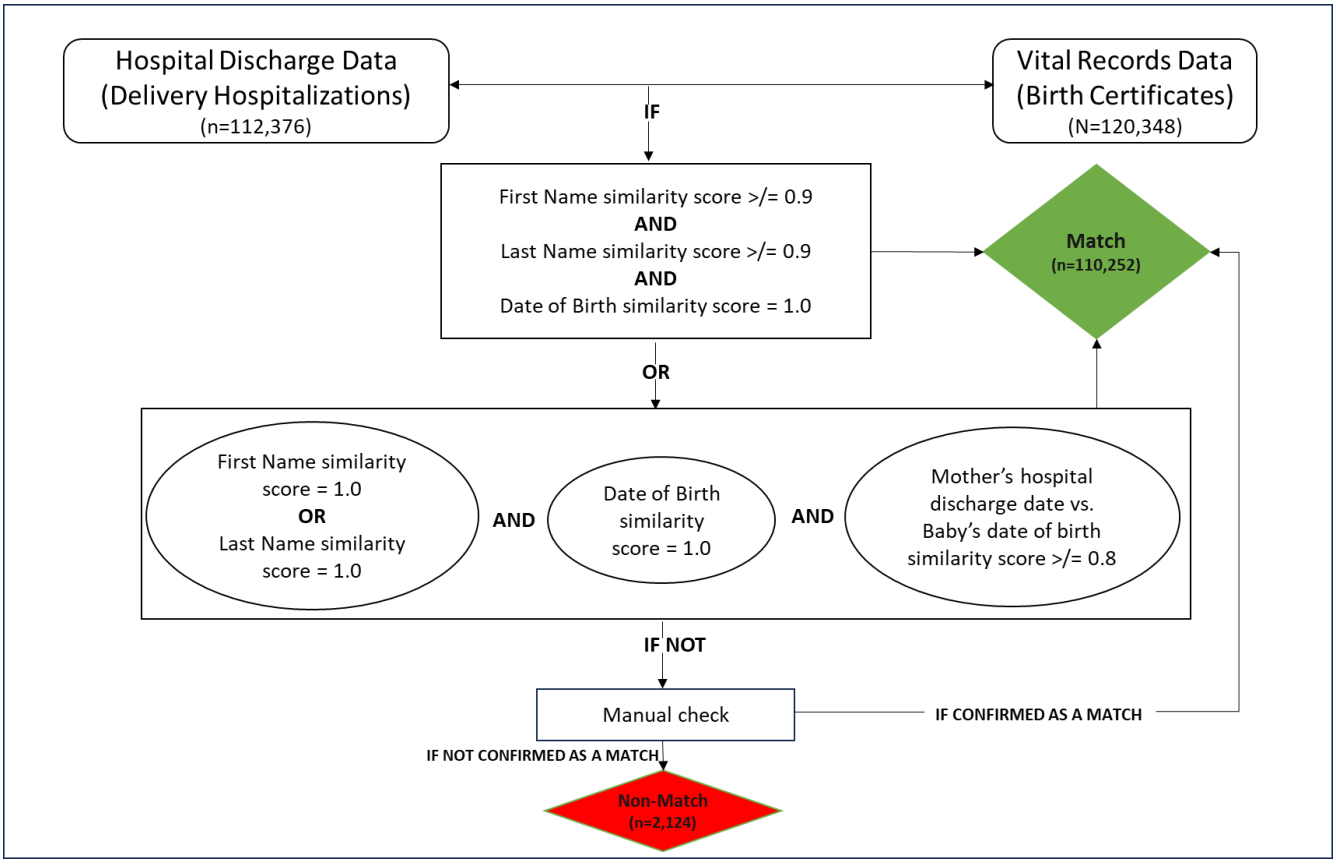
Hospital discharge data (HDD) provided by the Nebraska Hospital Association (NHA) from 2017-2021 were analyzed. Delivery hospitalizations were identified with CDC-developed standard definitions for women, Nebraska residents, aged 12 to 55 years old, whose diagnoses were related to delivery and whose outcome was not an abortion. SMM events were identified with ICD-10-CM codes to identify the indicators representing serious complications of pregnancy or delivery (*Table 1*). The analyses followed the HRSA recommendations from the Federally

Available Data (FAD) Resource Document 2023 edition (Maternal and Child Health Bureau, 2023), and were performed using SAS 9.4. Proportions were compared using a chi squared test with statistical significance assessed at $p<0.05$. The 95% confidence intervals (CI) were calculated for rates based on Poisson distribution (Ulm, 1990). Charts were produced in Microsoft Excel.

HDD Linkage to Birth Records

The NHA HDD data lacked completeness in race and ethnicity. These data were available in only 47.3% of delivery hospitalizations. To improve completeness, a probabilistic linkage of the HDD data and birth records was conducted using Match-Pro v2.4.4. Linkage was performed using women's names (first, middle, last, and maiden) and dates of birth. *Figure 1* presents the probabilistic linkage process performed and the classification rules. First, the woman's first name, last name, and date of birth from both the baby's birth certificate and the delivery hospitalization were used to determine matches. Next, the baby's date of birth and the mother's hospital discharge date were used. In the case a manual check was needed, additional information such as county of residence, hospital name, and diagnosis were used to determine matches.

Figure 1. Linkage process map



Source: Office of Maternal and Child Health Epidemiology, Nebraska Department of Health and Human Services.

Results

From 2017-2021, HDD was available for 112,376 delivery hospitalizations in Nebraska, among Nebraska residents. The total number of delivery hospitalizations with at least one SMM event was 657, corresponding to an SMM rate of 58.5 events per 10,000 delivery hospitalizations

Table *2 (Table 2*). The rate of SMM in the United States in 2020 was 88.2 events per 10,000 delivery hospitalizations (Hirai, 2023).

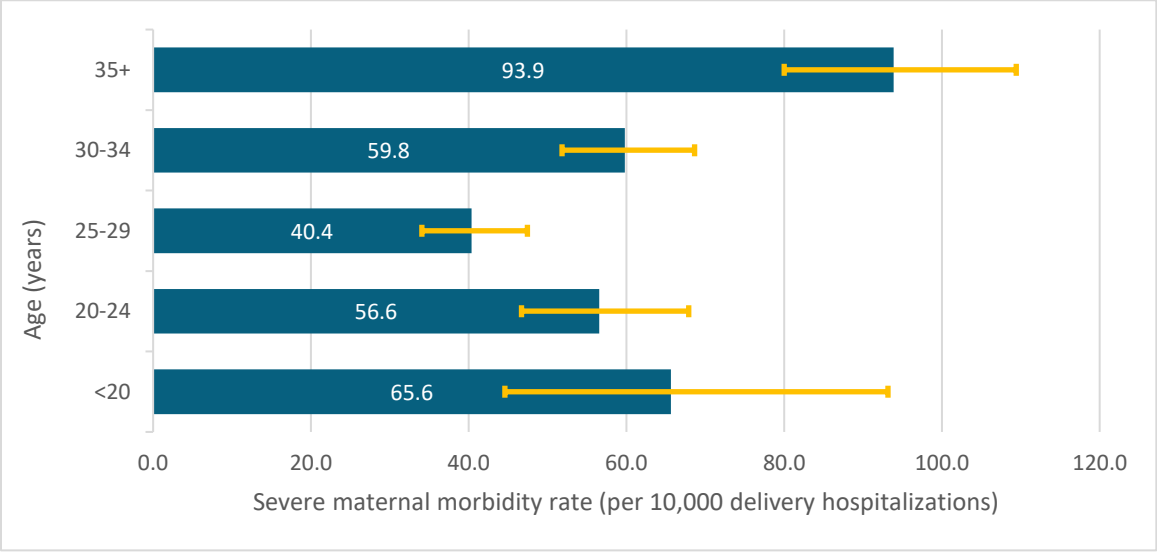
Table 2. Severe maternal morbidity by year, Nebraska 2017-2021.

Year	Number of severe maternal morbidity events	Total delivery hospitalizations	Rate per 10,000 deliveries		
			Rate	95% Confidence Interval (CI)	
2017	122	23,381	52.2	43.3	62.3
2018	120	23,240	51.6	42.8	61.7
2019	152	22,763	66.8	56.6	78.3
2020	132	21,495	61.4	51.4	72.8
2021	131	21,497	60.9	51.0	72.3
Total	657	112,376	58.5	54.1	63.1

Data source: Hospital discharge data, Nebraska Hospital Association.

Figure 2 presents the distribution of SMM by maternal age. The highest rate of SMM occurred in women 35 years old and above (93.9 per 10,000). The SMM rate was statistically lower in the age group 25-29 than the rates in the groups 30-34 and 35+ (p=0.002 and 0.001, respectively). The age group 20-24 had a statistically significantly lower rate than the age group 35 and above (p-value < 0.001).

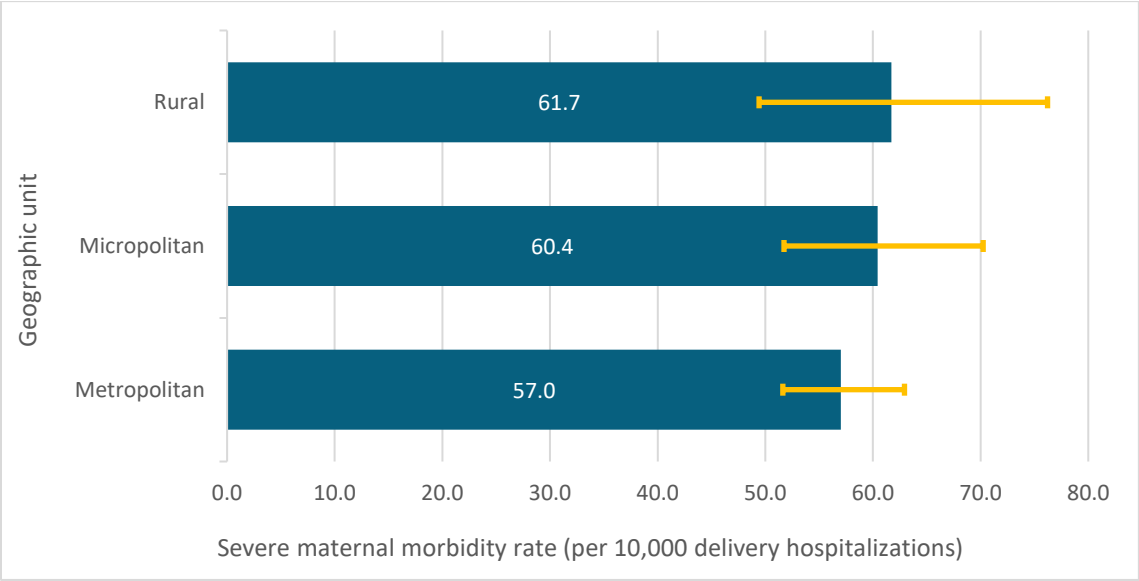
Figure 2. Severe maternal morbidity rates by maternal age group, Nebraska 2017-2021 (N=112,376; n=657).



Data source: Hospital discharge data, Nebraska Hospital Association.

The counties of residence of women were categorized by population into metropolitan (50,000 or higher), micropolitan (10,000 to 49,999), and rural (under 10,000), based on the county's total population as of 2020 (Census Bureau, 2023a). There were no statistically significant differences in SMM rates across the different geographic units (*Figure 3*).

Figure 3. Severe maternal morbidity rates by geographic unit, Nebraska 2017-2021 (N=112,371; n=657).



Missing geographic unit for delivery hospitalizations = 5

Data source: Hospital discharge data, Nebraska Hospital Association.

The majority (62.0%) of women with delivery hospitalizations data had private insurance (*Table 3*). Private insurance also included hospitalizations with insurance provider coded as: Preferred Provider Organization (PPO), Indemnity Insurance, Automobile Medical, Blue Cross/Blue Shield, Commercial Insurance Company, and Health Maintenance Organization (HMO). While most (56.3%) women who experienced SMM had private insurance, the SMM rate was statistically significantly greater in women with Medicaid than women with private insurance (p=0.001).

Table 3. Severe maternal morbidity by source of payment, Nebraska 2017-2021 (N=112,376; n=657).

Source of payment	**Delivery hospitalizations (N=112,376)**		**Severe maternal morbidity (n=657)**				
	Frequency	**Percent**	**Frequency**	**Percent**	Rate per 10,000 delivery hospitalizations	95% CI for the rate	
Private insurance	69,641	62.0	370	56.3	53.1	47.9	58.8
Medicaid	38,352	34.1	264	40.2	68.8	60.8	77.7
Other/Uninsured	4,383	3.9	23	3.5	52.5	33.3	78.7

Data source: Hospital discharge data, Nebraska Hospital Association.

Based on the ZIP code of residence, a median household income was attributed to each delivery hospitalization using the American Community Survey 5-Year Data for 2017-2021 (Census Bureau, 2023b). The total delivery hospitalizations were grouped into four quartiles: quartile 1: $1 to less than $31,100; quartile 2: $31,100 to less than $36,141; quartile 3: 36,141 to less than $41,850; quartile 4: $41,850 and above (*Table 4*). Women in quartile 4 experienced SMM at a statistically significantly lower rate than women in quartile 1 (p<0.001).

Table 4. Severe maternal morbidity by median household income, Nebraska 2017-2021 (N=112,084; n=655).

Median income quartiles	**Delivery hospitalizations (N=112,084)**		**Severe maternal morbidity (n=655)**				
	Frequency	**Percent**	**Frequency**	**Percent**	**SMM Rate per 10,000 delivery hospitalizations**	**95% CI for the rate**	
Quartile 1 ($1-$31,099)	16,951	15.1	124	18.9	73.2	60.8	87.2
Quartile 2 ($31,100-$36,140)	31,927	28.5	209	31.9	65.5	56.9	75.0
Quartile 3 ($36,141-$41,849)	23,363	20.8	124	18.9	53.1	44.1	63.3
Quartile 4 (≥$41,850)	39,843	35.6	198	30.2	49.7	43.0	57.1

Median household income was unavailable in Census data and therefore missing for 292 delivery hospitalizations and 2 severe maternal morbidity events.
Data source: Hospital discharge data, Nebraska Hospital Association.

Of the 20 indicators examined, disseminated intravascular coagulation, hysterectomy, acute renal failure, and adult respiratory distress syndrome occurred most frequently (*Table 5*).

Table 5. Severe maternal morbidity indicators, Nebraska 2017-2021 (N=112,376; n=657).

Severe maternal morbidity indicators	**Frequency**	**Rate per 10,000 delivery hospitalizations**		
		Rate	**95% CI for the rate**	
Disseminated intravascular coagulation	146	13.0	11.0	15.3
Hysterectomy	126	11.2	9.3	13.3
Acute renal failure	122	10.9	9.0	13.0
Adult respiratory distress syndrome	111	9.9	8.1	11.9
Pulmonary edema/acute heart failure	68	6.1	4.7	7.7
Shock	63	5.6	4.3	7.2
Eclampsia	62	5.5	4.2	7.1
Sepsis	62	5.5	4.2	7.1
Ventilation	41	3.7	2.6	4.9
Air and thrombotic embolism	29	2.6	1.7	3.7
Puerperal cerebrovascular disorders	17	1.5	0.9	2.4
Severe anesthesia complications	11	1.0	0.5	1.8
Cardiac arrest/ventricular fibrillation	9	0.8	0.4	1.5
Conversion of cardiac rhythm	7	0.6	0.3	1.3
Amniotic fluid embolism	6	0.5	0.2	1.2
Sickle cell disease with crisis	-	-	-	-
Temporary tracheostomy	-	-	-	-
Aneurysm	-	-	-	-
Acute myocardial infarction	-	-	-	-
Heart failure/arrest during surgery or procedure	0	0.0	0.0	0.3

"-" Values have been suppressed due to small counts from 1-5.

Note: The severe maternal morbidity indicators are not mutually exclusive. An individual may have experienced more than one event.

Data source: Hospital discharge data, Nebraska Hospital Association.

After grouping the indicators, hemorrhage, renal, and respiratory complications were the most frequent, followed by other obstetric and cardiac complications (*Table 6*).

Table 6. Severe maternal morbidity groups, Nebraska 2017-2021, (N=112,376; n=657).

Severe maternal morbidity group	**Frequency**	**Rate per 10,000 delivery hospitalizations**		
		Rate	**95% CI for the rate**	
Hemorrhage Complications	292	26.0	23.1	29.1
Renal Complications	122	10.9	9.0	13.0
Respiratory Complications	121	10.8	8.9	12.9
Other Obstetric Complications	106	9.4	7.7	11.4
Cardiac Complications	86	7.7	6.1	9.5
Sepsis Complications	62	5.5	4.2	7.1
Other Medical Complications[&]	22	2.0	1.2	3.0

Note: The severe maternal morbidity groups are not mutually exclusive. An individual may have experienced events occurring in more than one complication group.

[&]Other obstetric complications include Air and Thrombotic Embolism, Amniotic Fluid Embolism, Eclampsia, and Severe Anesthesia Complications.

Data source: Hospital discharge data, Nebraska Hospital Association.

Table 7-Table 11 display the five most frequent SMM complication groups: hemorrhage, renal, respiratory, cardiac, and other obstetric complications by select demographics: age group, geographic unit, and source of payment.

Table 7. Severe maternal morbidity: hemorrhage complications by select demographic characteristics, Nebraska 2017-2021.

Demographics	**Delivery hospitalizations**	**Hemorrhage complications**			
		Frequency	**Rate per 10,000 delivery hospitalizations**	**95% CI for the rate**	
Age group					
< 20	4,723	12	25.4	13.1	44.4
20-24	20,329	36	17.7	12.4	24.5
25-29	36,182	67	18.5	14.4	23.5
30-34	33,776	90	26.6	21.4	32.8
35+[#]	17,366	87	50.1	40.1	61.8
Total	112,376	292	26.0	13.1	44.4
Geographic unit					
Metropolitan	70,142	161	22.9	19.5	26.8
Micropolitan	28,295	87	30.7	24.6	37.9
Rural	13,934	44	31.6	22.9	42.4
Total	112,371*	292	26.0	19.5	26.8
Source of payment					
Private	69,641	164	23.5	20.1	27.4
Medicaid	38,352	118	30.8	25.5	36.8
Other/uninsured	4,383	10	22.8	10.9	42.0
Total	112,376	292	26.0	13.1	44.4

*Frequency missing = 5

[#]The rate in those aged 35+ is statistically significantly higher than in <20 and 20-24 (p=0.02 and <0.001 respectively)

Data source: Hospital discharge data, Nebraska Hospital Association.

Table 8. Severe maternal morbidity: renal complications by select demographic characteristics, Nebraska 2017-2021.

Demographics	Delivery hospitalizations	Renal complications			
		Frequency	Rate per 10,000 delivery hospitalizations	95% CI for the rate	
Age group					
<24	25,052	29	11.6	7.8	16.6
25-29	36,182	28	7.7	5.1	11.2
30-34	33,776	39	11.5	8.2	15.8
35+	17,366	26	15.0	9.8	21.9
Total	112,376	122	10.9	9.0	13.0
Geographic unit					
Metropolitan[#]	70,142	94	13.4	10.8	16.4
Micropolitan	28,295	18	6.4	3.8	10.1
Rural	13,934	10	7.2	3.4	13.2
Total	112,371*	122	10.9	9.0	13.0
Source of payment					
Private	69,641	73	10.5	8.2	13.2
Medicaid	38,352	43	11.2	8.1	15.1
Other/uninsured	4,383	6	13.7	5.0	29.8
Total	112,376	122	10.9	9.0	13.0

*Frequency missing = 5

[#]The rate in metropolitan areas is statistically significantly higher than in micropolitan areas (p=0.003)

Data source: Hospital discharge data, Nebraska Hospital Association.

Table 9. Severe maternal morbidity: respiratory complications by select demographic characteristics, Nebraska 2017-2021.

Demographics	Delivery hospitalizations	Respiratory complications			
		Frequency	Rate per 10,000 delivery hospitalizations	95% CI for the rate	
Age group					
<24	25,052	23	9.2	5.8	13.8
25-29	36,182	26	7.2	4.7	10.5
30-34	33,776	31	9.2	6.2	13.0
35+[#]	17,366	41	23.6	16.9	32.0
Total	112,376	121	10.8	8.9	12.9
Geographic unit					
Metropolitan	70,142	84	12.0	9.6	14.8
Micropolitan	28,295	23	8.1	5.2	12.2
Rural	13,934	14	10.0	5.5	16.9
Total	112,371*	121	10.8	8.9	12.9
Source of payment					
Private	69,641	63	9.0	7.0	11.6
Medicaid	38,352	-	-	-	-
Other	4,383	-	-	-	-
Total	112,376	121	10.8	8.9	12.9

*Frequency missing = 5

"-" Values have been suppressed due to small counts from 1-5.

[#]The rate in those aged 35+ is statistically significantly higher than in all other age groups ($p < 0.001$ respectively)

Data source: Hospital discharge data, Nebraska Hospital Association.

Table 10. Severe maternal morbidity: other obstetric complications by age group, Nebraska 2017-2021.

Demographics	Delivery hospitalizations	Other obstetric complications[&]			
		Frequency	Rate per 10,000 delivery hospitalizations	95% CI for the rate	
Age group					
<20	4,723	10	21.2	10.2	38.9
20-24	20,329	28	13.8	9.2	19.9
25-29[#]	36,182	20	5.5	3.4	8.5
30-34	33,776	36	10.7	7.5	14.8
35+	17,366	12	6.9	3.6	12.1
Total	112,376	106	9.4	7.7	11.4
Geographic unit					
Metropolitan	70,142	57	8.1	6.2	10.5
Micropolitan	28,295	34	12.0	8.3	16.8
Rural	13,934	15	10.8	6.0	17.8
Total	112,371*	106	9.4	7.7	11.4
Source of payment					
Private	69,641	60	8.6	6.6	11.1
Medicaid	38,352	-	-	-	-
Other/unknown	4,383	-	-	-	
Total	112,376	106	9.4	7.7	11.4

*Frequency missing = 5

[#]The rate in those aged 25-29 is statistically significantly lower than in <20 and 20-24 (p<0.001 respectively)

[&]Other obstetric complications include Air and Thrombotic Embolism, Amniotic Fluid Embolism, Eclampsia, and Severe Anesthesia Complications.

"-" Values have been suppressed due to small counts from 1-5.

Data source: Hospital discharge data, Nebraska Hospital Association.

Table 11. Severe maternal morbidity: cardiac complications by select demographics, Nebraska 2017-2021.

Demographics	Delivery hospitalizations	Cardiac complications			
		Frequency	Rate per 10,000 delivery hospitalizations	95% CI for the rate	
Age group					
<24	25,052	19	7.6	4.6	11.8
25-29	36,182	18	5.0	2.9	7.9
30-34	33,776	28	8.3	5.5	12.0
35+	17,366	21	12.1	7.5	18.5
Total	112,376	86	7.7	6.1	9.5
Geographic unit					
Metropolitan	70,142	54	7.7	5.8	10.0
Micropolitan	28,295	23	8.1	5.2	12.2
Rural	13,934	9	6.5	3.0	12.3
Total	112,371*	86	7.7	6.1	9.5
Source of payment					
Private	69,641	51	7.3	5.4	9.6
Medicaid	38,352	-	-	-	-
Other	4,383	-	-	-	-
Total	112,376	86	7.7	6.1	9.5

*Frequency missing = 5

"-" Values have been suppressed due to small counts from 1-5.

Data source: Hospital discharge data, Nebraska Hospital Association.

Linkage results

For the 5-year period 2017-2021, 98.1% (n=110,252) of delivery hospitalizations from Nebraska's HDD were successfully linked to birth records. *Table 12* presents the matching percentages by year. Additionally, the frequencies in the different categories of race and ethnicity are comparable (p>0.05 when assessed with a chi-squared test) to the distribution of all live births of the same period (*Figure 4*).

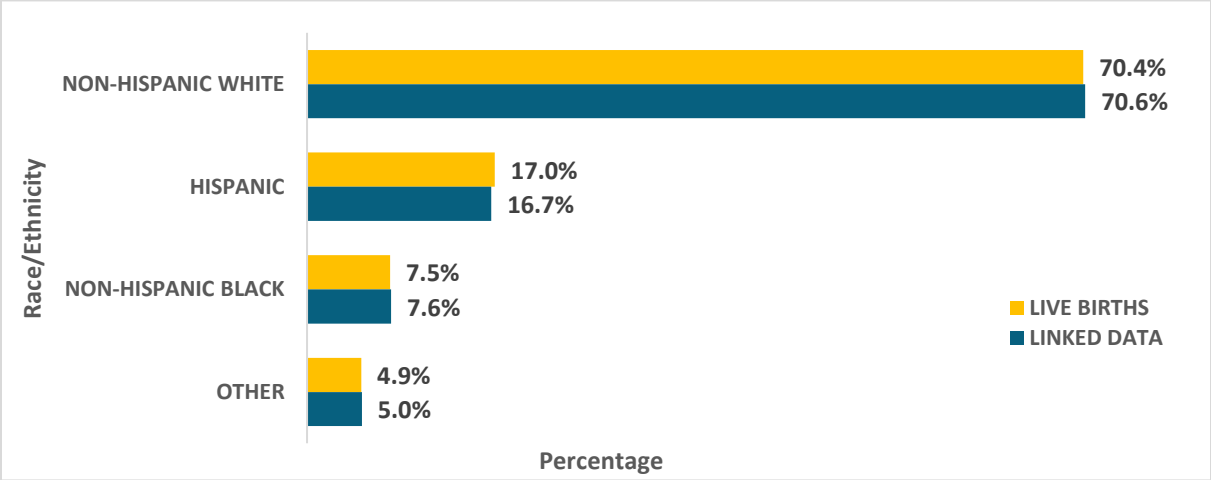
Table 12. Hospital discharge data linkage match to births records, Nebraska 2017-2021.

Year	Delivery hospitalizations	Match frequency	Match percentage
2017	23,381	22,961	98.2%
2018	23,240	22,790	98.1%
2019	22,763	22,323	98.1%
2020	21,495	21,025	97.8%
2021	21,497	21,155	98.4%
Total	112,376	110,252	98.1%

Source for live births data: Nebraska Vital Records Office.
Source for Hospital discharge data: Nebraska Hospital Association.

There was a slight difference between the SMM rate from the linkage data 52.9 (583/110,146; 95% CI 48.7, 57.4) per 10,000 delivery hospitalizations, but this difference was not statistically significantly different from the HDD SMM rate without linkage (58.5 (657/112,376; 95% CI 54.1, 63.1) (*Table 2* and *Table 13*).

Figure 4. Distribution by race and ethnicity of live births (N=120,231) and linked hospital discharge data (n=110,146), Nebraska 2017-2021.



Note: Race/ Ethnicity was unknown for n=106 linked data and for n=117 live births, not included.
Source for live births data: Nebraska Vital Records Office.
Source for hospital discharge data: Nebraska Hospital Association.
^Other race includes those with any race not included in non-Hispanic White, Hispanic, or non-Hispanic Black categories.

In the linked dataset, race and ethnicity data were unknown for 106 individuals of 110,252, approximately 0.1%. This corresponds to an increase in completeness of race and ethnicity data of 111.2% (from 47.3% to 99.9%) compared to HDD alone. Those with unknown race/ethnicity were excluded from the analyses.

SMM rates were statistically significantly different by race and ethnicity ($p < 0.001$) (*Table 13*). Non-Hispanic Black women and Hispanic women experienced significantly higher SMM events compared to non-Hispanic White women (p-value < 0.001 in both cases). There was not a significant difference between non-Hispanic Black women and Hispanic women.

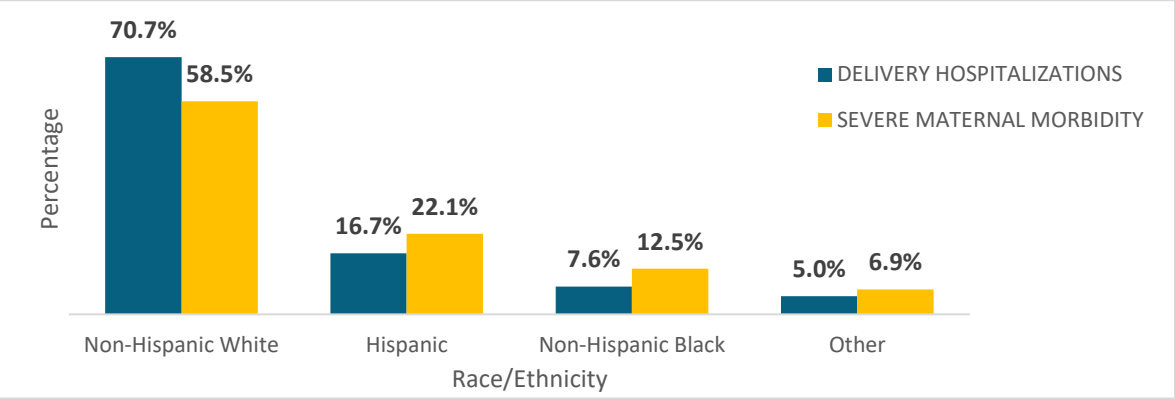
Table 13. Severe Maternal Morbidity by Race and Ethnicity (N=110,146), Nebraska 2017-2021.

Race and ethnicity	**Delivery hospitalizations**	**SMM**	**SMM rate per 10,000**	**95%CI for the rate**		**P-value**
Non-Hispanic White	77,825	341	43.8	39.3	48.7	< 0.001
Hispanic	18,430	129	70.0	58.4	83.2	
Non-Hispanic Black	8,409	73	86.8	68.1	109.2	
Other*	5,482	40	73.0	52.1	99.4	
Total	110,146	583	52.9	48.7	57.4	

Data source: Nebraska Vital Records Office and Nebraska Hospital Association.
^Other race includes those with any race not included in non-Hispanic White, Hispanic, or non-Hispanic Black categories.
Race/Ethnicity unknown for n=106, not included.

While non-Hispanic Black women represented 7.6% of the delivery hospitalizations during the reporting period, 12.5% of the SMM occurred among this population. Hispanic women represented 16.7% of delivery hospitalizations and experienced 22.1% of the SMM (*Figure 5*).

Figure 5. Proportion of delivery hospitalizations (N=110,146) and severe maternal morbidity (n=583) by race/ethnicity, Nebraska 2017-2021.



Data source: Nebraska Vital Records Office and Nebraska Hospital Association.
^Other race includes those with any race not included in non-Hispanic White, Hispanic, or non-Hispanic Black categories.
Race/Ethnicity unknown for n=106, not included.

The five most frequent SMM complication groups are shown in *Table 14* by race and ethnicity. Hemorrhage complications were statistically significantly higher in Hispanics compared to non-Hispanic Whites (p=0.002). Renal complications were statistically significantly higher in non-Hispanic Blacks than non-Hispanic Whites (p<0.001). There was not a statistically significant difference in respiratory, cardiac, and other obstetric complications by race and ethnicity.

Table 14. Most frequent severe maternal morbidity groups by race and ethnicity, Nebraska 2017-2021.

Race and ethnicity	Delivery hospitalizations	Hemorrhage complications		Renal complications		Respiratory complications		Other obstetric complications[&]		Cardiac complications	
		n	Rate* (95%CI)	n	Rate* (95%CI)	n	Rate* (95%CI)	n	Rate* (95%CI)	n	Rate* (95%CI)
Non-Hispanic White	77,810	156	20.0 (17.0, 23.5)	47	6.0 (4.4, 8.0)	60	7.7 (5.9, 9.9)	55	7.1 (5.3, 9.2)	50	6.4 (4.8, 8.5)
Hispanic	18,430	59	32.3 (24.4, 41.3)	21	11.4 (7.1, 17.4)	24	13.0 (8.3, 19.4)	25	13.6 (8.8, 20.0)	10	5.4 (2.6, 10.0)
Non-Hispanic Black	8,406	20	23.8 (14.5, 36.7)	22	26.2 (16.4, 39.6)	12	14.3 (7.4, 24.9)	9	10.7 (4.9, 20.3)	8	9.5 (4.1, 18.8)
Other	5,606	20	35.7 (21.8, 55.1)	6	10.7 (3.9, 23.3)	5	8.9 (2.9, 20.8)	6	10.7 (3.9, 23.3)	5	8.9 (2.9, 20.8)
Total	110,252	255	23.1 (20.4, 26.1)	96	8.7 (7.1, 10.6)	101	9.2 (7.5, 11.1)	95	8.6 (7.9, 10.5)	73	6.6 (5.2, 8.3)

*Rate = severe maternal morbidity per 10,000 delivery hospitalizations. n = frequency.

Data source: Nebraska Vital Records Office and Nebraska Hospital Association.

[&]Other obstetric complications include Air and Thrombotic Embolism, Amniotic Fluid Embolism, Eclampsia, and Severe Anesthesia Complications.

^Other race includes those with any race not included in non-Hispanic White, Hispanic, or non-Hispanic Black categories.

Conclusion

Severe maternal morbidity is an important component of maternal health, allowing analysis of greater numbers of maternal complications than maternal deaths. Linking HDD and vital records data for births enables the identification and a more complete analysis of the epidemiology of SMM in Nebraska. Grouping the SMM by type of complication rather than specific cause presents a broader picture of the situation and can assist in prioritizing areas for intervention to prevent future SMM events. Hemorrhage complications are the most frequent SMM encountered in Nebraska. Disparities exist in the SMM rates, with women aged 35 years old or older, women with Medicaid as their source of payment, and non-Hispanic Black and Hispanic women having higher rates of SMM.

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Appendix 1. Diagnosis and procedure codes used to define 21 indicators of severe maternal morbidity and corresponding ICD-10-CM/PCS codes during delivery hospitalization as specified by the CDC (Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau, 2023).

Severe Maternal Morbidity Indicator	DX or PR	ICD-10 short
1. Acute myocardial infarction	DX	I21.xx, I22.x
2. Aneurysm*	DX	I71.xx* I79.0*No I71.7 code exists, so ICD-10 list encompasses all possible I71 codes
3. Acute renal failure	DX	N17.x, O90.4
4. Adult respiratory distress syndrome	DX	J80, J95.1, J95.2, J95.3, J95.82x, J96.0x, J96.2x R09.2
5. Amniotic fluid embolism	DX	O88.1x
6. Cardiac arrest/ventricular fibrillation*	DX	I46.x, I49.0x
7. Conversion of cardiac rhythm	PR	5A2204Z, 5A12012
8. Disseminated intravascular coagulation	DX	D65, D68.8, D68.9, O72.3
9. Eclampsia	DX	O15. X
10. Heart failure/arrest during surgery or procedure	DX	I97.12x, I97.13x, I97.710, I97.711
11. Puerperal cerebrovascular disorders	DX	I60.xx- I68.xx, O22.51, O22.52, O22.53, I97.81x, I97.82x, O87.3 I62.9 – included but should not be captured if this is not a valid code.
12. Pulmonary edema / Acute heart failure	DX	J81.0, I50.1, I50.20, I50.21, I50.23, I50.30, I50.31, I50.33, I50.40, I50.41, I50.43, I50.9
13. Severe anesthesia complications	DX	O74.0 , O74.1 , O74.2, O74.3, O89.0x, O89.1, O89.2
14. Sepsis	DX	O85, O86.04, T80.211A, T81.4XXA, T81.44xx, **or** R65.20 **or** A40.x, A41.x, A32.7
15. Shock	DX	O75.1, R57.x, R65.21, T78.2XXA, T88.2 XXA, T88.6 XXA, T81.10XA , T81.11XA, T81.19XA
16. Sickle cell disease with crisis	DX	D57.0x, D57.21x, D57.41x, D57.81x
17. Air and thrombotic embolism	DX	I26.x, O88.0x, O88.2x, O88.3x, O88.8x
18. Blood products transfusion (no longer used, however presented for completeness in accordance with CDC definition)	PR	30233 Peripheral vein, percutaneous (7th digit: x=1: nonautologous) 30240 Central Vein, open (7th digit: x=1: nonautologous) 30243 Central Vein, percutaneous (7th digit: x=1: nonautologous x=0: autologous) + Hx (whole blood), Kx (frozen plasma), Lx (fresh Plasma), Mx (plasma cryoprecipitate), Nx (red blood cells), Px (frozen Red cells), Rx (platelets), Tx (fibrinogen), Blood Complete list of blood product transfusion codes not included here to save space
19. Hysterectomy	PR	0UT90ZZ, 0UT94ZZ, 0UT97ZZ, 0UT98ZZ, 0UT9FZZ
20. Temporary tracheostomy*	PR	0B110Z, 0B110F, 0B113, 0B114
21.Ventilation	PR	5A1935Z, 5A1945Z, 5A1955Z