

Are there Precursors to Severe Maternal Morbidity?

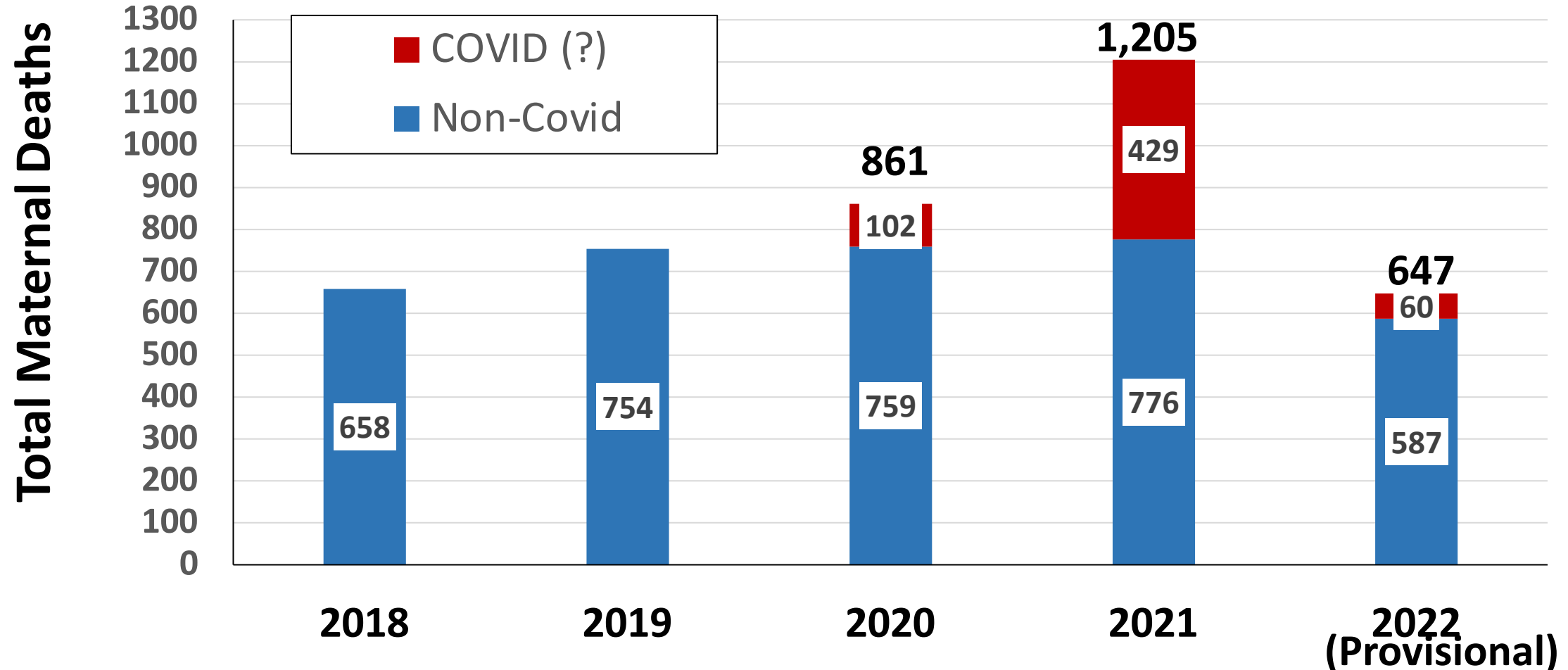
NICHD Maternal Health Coordinating Committee
May 16, 2023

Gene Declercq, PhD
Boston University School of Public Health
NIH: R01MD016026



Why do we focus on Severe Maternal Morbidity?

2018-2022 COVID & Maternal Deaths



Relatively small numbers of deaths at the national level

Source: CDC Wonder Mortality File

Severe Maternal Morbidity

- If deaths are too rare to serve as a basis for policy and practice, can we identify and learn lessons from near death experiences?
- The problem with severe maternal morbidity



***“One searches
where there is
light”***

Goethe 1749–1832

Source: Barry. *The Great
Influenza*. 2004 p. 71

Considering Severe Maternal Morbidity

- The “Textbook” definition of maternal morbidity:
 - “Condition directly caused by pregnancy, regardless of whether it manifests during or after pregnancy termination [end].”

Or....

- “Condition that existed before pregnancy, but is exacerbated by pregnancy.”

Or even....

- “Condition whose causal relationship to pregnancy is undetermined.” (but it occurred during or after pregnancy)

(Adams, Alexander, Kirby & Wingate, 2007)

Or the CDC definition

Severe maternal morbidity includes unexpected outcomes of labor and delivery that result in significant short- or long-term consequences to a woman’s health.

Severe Maternal Morbidity

- **How do you identify cases?**
 - **Diagnosis** of disease/condition (GDM, preeclampsia, depression, dehydration)
 - **Event** (stroke, seizure, hemorrhage, perineal tear, postpartum infection)
 - **Treatment/intervention** (blood transfusion, sutures, antibiotics, hydration therapy, etc...)

Where would you find systematic data on these?

**CDC's revised
Algorithm:
16 conditions
& 5 procedures**

**Relatively easy
algorithm to
apply to any
ICD based
dataset.**

Led to.....

Severe maternal morbidity indicator	Diagnosis or procedure	ICD-9-CM code
Acute myocardial infarction	Diagnosis	410.xx
Aneurysm	Diagnosis	441.xx
Acute renal failure	Diagnosis	584.5, 584.6, 584.7, 584.8, 584.9, 669.3x
Adult respiratory distress syndrome	Diagnosis	518.5x, 518.81 518.82 518.84, 799.1
Amniotic fluid embolism	Diagnosis	673.1x
Cardiac arrest/ventricular fibrillation	Diagnosis	427.41, 427.42, 427.5
Disseminated intravascular coagulation	Diagnosis	286.6, 286.9, 666.3x
Eclampsia	Diagnosis	642.6x
Heart failure/arrest during surgery or procedure	Diagnosis	997.1
Puerperal cerebrovascular disorders	Diagnosis	430.xx, 431.xx, 432.xx, 433.xx, 434.xx, 436.xx, 437.xx, 671.5x, 674.0x, 997.02
Pulmonary edema/acute heart failure	Diagnosis	518.4, 428.1, 428.0, 428.21, 428.23, 428.31, 428.33, 428.41, 428.43
Severe anesthesia complications	Diagnosis	668.0x, 668.1x, 668.2x
Sepsis	Diagnosis	038.xx, 995.91, 995.92, 670.2x
Shock	Diagnosis	669.1x, 785.5x, 995.0, 995.4, 998.0x
Sickle cell disease with crisis	Diagnosis	282.42, 282.62, 282.64, 282.69
Air and thrombotic embolism	Diagnosis	415.1x, 673.0x, 673.2x, 673.3x, 673.8x
Blood transfusion	Procedure	99.0x
Conversion of cardiac rhythm	Procedure	99.6x
Hysterectomy	Procedure	68.3x–68.9x
Temporary tracheostomy	Procedure	31.1
Ventilation	Procedure	93.90, 96.01, 96.02, 96.03, 96.05

Severe maternal morbidity and comorbid risk in hospitals performing <1000 deliveries per year

Mark P. Hehir, MD, MBA, MRCPI; Cande V. Ananth, PhD, MPH; Jason D. Wright, MD; Zainab Siddiq, MS; Mary E. D'Alton, MD; Alexander M. Friedman, MD, MPH

The impact of socioeconomic position on severe maternal morbidity outcomes among women in Australia: a national case-control study

A Lindauist.^{a,b,*} N Noor.^{a,*} E Sullivan.^c M Kniat^a

Severe Maternal Morbidity and Mortality of Pregnant Patients With COVID-19 Infection During the Early Pandemic Period in the US

Koji Matsuo, MD, PhD; Jessica M. Green, MD; Sarah A. Herrman, BS; Rachel S. Mandelbaum, MD; Joseph G. Ouzounian, MD, MBA

Racial Disparities in Severe Maternal Morbidity in an Integrated Health Care System, Southern California, 2008–2017

Lisa P. Oakley, PhD, MPH^{a,b,*}, Xia Li, MS^b, Sara Y. Tartof, PhD^b, Madalynne Wilkes-Grundy, MD^c, Michael J. Fassett, MD^d, Jean M. Lawrence, ScD, MPH^b

Trend and risk factors for severe peripartum maternal morbidity - a population-based cohort study

Danielle Ben-Ayoun¹ · Asnat Walfisch² · Tamar Wainstock³ · Eyal Sheiner⁴ · Majdi Imterat^{4,5}

State Variation in Severe Maternal Morbidity Among Individuals With Medicaid Insurance

Lindsay K. Admon, MD, MSc, Samantha G. Auty, MS, Jamie R. Daw, PhD, Katy B. Kozhimannil, PhD, MPA, Eugene R. Declercq, PhD, Na Wang, PhD, and Sarah H. Gordon, PhD

Evaluating Iowa Severe Maternal Morbidity Trends and Maternal Risk Factors: 2009–2014

Brittini N. Frederiksen^{1,2,7} · Catherine J. Lillehoj³ · Debra J. Kane^{1,4} · Dave Goodman⁵ · Kristin Rankin⁶

Severe Maternal Morbidity and the Use of Assisted Reproductive Technology in Massachusetts

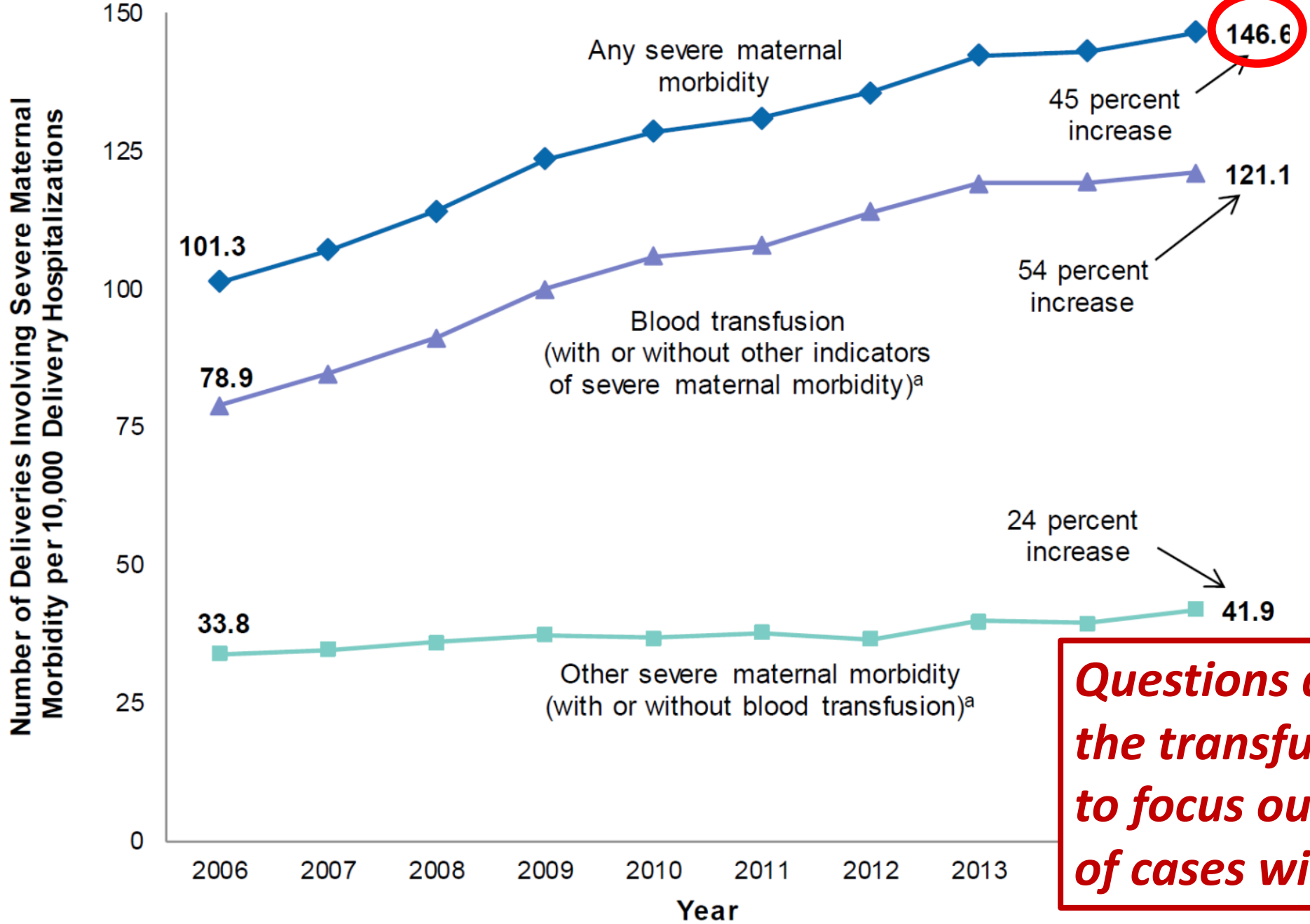
Candice Belanoff, ScD, MPH, Eugene R. Declercq, PhD, Hafsatou Diop, MD, MPH, Daksha Gopal, MPH, Milton Kotelchuck, PhD, MPH, Barbara Luke, ScD, MPH, Thien Nguyen, MPH, and Judy E. Stern, PhD

Severe Maternal Morbidity in Twins

Anna Binstock, MD¹ · Lisa M. Bodnar, PhD, MPH, RD² · Katherine P. Himes,

Severe Maternal Morbidity Associated With Maternal Birthplace: A Population-Based Register Study

Contemporary Studies of Maternal Morbidity



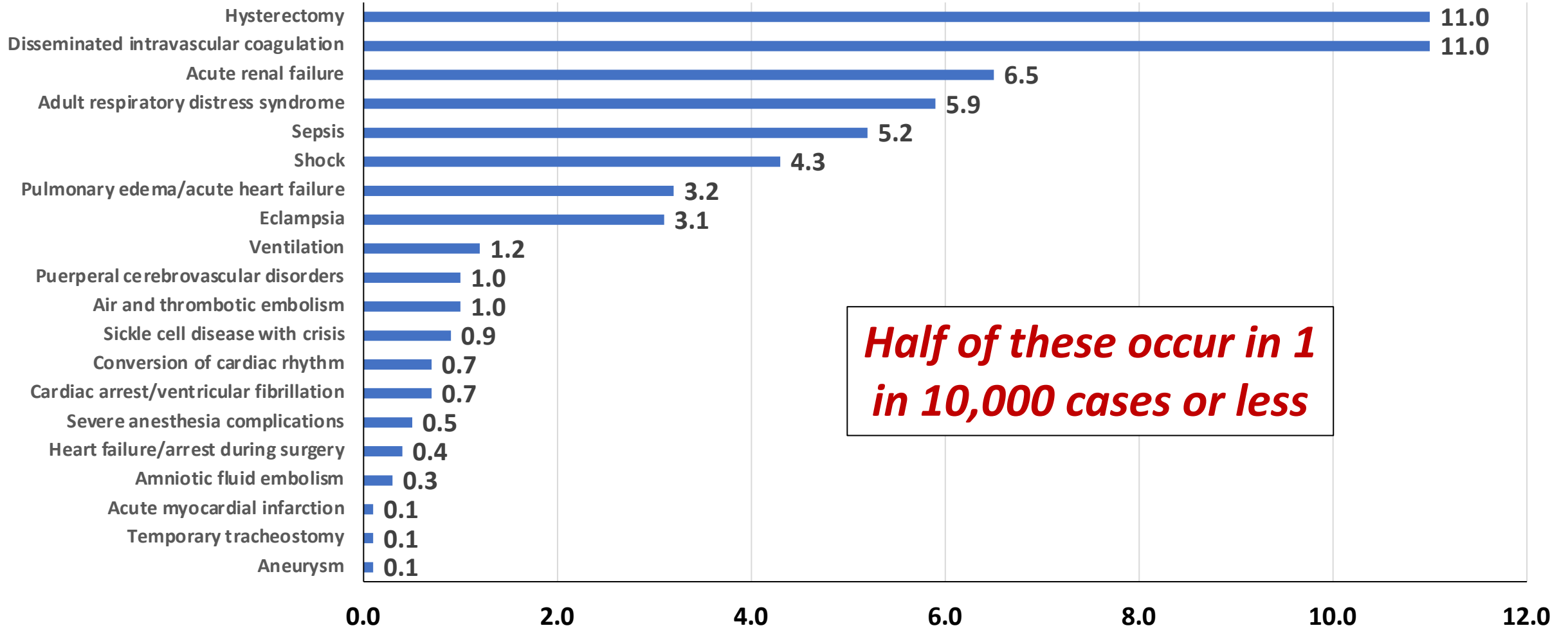
Trends in delivery hospitalizations involving severe maternal morbidity, 2006–2015

Questions about the validity of the transfusion measure led us to focus our research on rates of cases without transfusion.

Source: Finger K. Trends and Disparities in Delivery Hospitalizations Involving Severe Maternal Morbidity, 2006–2015. HCUP Stat Brief #243. Sept., 2018.

Delivery hospitalizations involving severe maternal morbidity, for each indicator of severe maternal morbidity, 2015

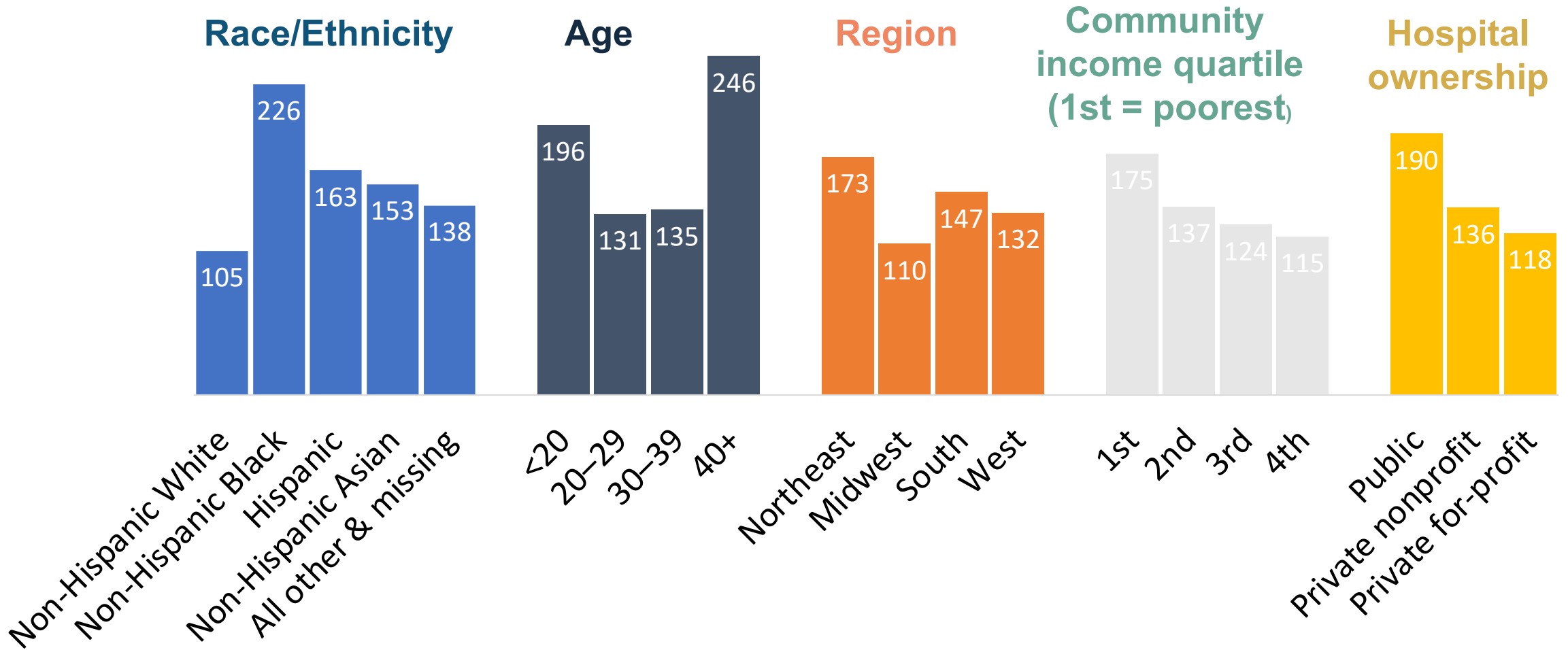
Rate per 10,000



Half of these occur in 1 in 10,000 cases or less

There are strong relationships between SMM & race/ethnicity, age, region, community-level income, and hospital type.

Severe maternal morbidity per 10,000 births, 2016–17

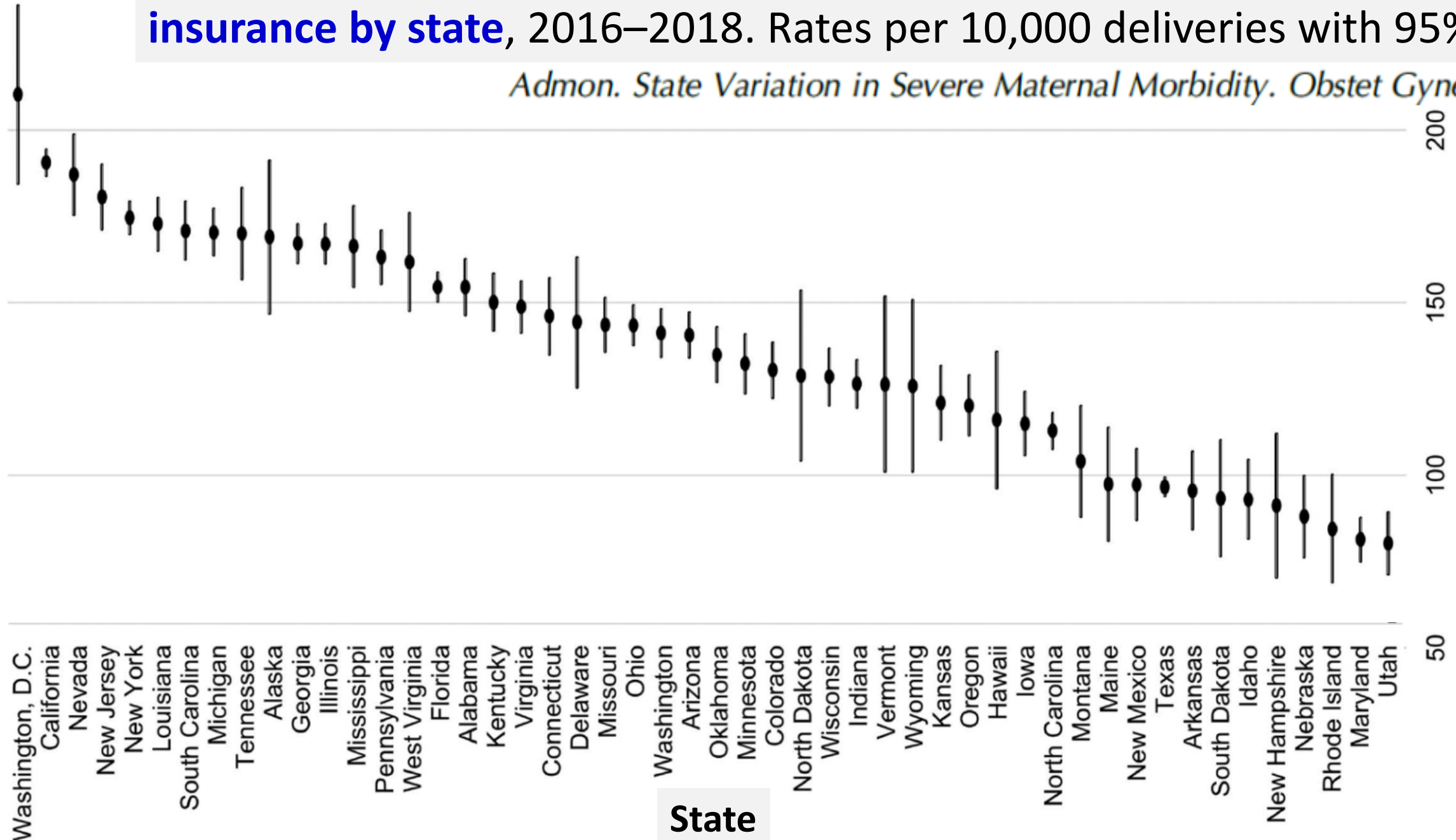


Data: Clare C. Brown et al., "[Associations Between Comorbidities and Severe Maternal Morbidity](#)," *Obstetrics and Gynecology* 136, no. 5 (Nov. 2020): 892–901.

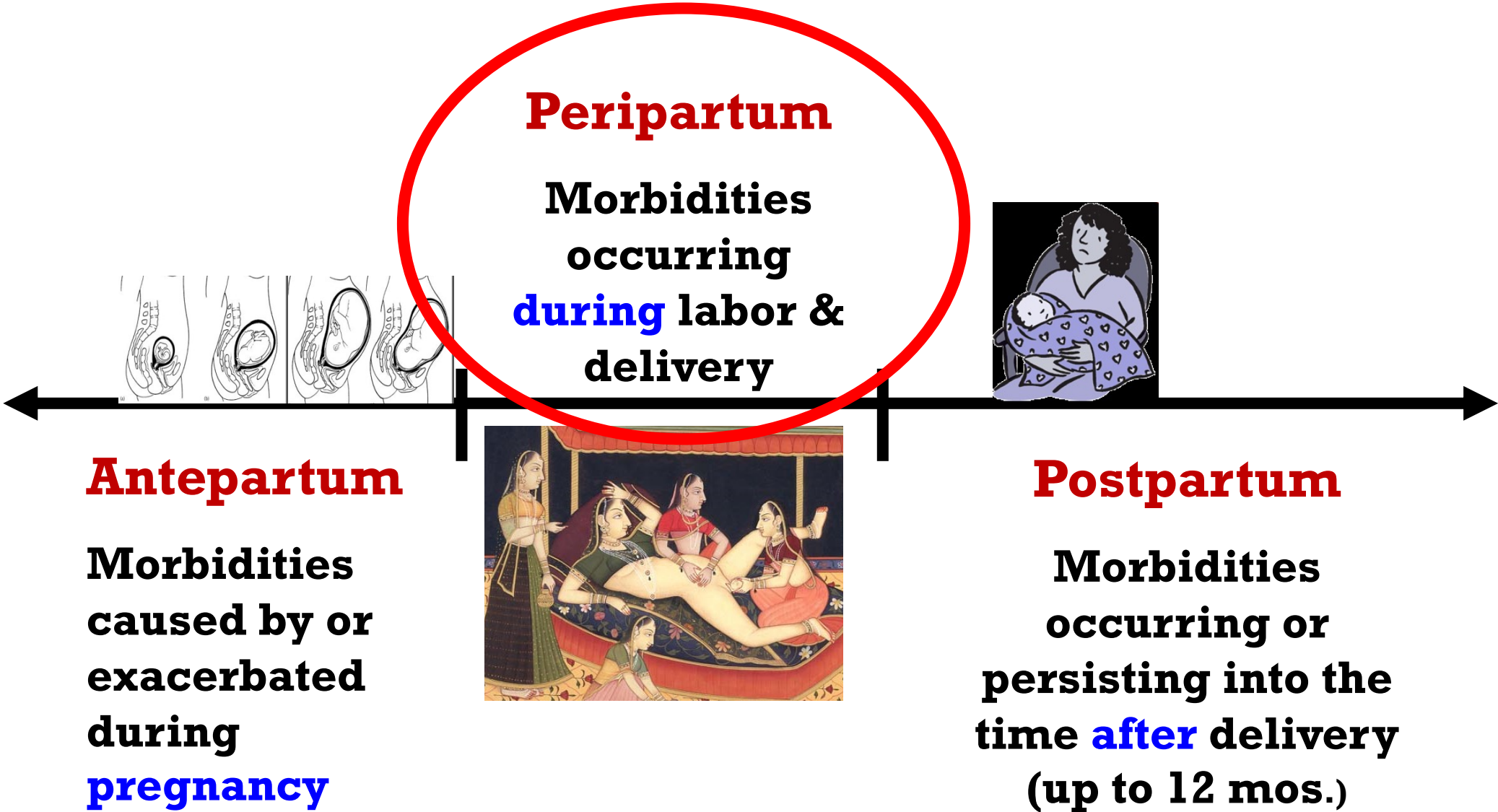
Source: Eugene Declercq and Laurie Zephyrin, *Severe Maternal Morbidity in the United States: A Primer* (Commonwealth Fund, Oct. 2021).

Rates of severe maternal morbidity among **individuals with Medicaid insurance by state**, 2016–2018. Rates per 10,000 deliveries with 95% CIs.

Admon. State Variation in Severe Maternal Morbidity. Obstet Gynecol 2023.

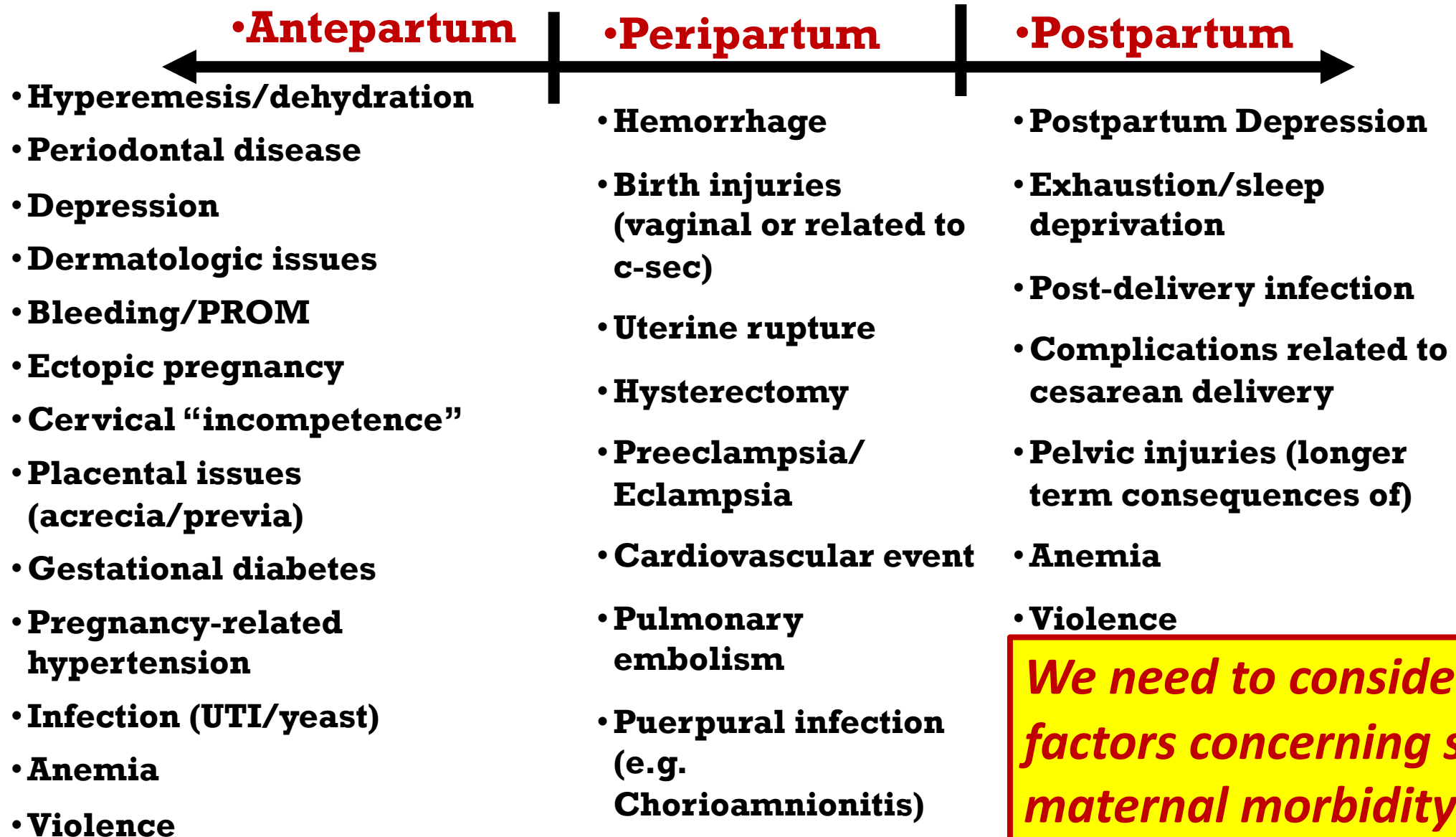


Rethinking the Scope of Maternal Morbidity



Rethinking the Scope of maternal morbidity

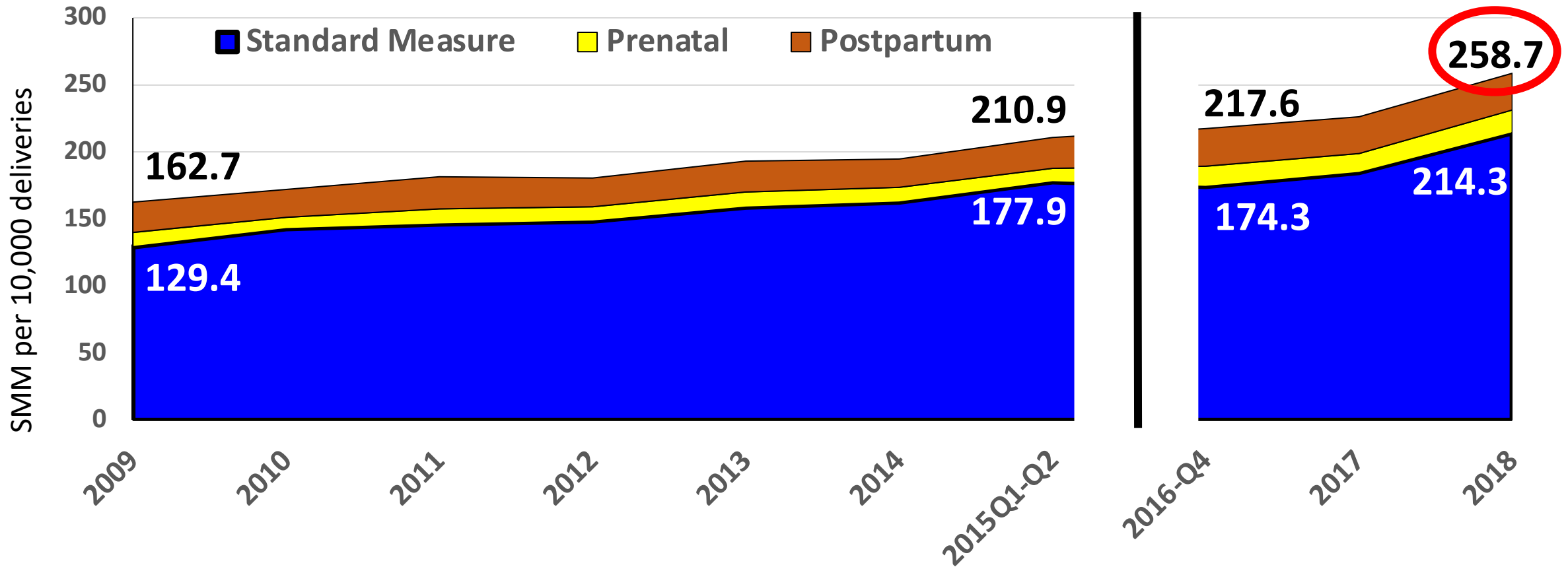
*Note: These are all unlikely to happen to **you**. Especially the really bad ones.....*



We need to consider 2 more factors concerning severe maternal morbidity

(1) Frequency of severe morbidities outside of the birth hospitalization? (21% more cases)

Severe Maternal Morbidity (per 10,000 deliveries), by Timing, Mass. 2009-18



SMM21 Based on ICD-9

SMM Based on ICD-10

(2) Mothers' voices – what are the problems they face from their perspective? (often don't involve hospitals)

Table 4. Mothers' experience of selected new-onset health problems in first two months and at six months or more after birth

Base: all mothers eligible for question (see notes)	In first two months			Problem persisted to six months or more
	Major new problem	Minor new problem	Major/minor new problem	
Vaginal only*				
Painful perineum <i>n</i> =1656	11%	30%	41%	7%
Infection from cut or torn perineum <i>n</i> =1656	5%	13%	18%	4%
Cesarean only (base varies)				
Pain at site of cesarean incision <i>n</i> =744*	19%	39%	58%	16%
Infection at site of cesarean incision <i>n</i> =744*	8%	16%	24%	5%

Learning from Listening to Mothers

How much did pain interfere with your routine activities?

	In two months after birth Base: all initial <i>LTM III</i> mothers		
	Vaginal <i>n</i> =1656	Cesarean <i>n</i> =744	All <i>n</i> =2400
Extremely	3%	10%	4%
Quite a bit	6%	16%	7%
Moderately	21%	25%	22%
A little bit	43%	36%	42%
Not at all	27%	14%	24%

SMM also doesn't include postpartum depression

American Journal of Obstetrics & Gynecology

AJOG • MFM

Maternal-Fetal Medicine

Preconception and Perinatal Hospitalizations as Indicators of Risk for Severe Maternal Morbidity in Primiparas

- Audra R Meadows, MD, MPH
- Howard Cabral, PhD, MPH
- Chia-ling Liu, ScD, MPH
- Ndidiyama Amutah-Onukagha, PhD, MPH
- Hafsatou Diop, MD, MPH
- Eugene R. Declercq, PhD

In progress – final proof not yet available

PELL Data System

Program Participation Data

WIC

Early Intervention

Assisted Reproductive Tech.

All Payers Claims (Partial)

CORE

Birth Certificate

(HD) Birth Mothers

Longitudinal

Fetal Death

(HD) Birth Child

1998-2018
1,641,514 births

Future Datasets: All Payers Data, DESE (School),

Vital and Health Status Data

Newborn Hearing Screening

Birth Defects Registry

Child and Mother deaths

Pregnancy-associated deaths

Linked birth-infant deaths

Cancer Registry

PRAMS

Contextual Data

Geocoded birth data

Census 2020 Data

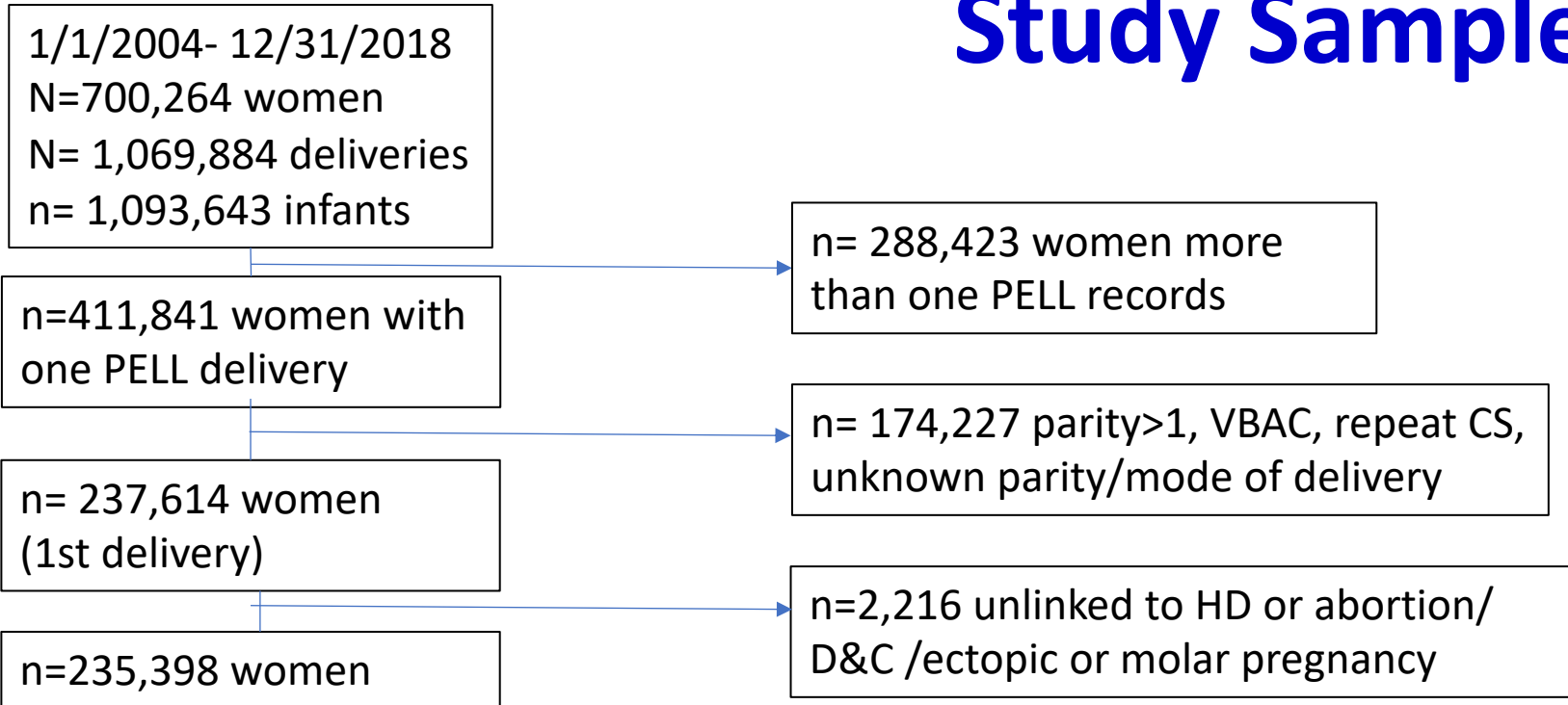
Health Services Utilization Data w/ diagnosis codes & charges

Non-birth Hospital Discharge

Observational Stays

Emergency Department

Study Sample



N= 2,120 women with SMM20

N= 233,278 women without SMM20

N= 2,085 livebirths

N= 35 fetal deaths

Using 2004-2018 so we can explore 5 years of hospitalization prior to pregnancy

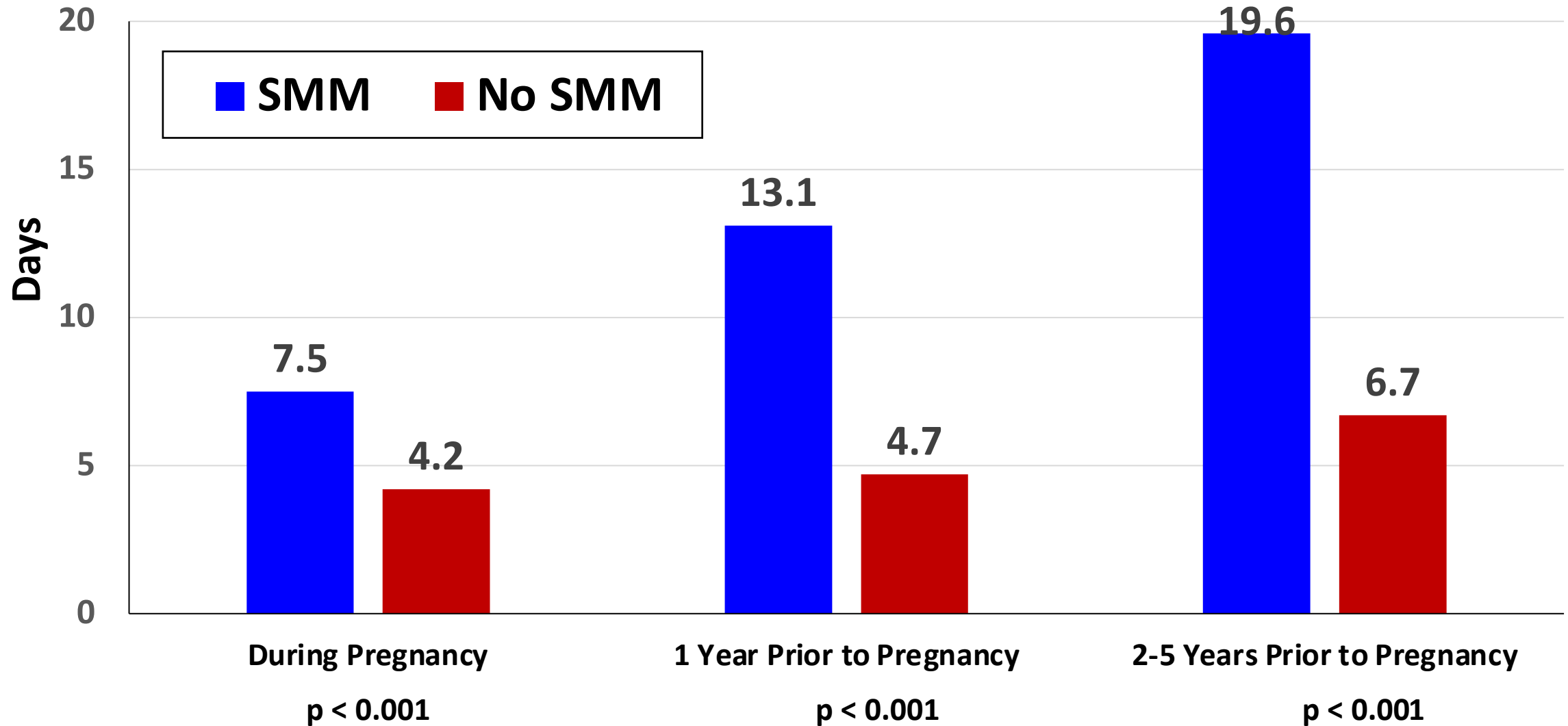
Profiling SMM Mass. 2004-2018	SMM20		Non-SMM20		SMM/ 10,000	(95% C.I.)
	n	%	n	%		
Total	2,120	100.0	233,278	100.0	90.1	87.0-94.7
Maternal Age						
<25	449	21.2	64,905	27.8	68.7	62.8-75.5
25-29	474	22.4	57,729	24.7	81.4	74.8-89.4
30-34	598	28.2	66,291	28.4	89.4	83.0-97.4
35-39	419	19.8	33,763	14.5	122.6	112.4-135.8
40+	180	8.5	10,590	4.5	167.1	145.6-194.4
Race Ethnicity						
Non-Hispanic White	1,142	53.9	142,903	61.3	79.3	75.3-84.5
Non-Hispanic Black	328	15.5	22,339	9.6	144.7	131.2-162.5
Non-Hispanic Asian/Pac.Isl.	229	10.8	25,277	10.8	89.8	79.0-102.2
Non-Hispanic Amer. Ind.AN	34	1.6	3,072	1.3	109.5	73.9-147.5
Hispanic	332	15.7	36,886	15.8	89.2	80.4-99.6
Maternal Education						
< High School	180	8.5	20,192	8.7	88.4	76.2-102.1
High School or GED	479	22.6	58,824	25.2	80.8	74.2-88.7
Some College	410	19.3	43,954	18.8	92.4	84.3-102.2
College and Above	987	46.6	106,779	45.8	91.6	86.7-98.1

Likelihood of a Prior Hospital Contact for Women with & without SMM, Mass., 2004--18

	SMM20 % hosp. contacts (n=2,120)	Non-SMM20 % hospital Contacts (n=233,278)	Crude		Adjusted*	
			RR*	95% CI	RR*±	95% CI
Prenatal						
Hospital Admissions	10.4	4.3	2.44	2.15-2.76	1.31	1.16-1.49
Emerg. Dept. Visits	30.9	26.4	1.17	1.10-1.25	1.13	1.06-1.20
HD/ED/Observ Stay	41.3	34.7	1.19	1.13-1.25	1.07	1.02-1.13
1 yr prior pregnancy						
Hospital Admissions	4.4	2.2	2.04	1.67-2.49	1.60*	1.31-1.96
Emerg. Dept. Visits	24.1	23.2	1.04	0.96-1.12	1.02*	0.94-1.09
HD/ED/OS	25.5	24.2	1.05	0.98-1.13	1.01*	0.95-1.09
2-5 yrs prior preg.						
Hospital Admissions	9.2	5.3	1.72	1.50-1.97	1.41*	1.23-1.62
Emerg. Dept. Visits	38.3	37.3	1.03	0.97-1.08	0.99*	0.94-1.04
HD/ED/OS	40.5	38.8	1.04	0.99-1.10	1.00*	0.95-1.05

*Adjusted for mat. age, race/ethnicity, educ., health ins., chronic & gestational hypert. & diabetes, plurality, gest., Method of Delivery, birth outcome & time period

Mean Total Length of Hospital Stays, by Time Period and Severe Maternal Morbidity, Massachusetts, 2004-18



Conditions Associated with Hospital Admissions among Women with & without SMM during Pregnancy, Mass., 2004 – 2018

PRENATAL	SMM (N=2,120)		non-SMM (N=233,278)		Rate Ratio	95% CI
	n	%	n	%		
Any Hospital Admission	220	10.4	9,939	4.3	2.44	2.15-2.76
Neuro/Psychiatric	55	2.6	1,940	0.8	3.12	2.39-4.06
Respiratory/Pulmonary	45	2.1	1,164	0.5	4.25	3.17-5.71
Musculoskeletal	38	1.8	426	0.2	9.82	7.06-13.64
Gastrointestinal/Digestive	48	2.3	1,432	0.6	3.69	2.78-4.90
Endocrine	77	3.6	2,081	0.9	4.07	3.26-5.09
Cardiovascular	48	2.3	543	0.2	9.73	7.26-13.03
Renal/Urinary	44	2.1	1,754	0.8	2.76	2.05-3.71
Hematologic	70	3.3	1,106	0.5	6.96	5.49-8.83
Reproductive	213	10.0	9,450	4.1	2.48	2.18-2.82

Conditions Associated with Hospital Admissions among Women with & without SMM, One Year Prior to Pregnancy, Mass., 2004 – 2018

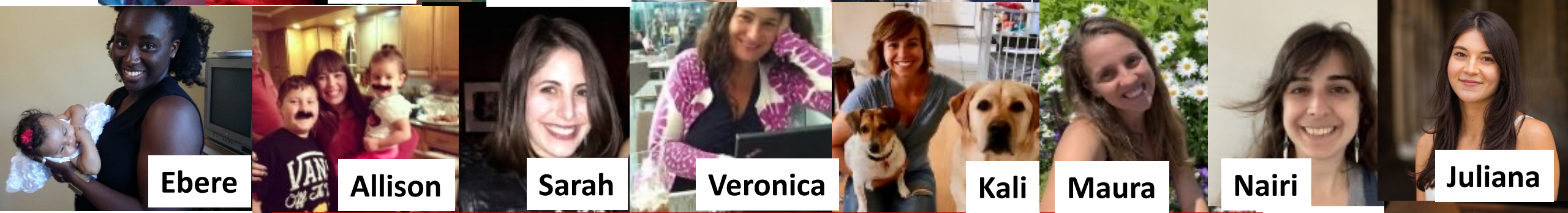
One Year Prior	SMM (N=2,120)		non-SMM (N=233,278)		Rate Ratio	95% CI
	n	%	n	%		
Any Hospital Admission	93	4.4	5,025	2.2	2.04	1.67-2.49
Neuro/Psychiatric	60	2.8	2,737	1.2	2.41	1.87-3.10
Respiratory/Pulmonary	31	1.5	1,170	0.5	2.92	2.05-4.15
Musculoskeletal	26	1.2	590	0.3	4.85	3.28-7.17
Gastrointestinal/Digestive	40	1.9	1,540	0.7	2.86	2.09-3.90
Endocrine	39	1.8	1,584	0.7	2.71	1.98-3.71
Cardiovascular	27	1.3	602	0.3	4.94	3.36-7.24
Renal/Urinary	32	1.5	1,196	0.5	2.94	2.08-4.17
Hematologic	34	1.6	600	0.3	6.24	4.43-8.79

Conditions Associated with Hospital Admissions among Women with & without SMM 2-5 years Prior to Pregnancy, Mass., 2004 – 2018

2-5 yrs prior pregnancy	SMM		non-SMM		Rate Ratio	95% CI
	n	%	n	%		
Any Hospital Admission	194	9.2	12,417	5.3	1.72	1.50-1.97
Neuro/Psychiatric	90	4.2	6,152	2.6	1.61	1.31-1.97
Respiratory/Pulmonary	69	3.3	3,067	1.3	2.48	1.96-3.13
Musculoskeletal	42	2.0	1,683	0.7	2.75	2.03-3.72
Gastrointestinal/Digestive	68	3.2	3,974	1.7	1.88	1.49-2.38
Endocrine	83	3.9	3,740	1.6	2.44	1.97-3.02
Cardiovascular	72	3.4	1,547	0.7	5.12	4.06-6.46
Renal/Urinary	63	3.0	2,881	1.2	2.41	1.88-3.08
Hematologic	62	2.9	1,580	0.7	4.32	3.36-5.55

Lessons from Severe Maternal Morbidity

- The popular CDC definition, focusing on birth hospitalizations, is too narrow to really capture challenges we now face in childbirth and women's health care.*
- Women who experience SMM have a history of greater hospital admissions during & prior to pregnancy. Missed opportunities for preventive care?*
- These data are still hospital based and don't capture ambulatory care or the life experiences of pregnant women beyond medical encounters.*



www.birthbythenumbers.org

EMAIL: birthbynumbers@gmail.com

FACEBOOK: www.facebook.com/BirthByTheNumbers

Gene