

What we know (and don't know) about maternal mortality and severe morbidity in the U.S.

Gene Declercq, PhD

Boston University School of Public Health

OB/GYN Grand Rounds

Boston Medical Center

July 3, 2024

www.birthbythenumbers.org

Goals of the session

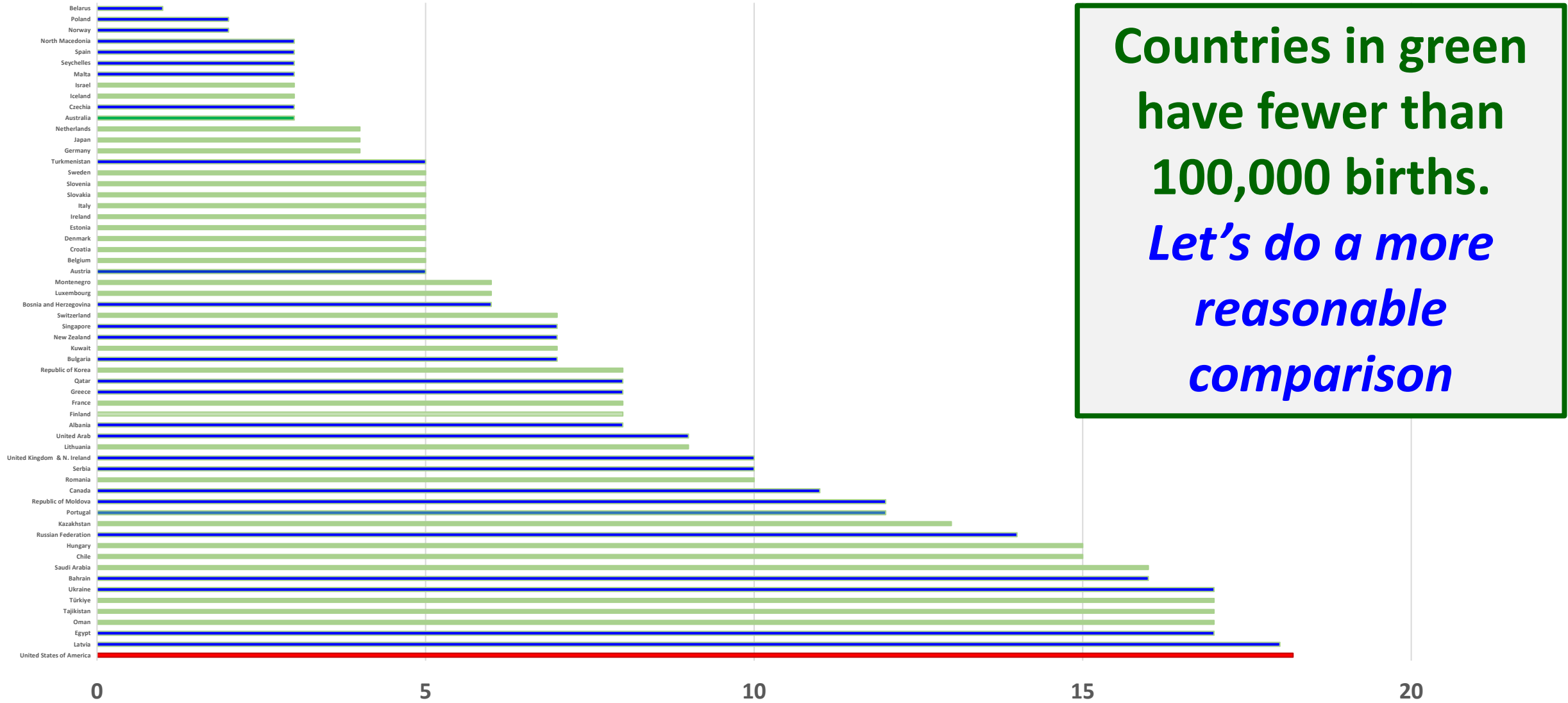
- Describe the challenges in systematically measuring maternal mortality in the U.S.
- Describe current trends and disparities in maternal mortality and severe morbidity in the U.S.
- Identify steps being taken to improve the measurement of mortality and morbidity.

Theme of the session

There are serious and challenging problems in accurately measuring maternal mortality in the U.S., but they don't get us off the hook – we still have a problem.

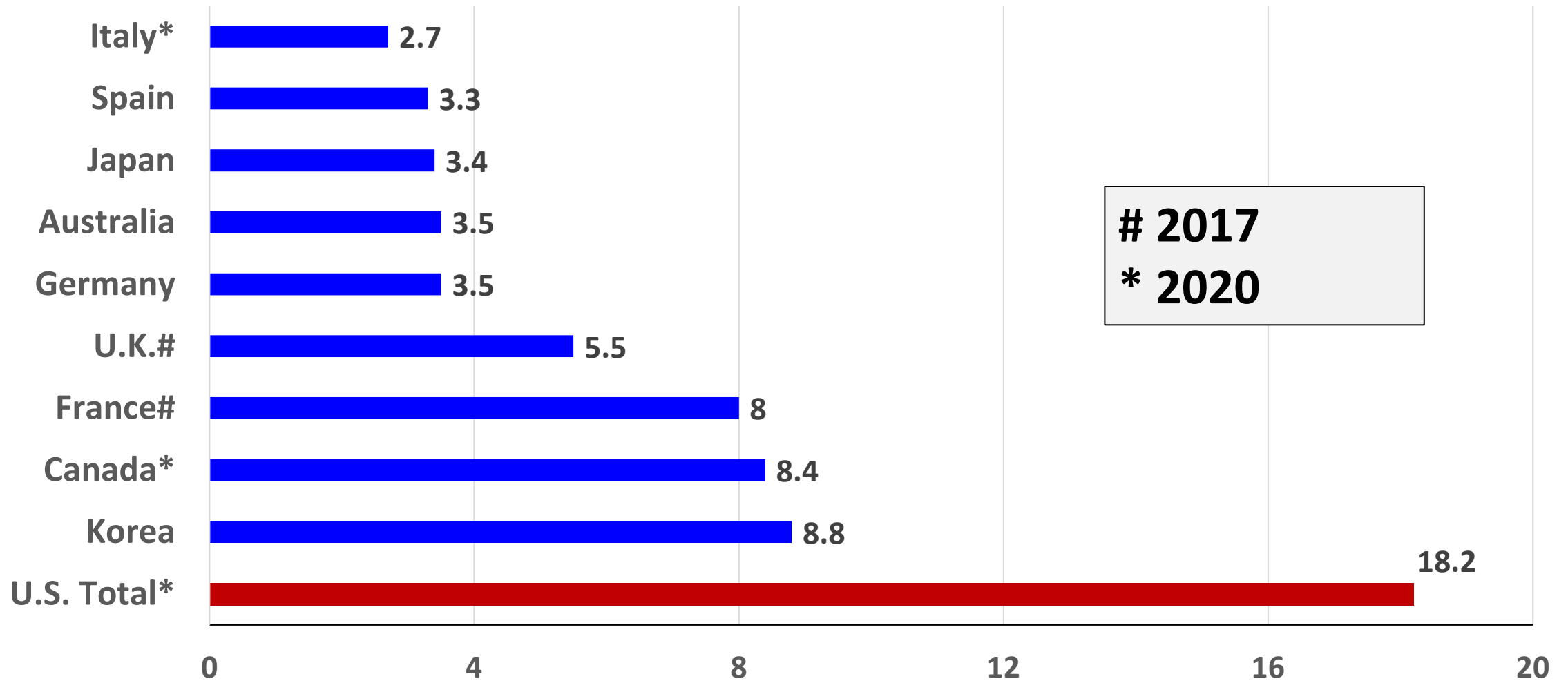
Maternal Mortality Ratios (per 100,000 births), 2020

Using the most conservative measure we have of U.S. maternal mortality

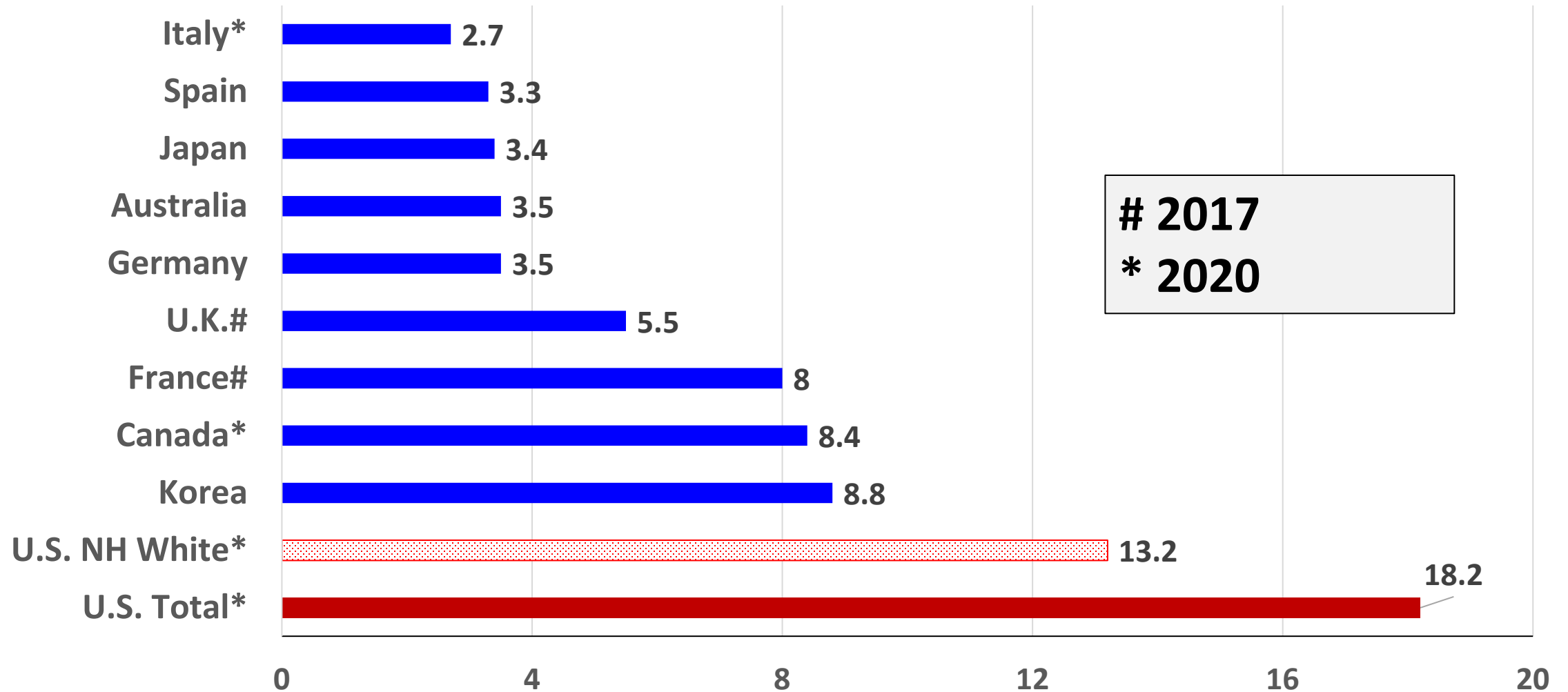


Countries in green have fewer than 100,000 births.
Let's do a more reasonable comparison

U.S. Maternal Mortality Ratio (per 100,000 births) Compared to Industrialized Countries with 300,000+ births, 2021-22

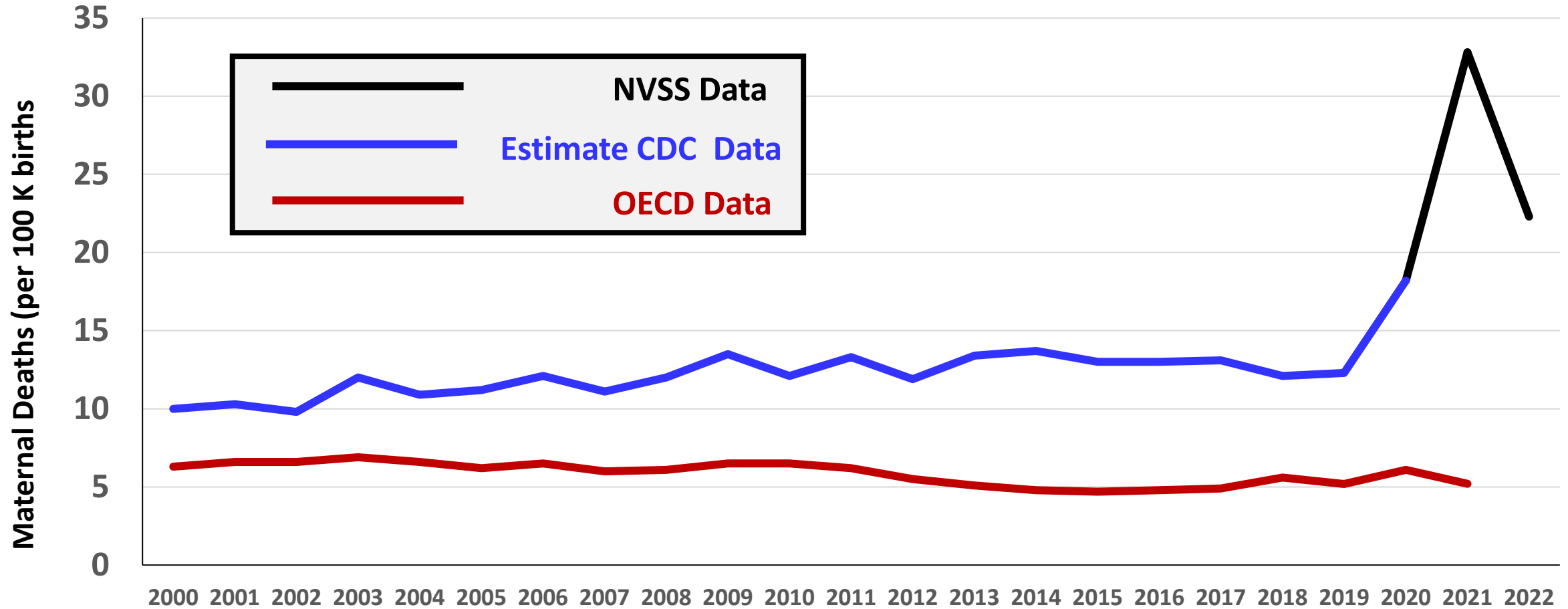


U.S. Maternal Mortality Ratio (per 100,000 births) Compared to Industrialized Countries with 300,000+ births, 2021-22



2017
* 2020

Maternal Mortality Ratio (per 100K births), 2000-2022, U.S. & Comparable Countries*



* Countries with **300,000+** births (2019): Australia, Canada, France, Germany, Italy, Japan, S. Korea, Spain, United Kingdom

Sources: OECD Health Data 2024; & U.S. Estimated from NVSS & Pregnancy Mortality Surveillance System

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1. Challenges in systematically measuring maternal mortality in the U.S. – the source matters

Death is easy, determining it is “pregnancy related” is hard.

Would this person have died if they hadn't been pregnant?

Three systems in the U.S.:

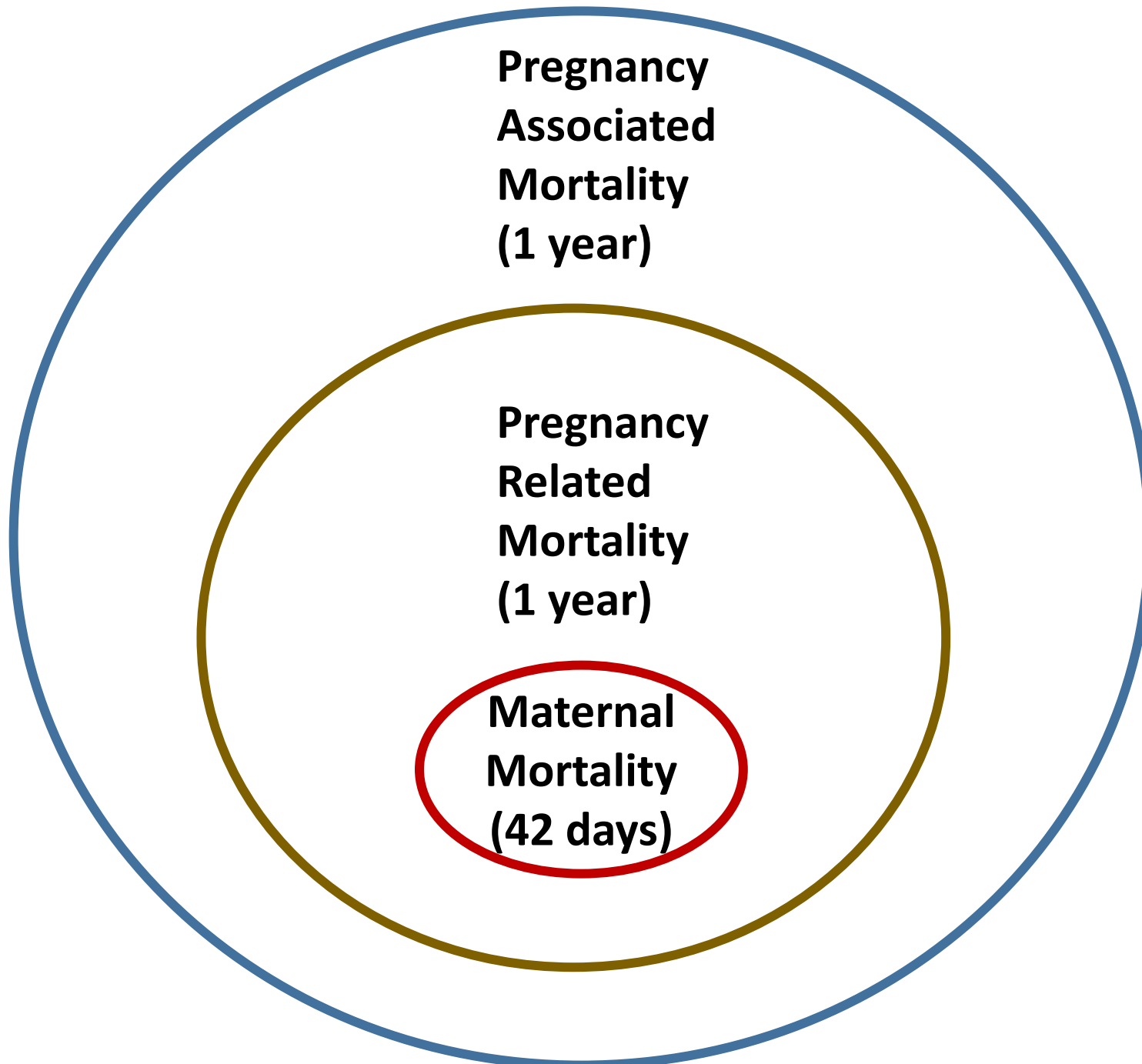
- **CDC (MD)**– National Vital Statistics System (NVSS)
- **CDC (Atlanta)** – Pregnancy Mortality Surveillance System (PMSS)
- State & Local Maternal Mortality Review Committees (MMRCs)

US Maternal Mortality Surveillance

	CDC – National Vital Statistics System (NVSS)	CDC – Pregnancy Mortality Surveillance System (PMSS)	State and Local Maternal Mortality Review Committees (MMRCs)
Data Source	Death certificates	Death certificates linked to fetal death and birth certificates	Death certificates linked to fetal death and birth certificates, medical records, social service records, autopsy, informant interviews, etc.
Time Frame	During pregnancy – 42 days	During pregnancy – 365 days	During pregnancy – 365 days
Source of Classification	ICD-10 codes	Medical epidemiologists	Multidisciplinary committees
Terms	Maternal death	Pregnancy associated, (Associated and) Pregnancy related, (Associated but) Not pregnancy related	Pregnancy associated, (Associated and) Pregnancy related, (Associated but) Not pregnancy related
Measure	Maternal Mortality Rate - # of Maternal Deaths per 100,000 live births	Pregnancy Related Mortality Ratio - # of Pregnancy Related Deaths per 100,000 live births	Pregnancy Related Mortality Ratio - # of Pregnancy Related Deaths per 100,000 live births
Purpose	Show national trends and provide a basis for international comparison	Analyze clinical factors associated with deaths, publish information that may lead to prevention strategies	Understand medical and non-medical contributors to deaths, prioritize interventions that effectively reduce maternal deaths

Three Definitions (in the U.S.)

- **Pregnancy Associated Death** – The death of a woman while pregnant or *within one year* of termination of pregnancy, *irrespective of cause*. (*WHO calls these “pregnancy related”*). *Starting point for analyses*.
- **Pregnancy Related Death** – the death of a woman during pregnancy or *within one year* of the end of pregnancy *from a pregnancy complication, a chain of events initiated by pregnancy*, or the aggravation of an unrelated condition by the physiologic effects of pregnancy. *Used by CDC for U.S. trends*.
- **Maternal Mortality Ratio** – the death of a woman *while pregnant or within 42 days of termination of pregnancy*, irrespective of the duration and site of the pregnancy, from any cause *related to or aggravated by the pregnancy* or its management but not from accidental or incidental causes. Typically reported as a ratio per 100,000 births. *Used in international comparisons*.



Pregnancy Associated Mortality: Deaths during pregnancy and up to **1 year postpartum**

Pregnancy Related Mortality: Deaths during pregnancy and up to **1 year postpartum & related to the pregnancy**

Maternal Mortality: Deaths during pregnancy and up to **42 days postpartum & related to the pregnancy**

Illinois Maternal Morbidity and Mortality Report

Maternal Mortality in Colorado 2016-2020


LOUISIANA PREGNANCY-ASSOCIATED MORTALITY REVIEW



2020 Maternal Mortality Review

A MULTI YEAR LOOK AT MATERNAL MORTALITY IN MISSOURI, 2017-2019 PREGNANCY-ASSOCIATED MORTALITY REVIEW

FLORIDA DEPARTMENT OF HEALTH
 Florida's Maternal Mortality Review Committee 2020



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 Vera Beloshitzkaya, PhD
 Angela Thompson, RN, BSN

Maternal and Child Health Section
 Bureau of Family Health Services
 Division of Community Health Promotion

October 2022

NORTH CAROLINA Maternal Mortality Review Report

Annual Report
Published 2022

Texas Maternal Mortality and Morbidity Review Committee and Department of State Health Services Joint Biennial Report 2022

Pennsylvania Maternal Mortality Review: 2021 Report

Maternal Mortality Review

A Report on Maternal Deaths in Washington 2014-2015

Illustrating the Differences in Measures of Maternal Death: Same State (Tennessee); Same Years; 4 different results.

Pregnancy Associated Mortality (1 year)

113.0

Pregnancy Related Mortality (1 year)

41.2

Maternal Mortality (42 days)

28.0

NOTE: NVSS Data on Tenn. Maternal Mortality for 2017-2021: 167 Deaths; 402,623 births
Rate – 41.5/100,000

Sources: *Maternal Mortality in Tennessee 2021* & NVSS

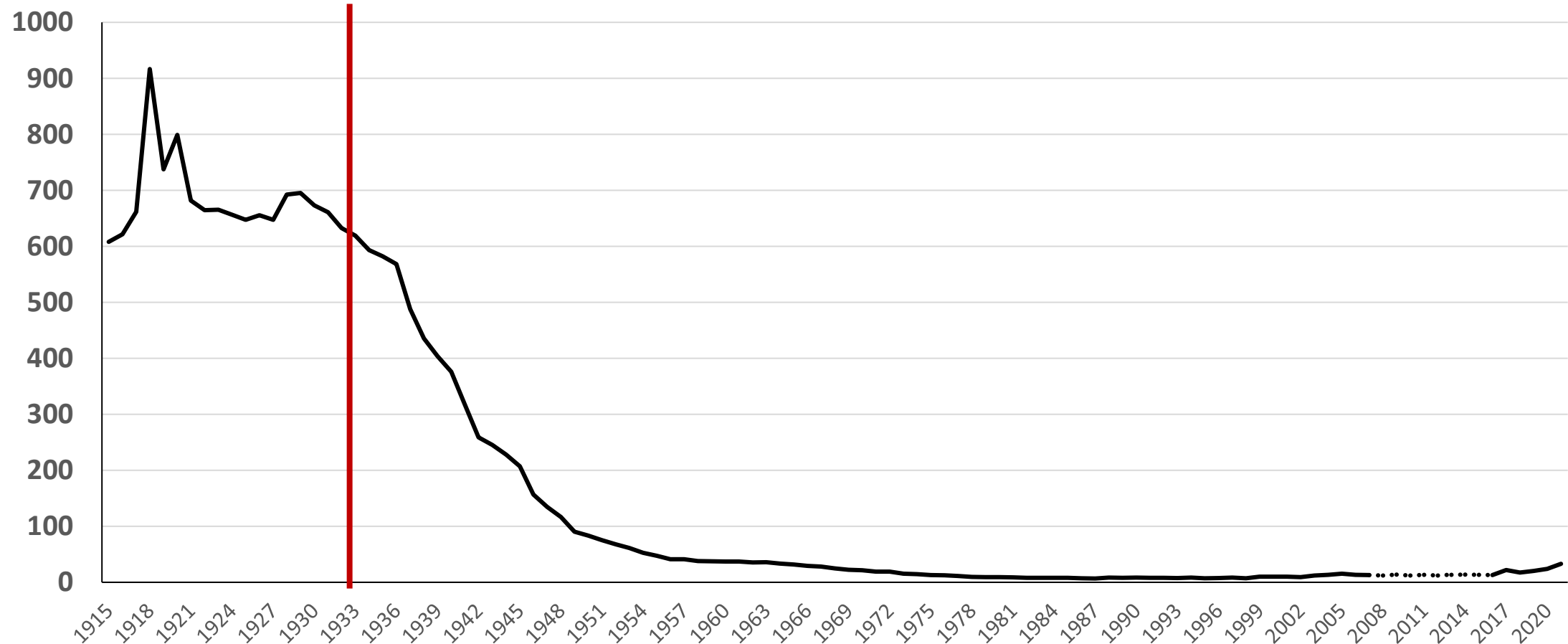
Mortality Rates from the Tennessee Maternal Mortality Rev. Comm. per 100,000 live births, 2017-21

Points of Contention

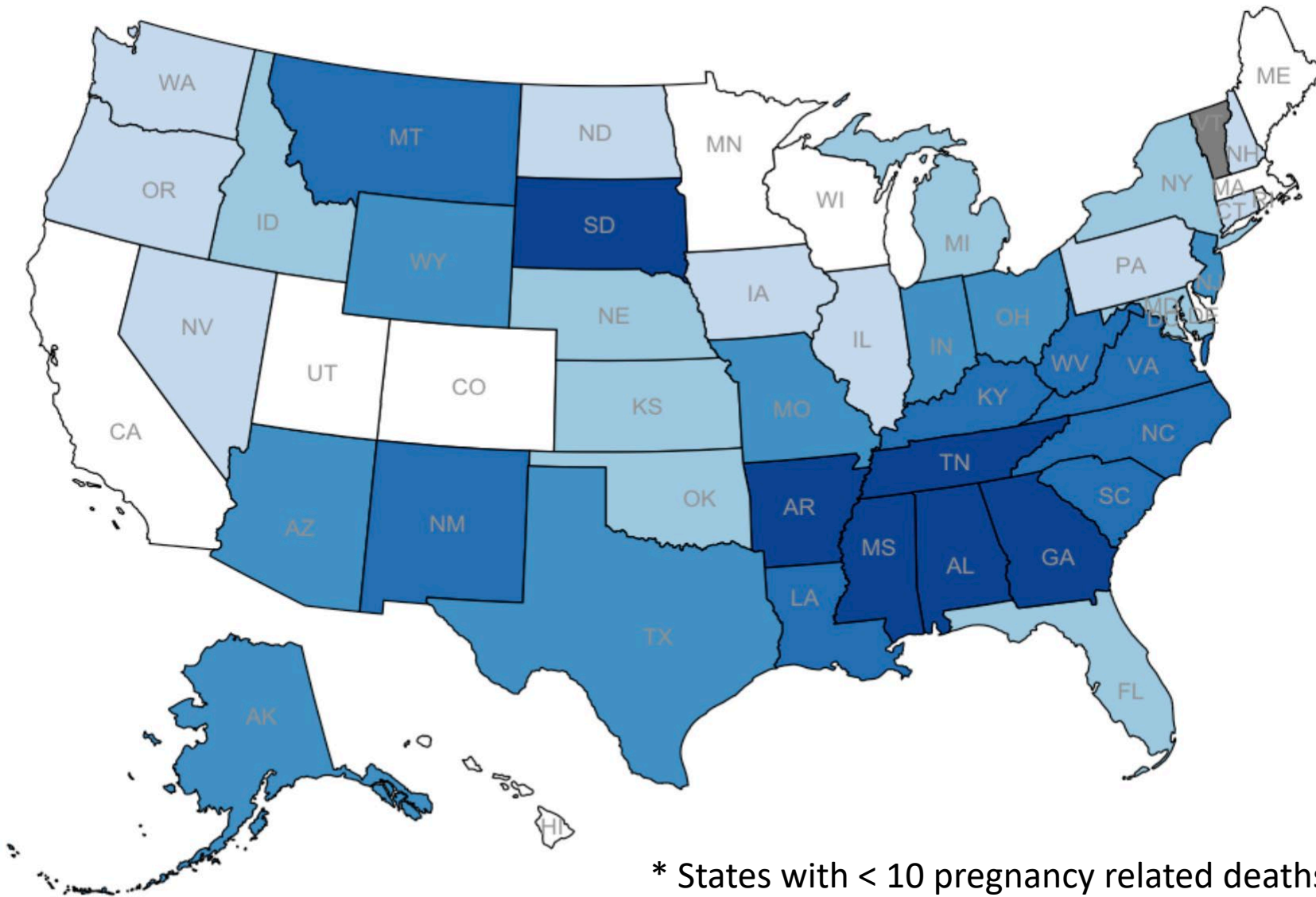
- The pregnancy checkbox & NVSS data
- Cases involving violence, suicide or/and substance use – was this death caused by the pregnancy or did the pregnancy contribute to the death?

2. Trends & disparities in maternal mortality and SMM in the U.S.

U.S. Maternal Mortality (per 100,000 births), 1915-2021



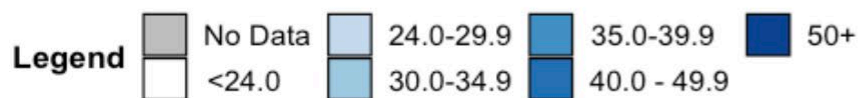
Sources: NCHS. Maternal Mortality and Related Concepts. Vital & Health Statistics. Series 33; #3. & annual data reports. 1915-1960 data from NCHS. *Vital Statistics Rates In The United States 1940-1960*. NOTE: Shifts in measurement (e.g. not all states were part of registration system prior to 1933) accounts for some of the variation over time. 2007-2016 based on 2 year estimates of the pregnancy related mortality rate: Petersen E. *MMWR*.9/6/19; 2017: Rossen. *Impact of Pregnancy Checkbox, U.S. 1999-2017*.NCHS.VitalHlthStat.3(44);2020.; 2018: U.S. Hoyert DL Health E-Stat.Hyattsville, MD: NCHS. 2/2022.



Pregnancy Related Mortality[#] Ratios, U.S. States*, 2018-22

Deaths during pregnancy through 1 year postpartum

* States with < 10 pregnancy related deaths, 2018-2022, are excluded from reporting



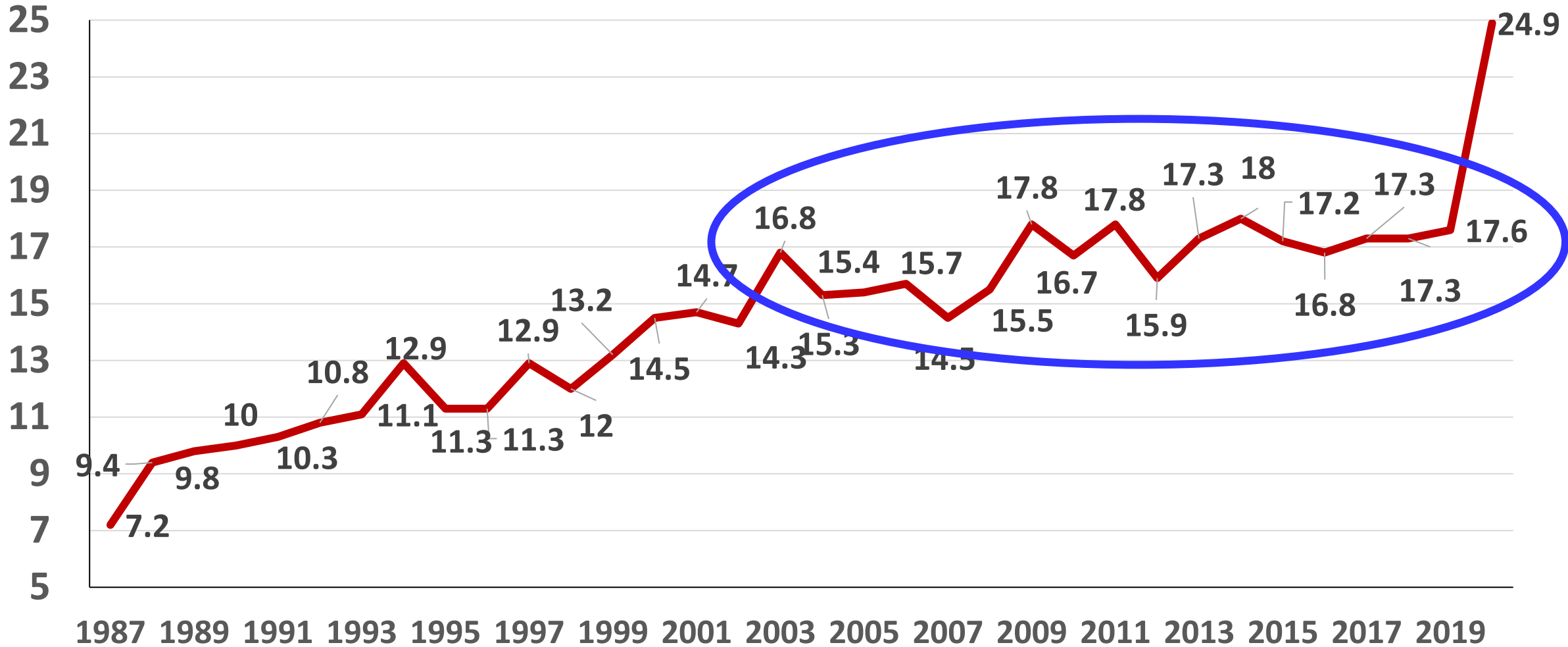
Source: CDC Wonder Mortality File

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Our best existing measure

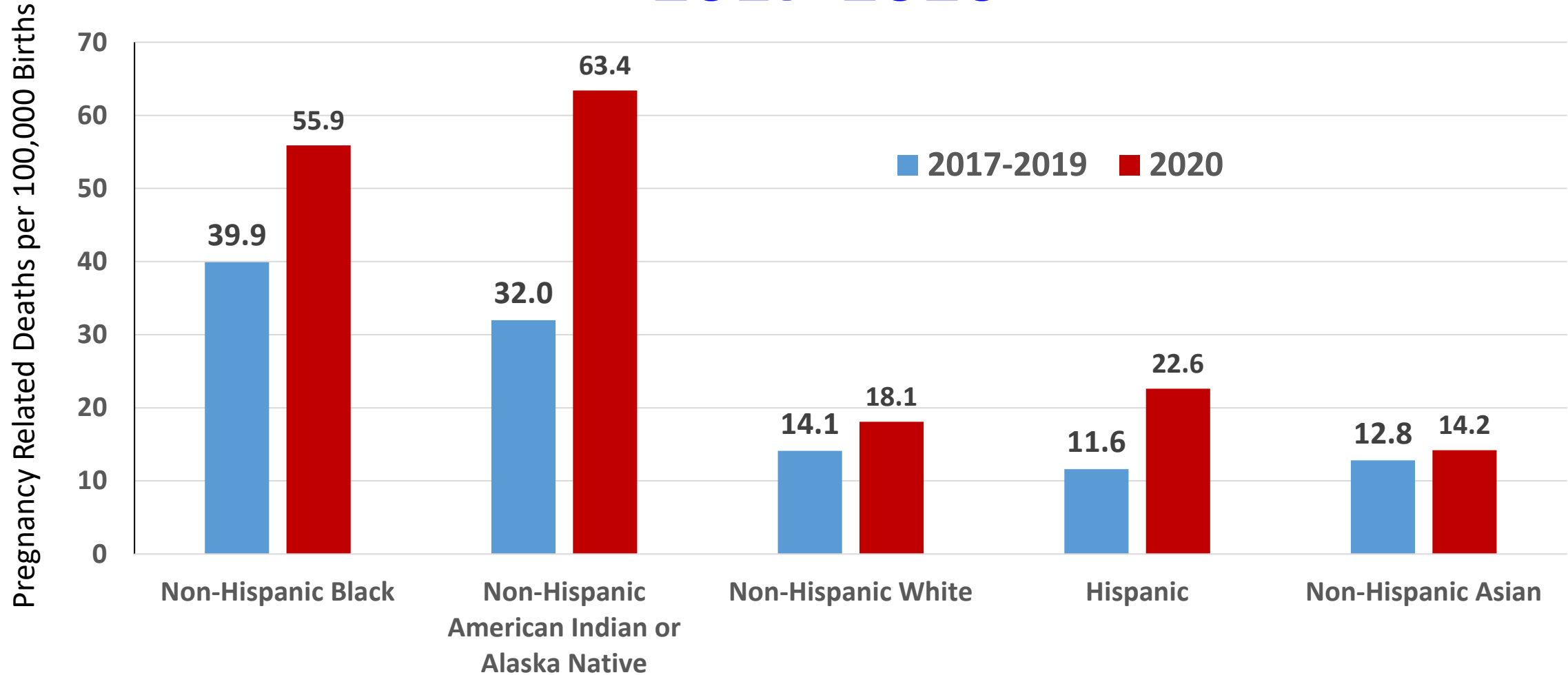
Pregnancy Related Mortality, U.S., 1987-2020

Pregnancy Related Mortality Ratio (per 100,000 births)



Source: CDC. <https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm>

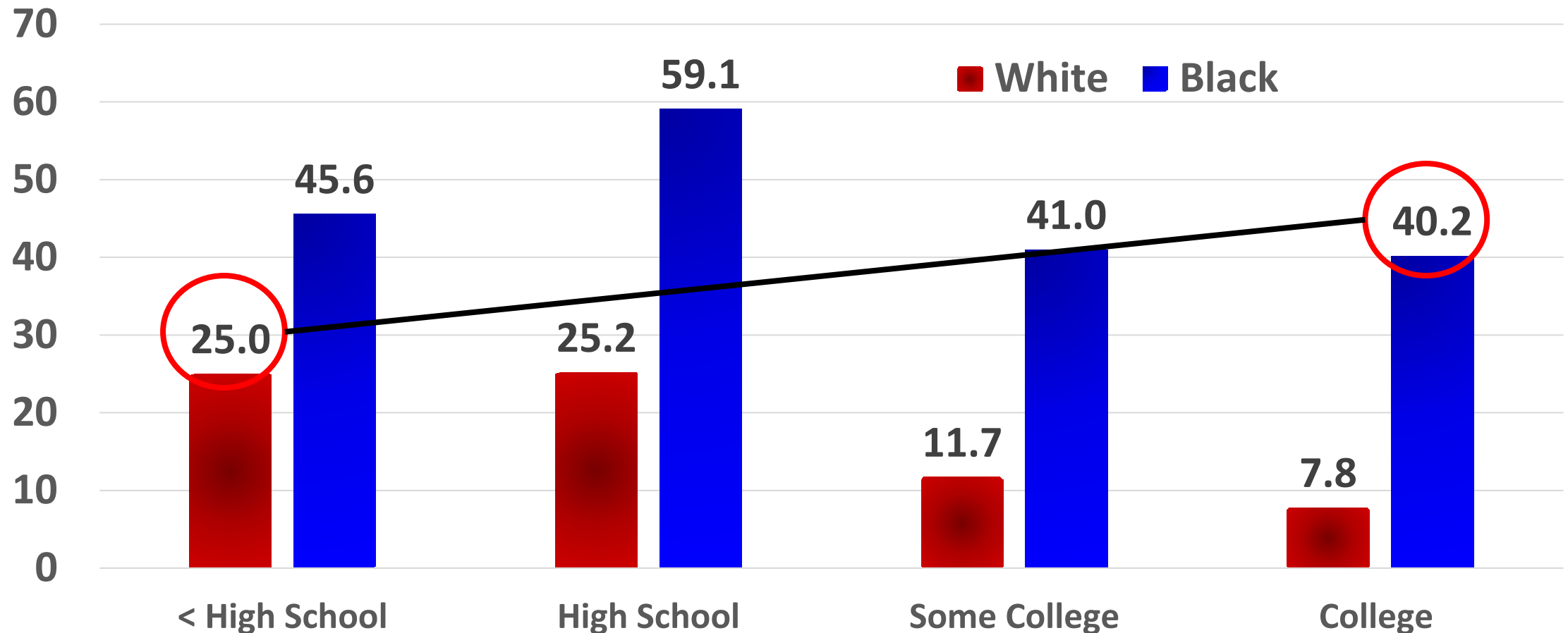
U.S. Pregnancy Related Mortality by Race, 2017-2020



Source: CDC Pregnancy Related Mortality Surveillance System.

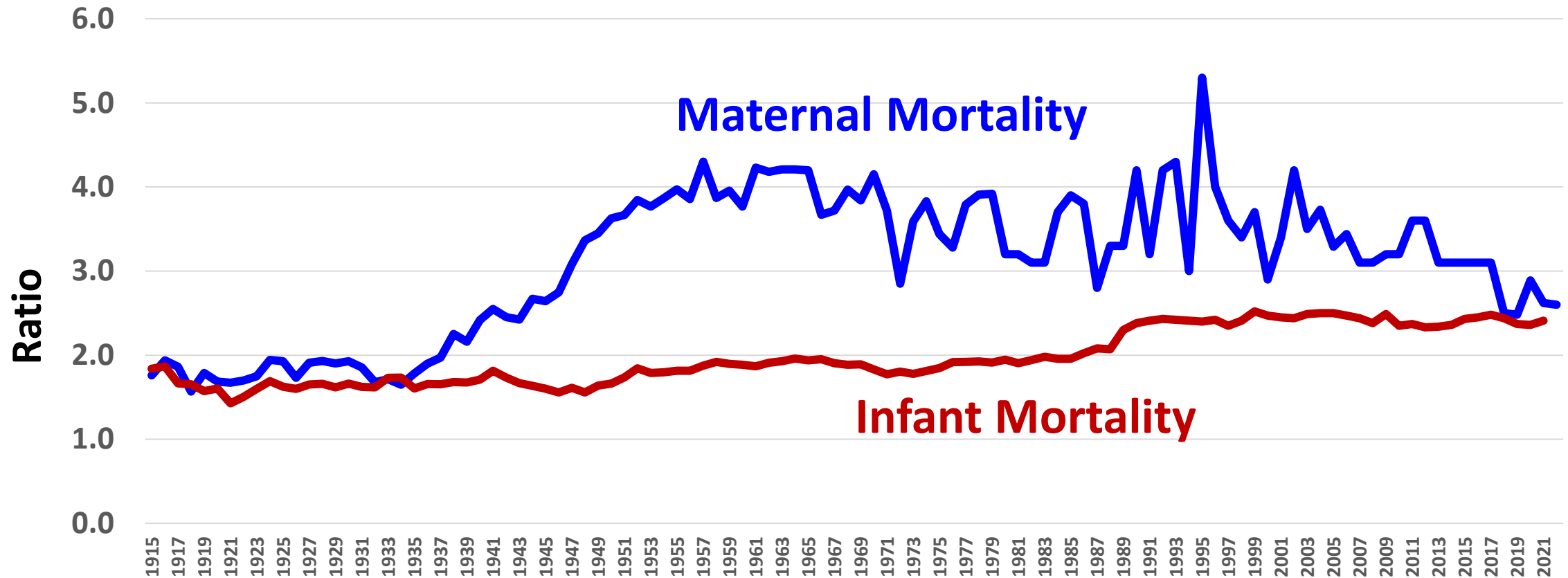
https://www.cdc.gov/maternal-mortality/php/pregnancy-mortality-surveillance/?CDC_AAref_Val=https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm

Pregnancy-related mortality ratios (per 100,000 live births) by race/ethnicity, U.S. 2007-2016



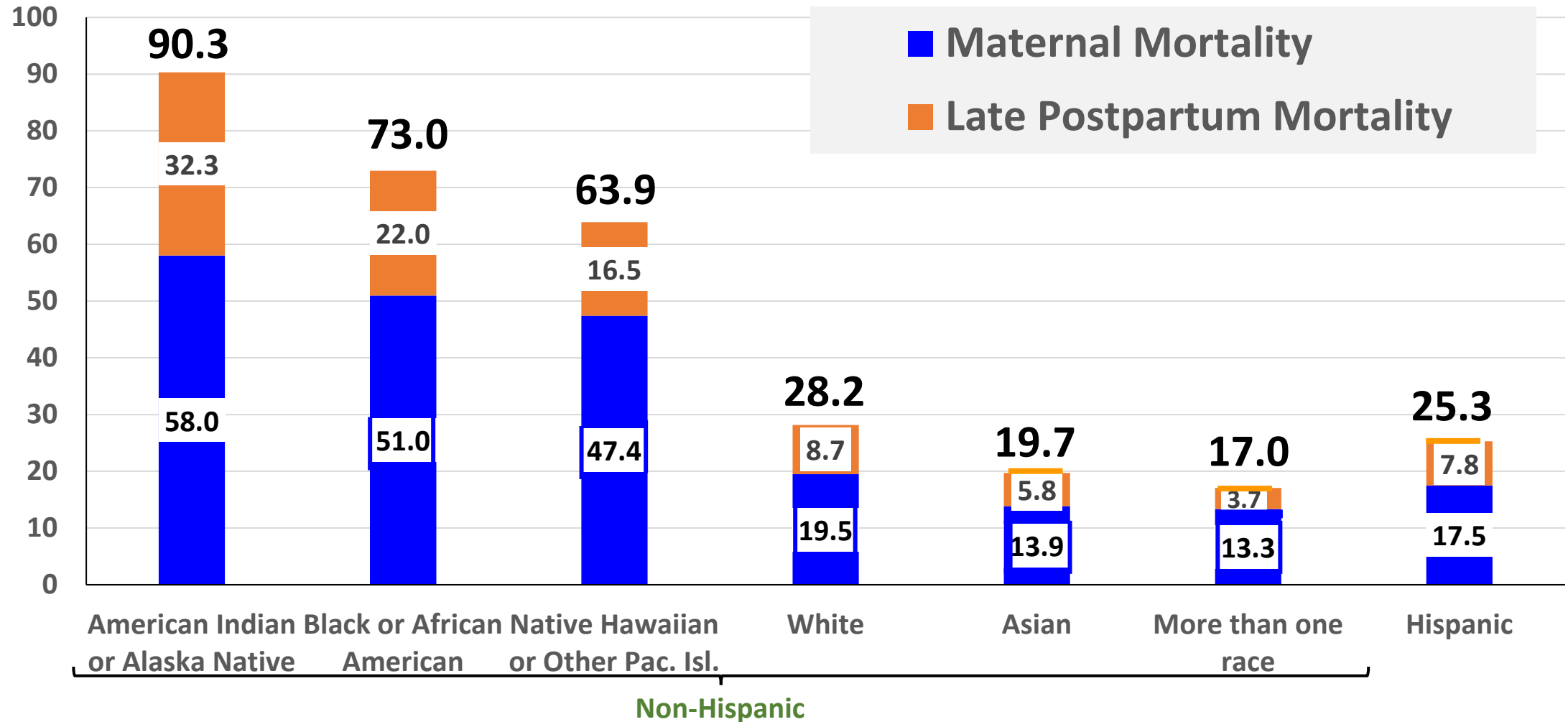
Source: Petersen E et al. Racial/Ethnic Disparities in Pregnancy-Related Deaths — United States, 2007–2016. *MMWR* 2/7/19; 68 (35): 762-765.

Black to White Ratios, U.S. Infant & Maternal Mortality, 1915-2022

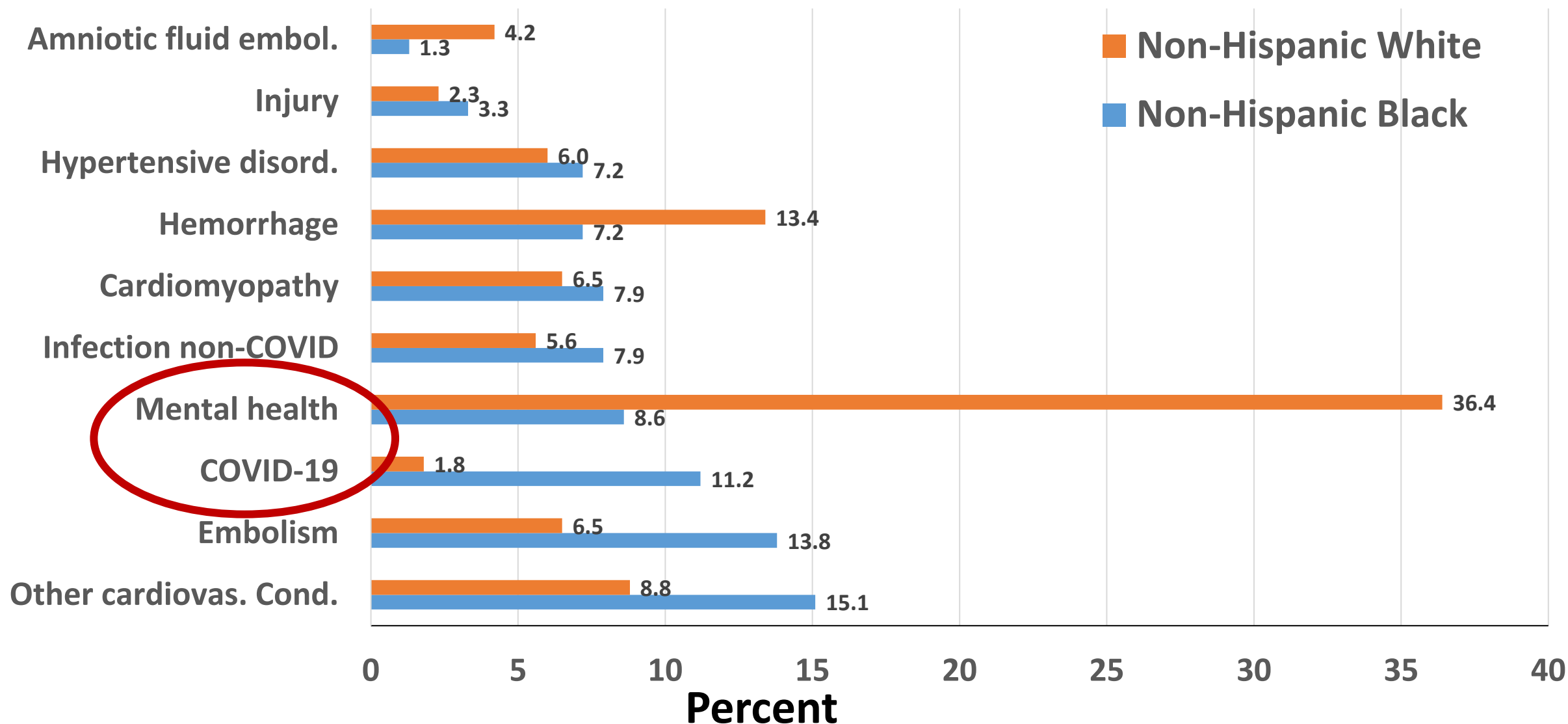


Source: NCHS. Maternal Mortality and Related Concepts. Vital & Health Statistics. Series 33; #3. & annual data reports. 1915-1960 data from NCHS. *Vital Statistics Rates In The United States 1940-1960*. NOTE: Shifts in measurement (e.g. not all states were part of registration system prior to 1933; infant race was based on race of the child until 1980 & then race of the mother post 1980) accounts for some of the variation over time. 2007-2016 based on 2 year estimates of the pregnancy related mortality rate: Petersen E. *MMWR*.9/6/19.

U.S. Maternal and Pregnancy Related Mortality, 2018-2022

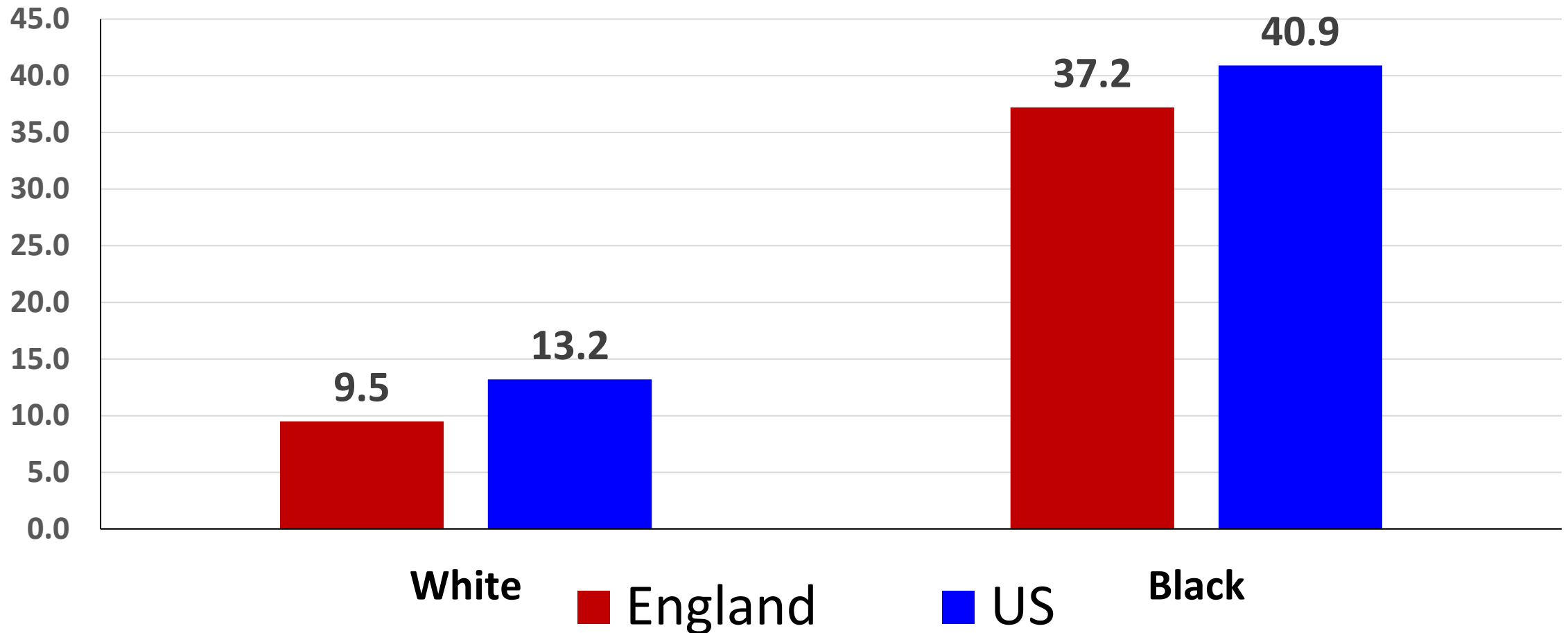


Underlying Causes of Maternal Deaths by Race, Maternal Mortality Review Committees, 38 U.S. States, 2020



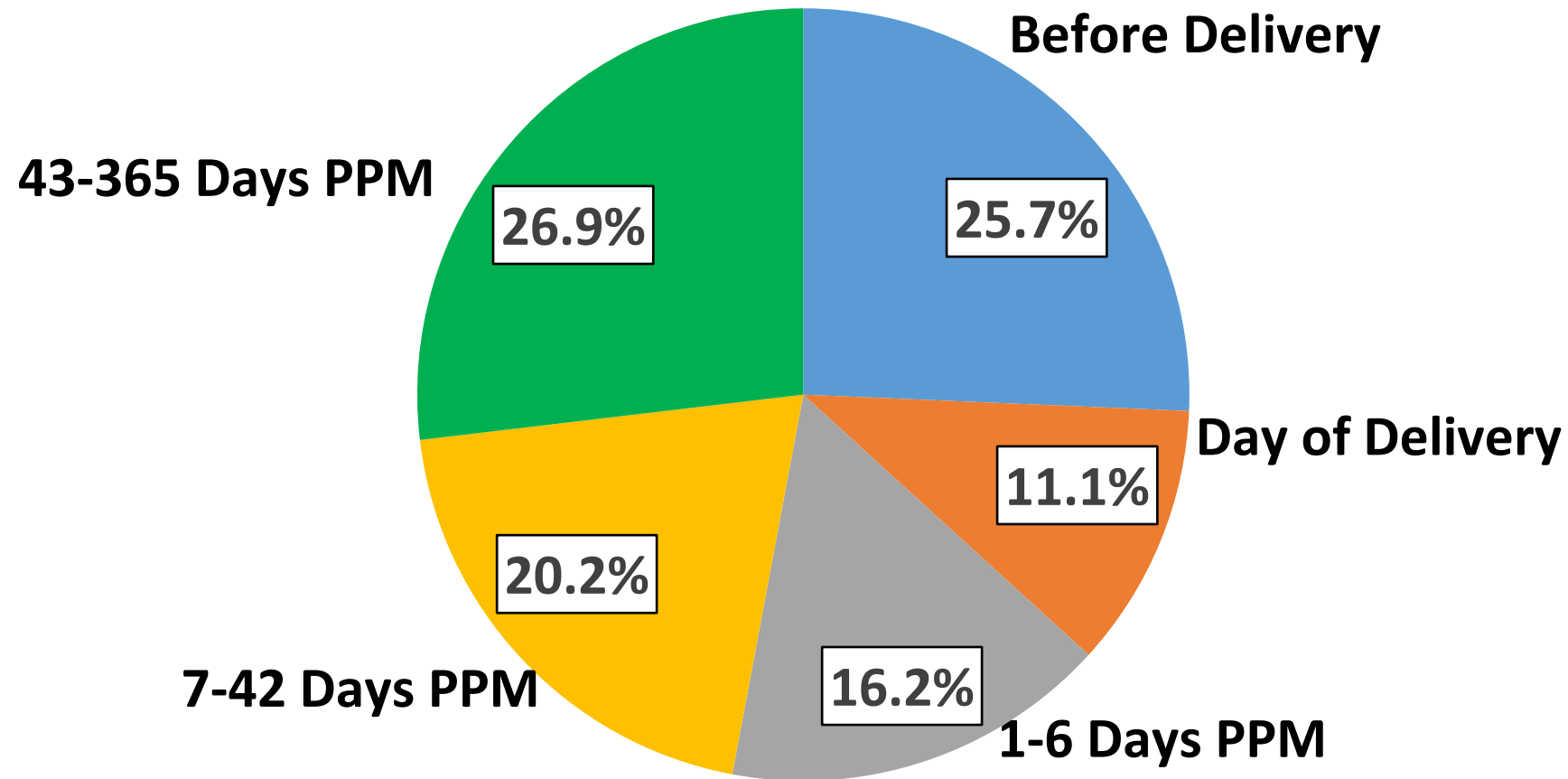
Source: Trost SL, Busacker A, Leonard M, et al. Pregnancy-Related Deaths: Data from Maternal Mortality Review Committees in 38 U.S. States, 2020. CDC, U.S. DHHS; 2024. <https://www.cdc.gov/maternal-mortality/php/data-research/index.html#:~:text=Data%20on%20525%20pregnancy%2Drelated,Non%2DHispanic%20Black>

Maternal Mortality (per 100,000 births) by Race, U.S. (2020) and England (2019-2021)



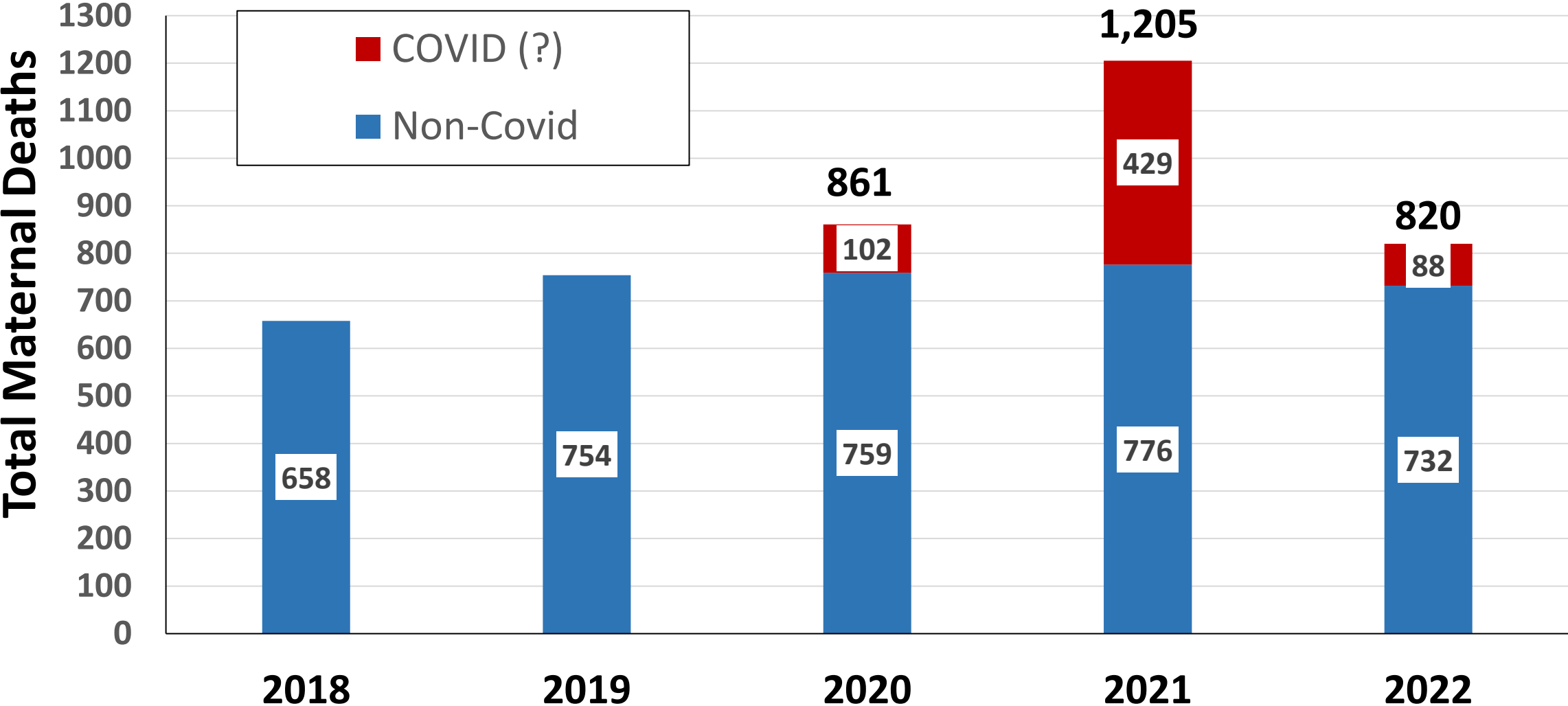
Sources: U.S., Adjusted PMSS rate; 2/22/22; MBRRACE-UK. Confidential Enquiries into Maternal Deaths and Morbidity 2019-21. Oxford:NPEU, 2022.

Timing of Maternal Deaths (2020)



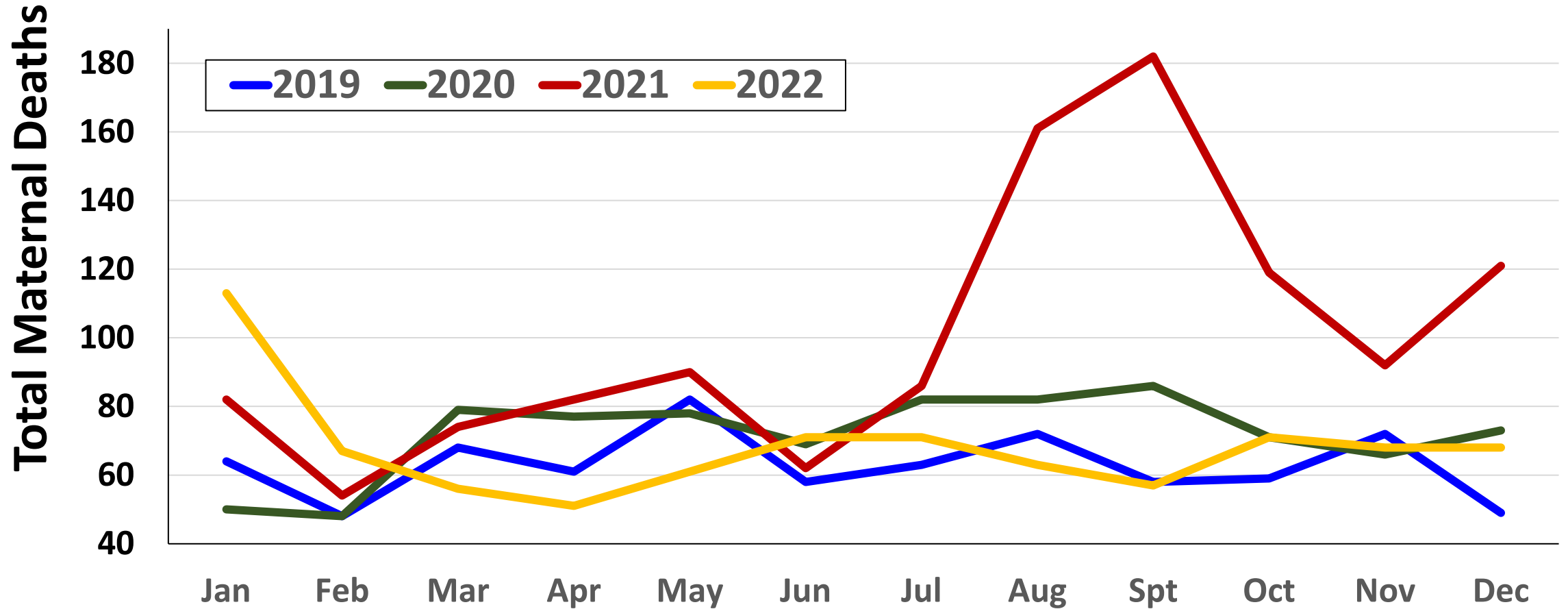
Source: Trost SL, Busacker A, Leonard M, et al. Pregnancy-Related Deaths: Data from Maternal Mortality Review Committees in 38 U.S. States, 2020. CDC, U.S. DHHS; 2024. <https://www.cdc.gov/maternal-mortality/php/data-research/index.html#:~:text=Data%20on%20525%20pregnancy%2Drelated,Non%2DHispanic%20Black>

2018-2022 COVID & Maternal Deaths

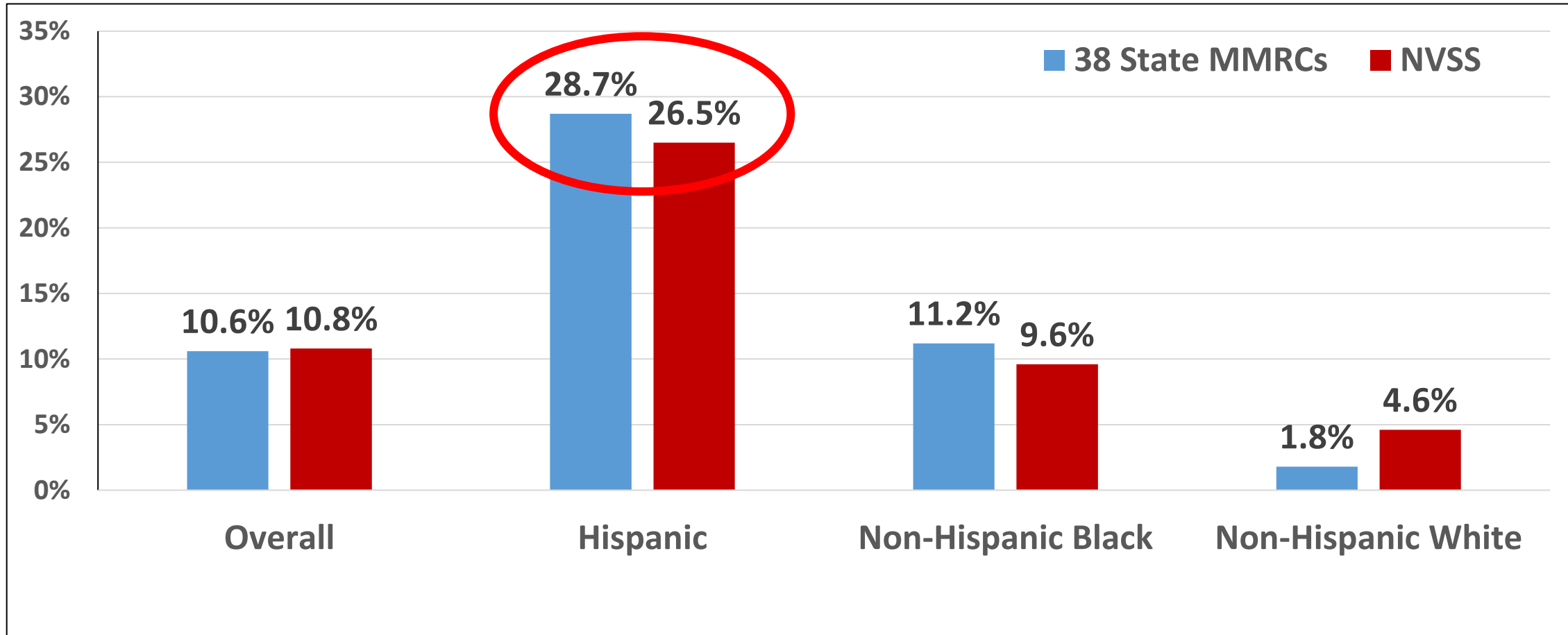


Source: NVSS – CDC Wonder Mortality File

U.S. Maternal Deaths per Month, 2019-2022



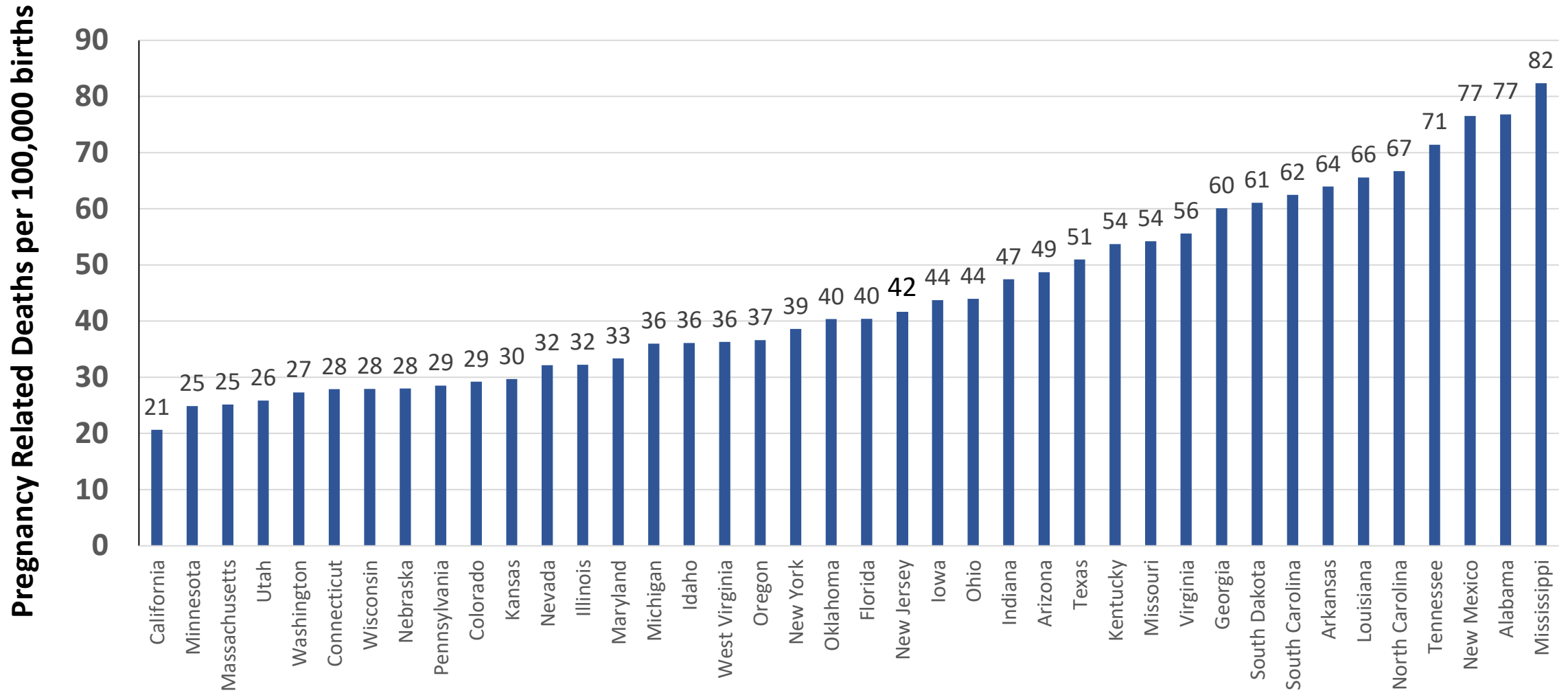
COVID Pregnancy Related Deaths with COVID from 2 Distinct Data Sources, 2020



Sources: NVSS – National Vital Statistics System through CDC Wonder ; 38 State MMRCs – Trost SL, Busacker A, Leonard M, et al. Pregnancy-Related Deaths: Data from Maternal Mortality Review Committees in 38 U.S. States, 2020. CDC, U.S. DHHS; 2024. <https://www.cdc.gov/maternal-mortality/php/data-research/index.html#:~:text=Data%20on%20525%20pregnancy%2Drelated,Non%2DHispanic%20Black>

Pregnancy Related Mortality*

by State during the Pandemic (2020Q2-Q4 & 2021)

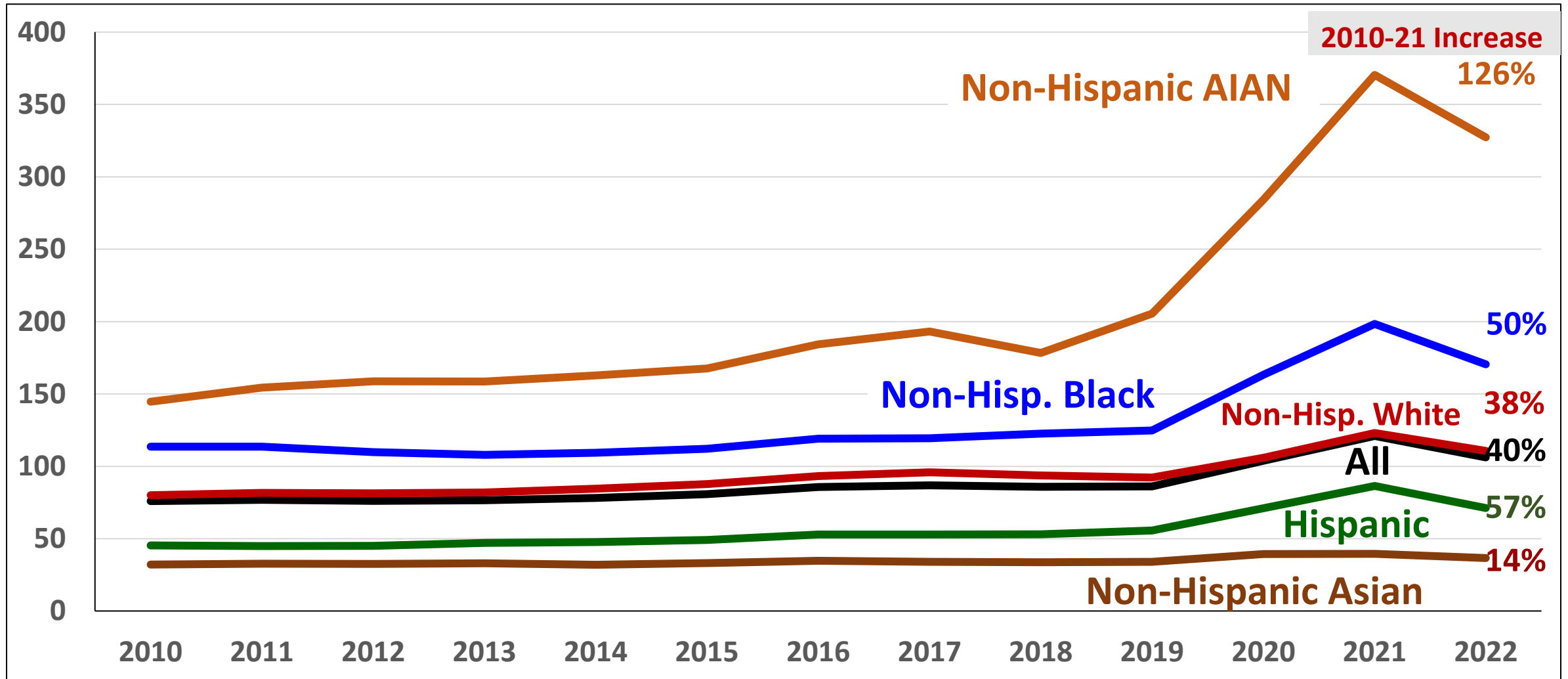


* States with > 10 maternal deaths

Source: NVSS Mortality File CDC Wonder

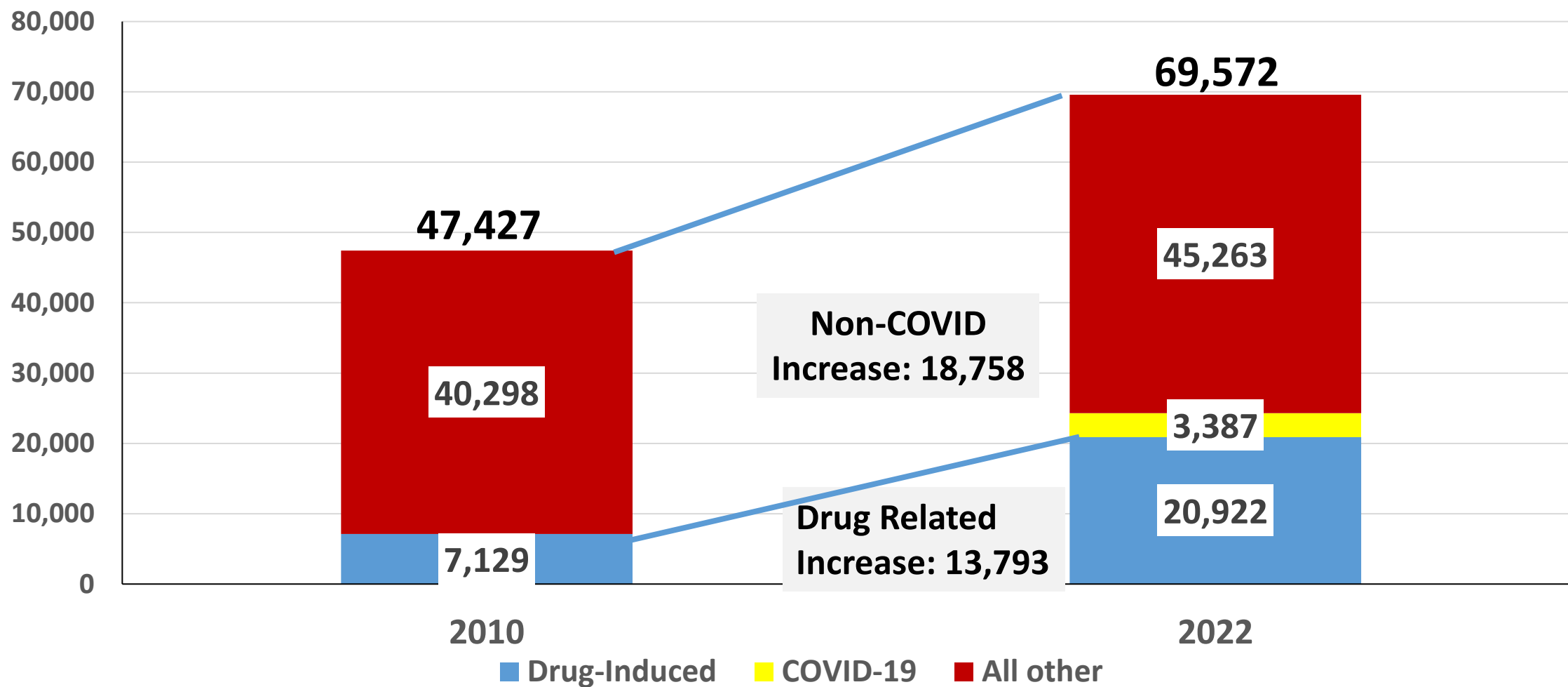
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Overall Deaths rates (per 100K), Females 15-44, 2010-2022



All Female Deaths 15-44
2010 -- 47,427; 2022 – 69,572 (COVID 3,387)

Female Deaths (15-44) 2010-2022: **73%** of the non-COVID increase came from Drug Related Causes



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

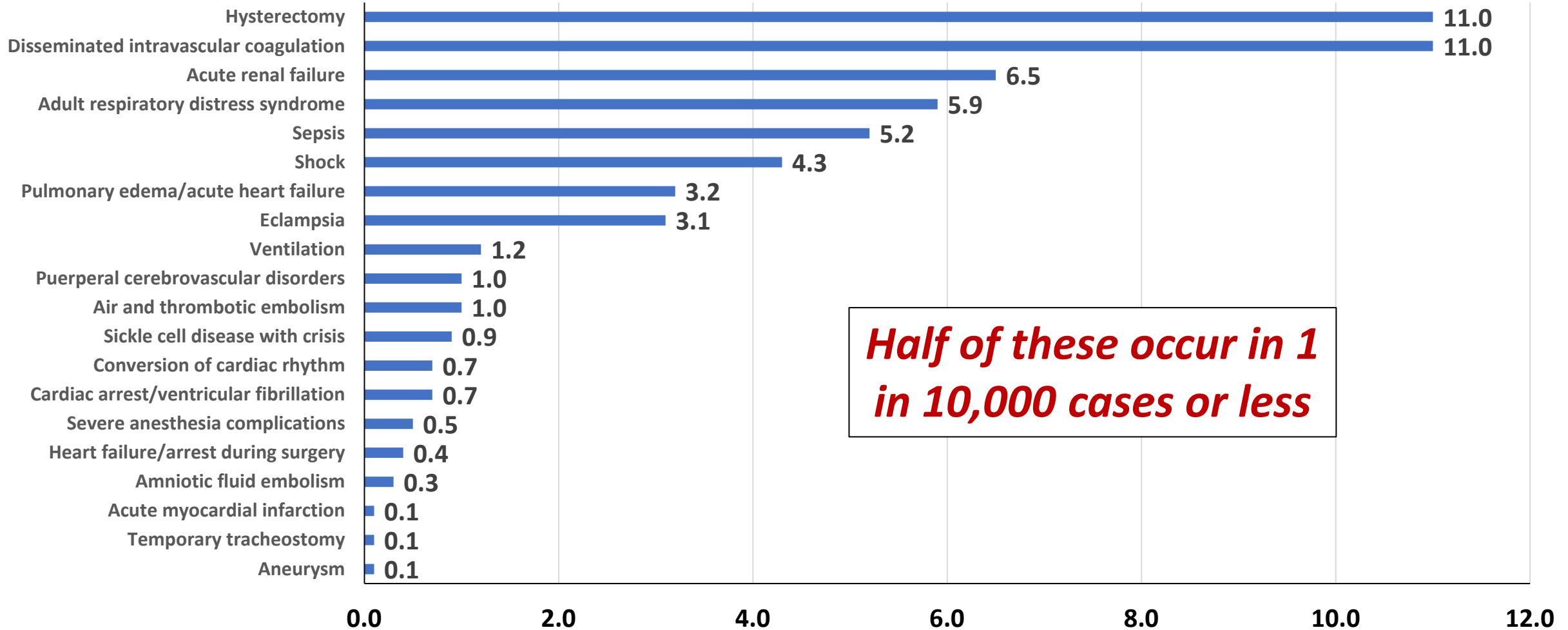
Source: Barry. *The Great
Influenza*. 2004 p. 71

Severe Maternal Morbidity Diagnoses & Procedures

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,
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, 428.22, 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, 995.5
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, 96.04

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

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 Lindquist,^{a,b,*} N Noor,^{a,*} E Sullivan,^c M Knight^a

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

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

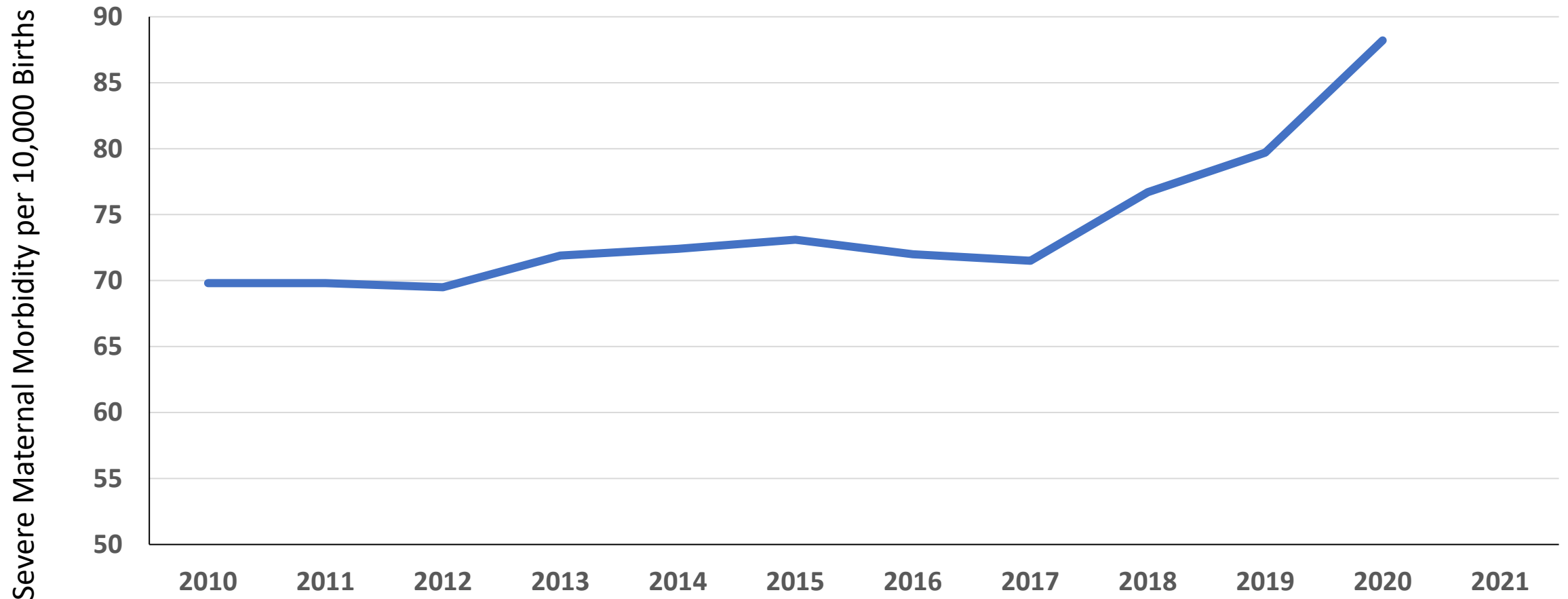
Evaluating Iowa Severe Maternal Morbidity Trends and Maternal Risk Factors: 2009–2014

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

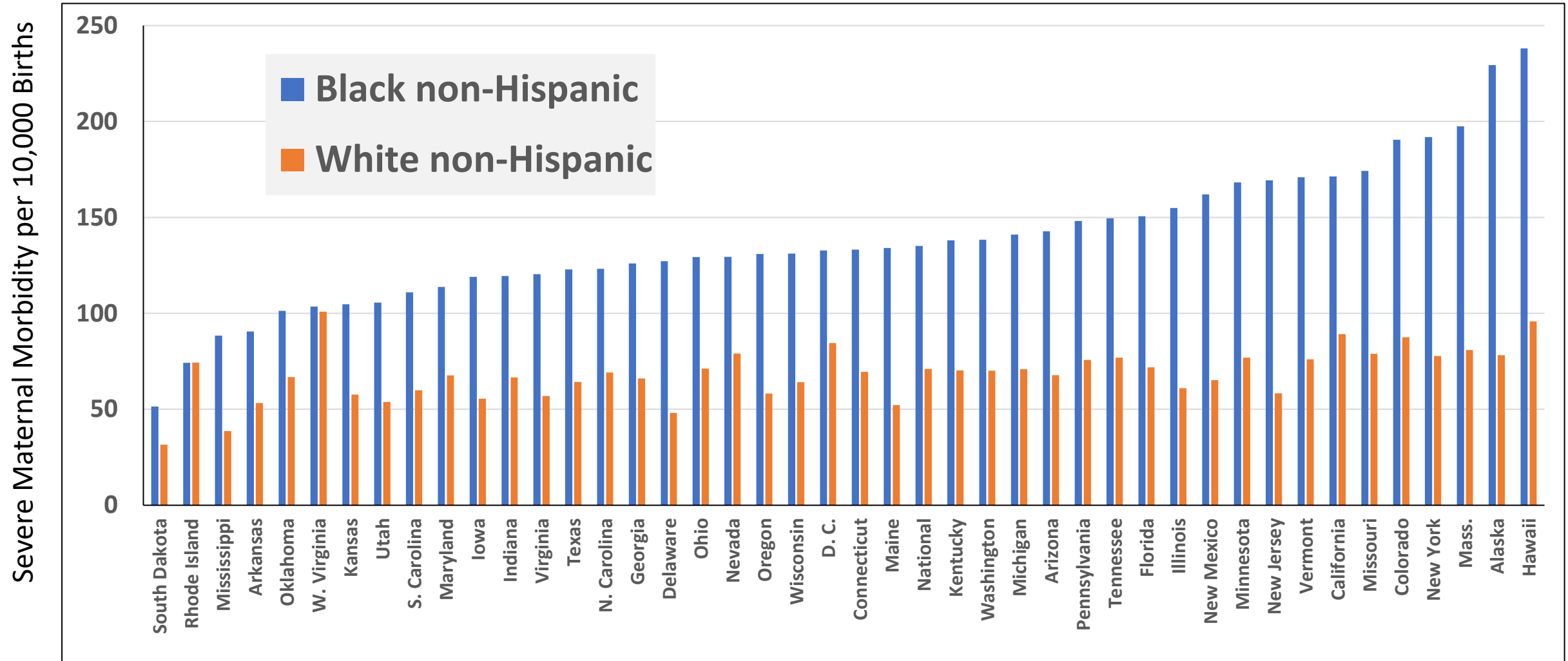
Marcelo L. Urquia, PhD;^{1,2,3} Susitha Wanigaratne, PhD;^{2,3} Joel G. Ray, MD, MSc;^{3,4} K. S. Joseph, MD, PhD^{5,6}

Contemporary Studies of Maternal Morbidity

Severe Maternal Morbidity per 10,000 Births, U.S., 2010-2020



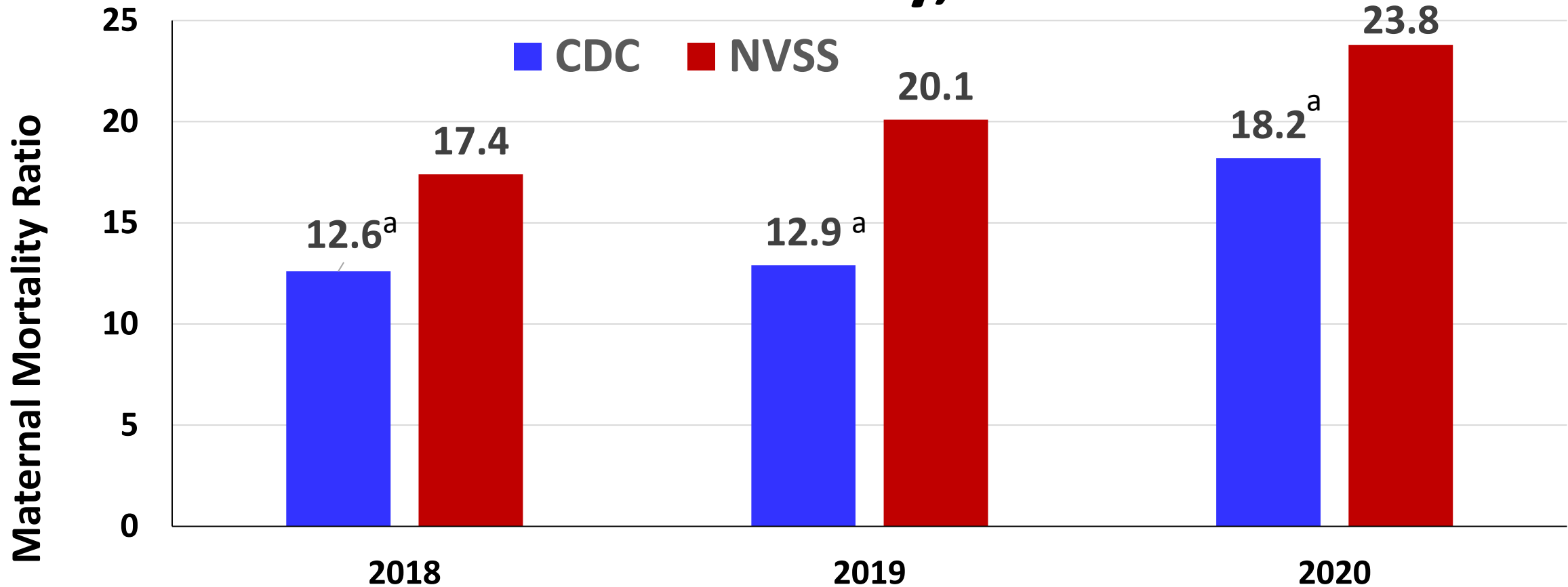
Severe Maternal Morbidity (per 10,000 Births), by Race, U.S. States*, 2020



Source: HCUP. * In states reporting SMM for both races in 2020.

3. Steps being taken to improve the measurement of mortality and morbidity

Comparing CDC & NVSS Estimates of U.S. Maternal Mortality, 2018 – 2020



NVSS – National Vital Statistics System; **CDC** – Pregnancy Mortality Surveillance System

a. Based on the reported pregnancy related rate limited to 42 days postpartum. Figure adjusted based on CDC report estimating 73.1% of maternal deaths occurring during pregnancy and up to 42 days postpartum.

Sources: NVSS Hoyert. Maternal mortality rates in the United States, 2021. NCHS Health E-Stats. 2023; CDC: adapted from <https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm>.

U.S. Maternal Mortality in Different Measurement Systems

	State Comparisons of Maternal Deaths through 1 year Postpartum ^a		
	National Vital Statistics System	State Maternal Mortality Review Committees ^b	% NVSS Higher
	Florida		
2018-2020	27.8	18.9	47.0%
	Georgia		
2018-2020	45.9	30.1	52.5%
	Indiana		
2018-2020	36.9	17.8	107.4 %
	Louisiana		
2018-2019	39.6	24.5	61.6%
	Maryland		
2018	23.9	25.3	-5.5%
	Missouri		
2018-2019	27.5	24.8	10.9%
	New York		
2018	28.7	18.2	57.7%
	Tennessee		
2018-2020	44.6	37.9	17.7%

a. PMSS state rates are not presented for comparison because CDC cannot, based on contracts with the states to supply their data to CDC, publish specific state rates.

b. Rates drawn from state MMRC reports from states averaging at least 50,000 births annually and which published reports that included data on the years 2018, 2019 or 2020. To stabilize estimates, when available multiple years were combined.

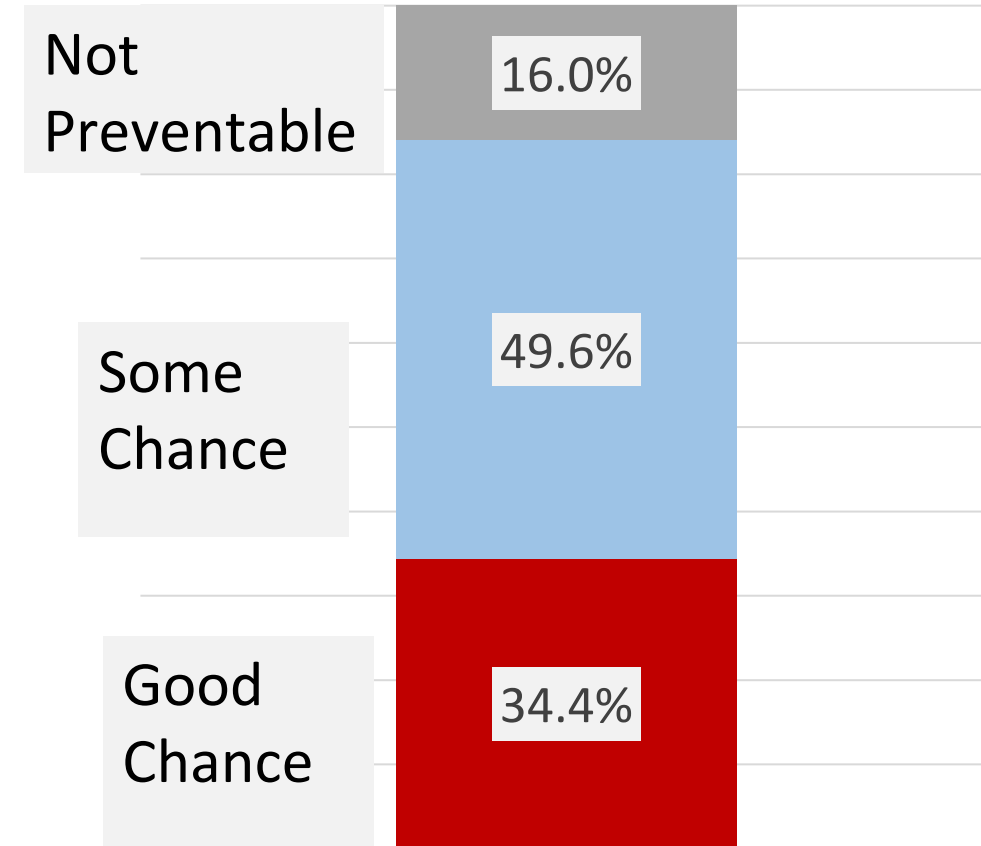
Source: Measuring Maternal Mortality. *JAMA*. 2023

Are Maternal Mortality Review Committees the Solution?

- 49 states, the DC, NYC, Phil. have a formal maternal mortality review committee or legal requirement to review pregnancy-related deaths.
- 37 states, DC, NYC require multidisciplinary committee membership
- They participate in a national system (MMRIA) that compiles data ultimately for national reporting (38 states thus far)
- They report on preventability and make clinical, public health and policy recommendations to prevent future maternal deaths.

Preventability

- **Definition:** A death is considered preventable if the committee determines there was at least some chance of the death being averted by one or more reasonable changes to patient, family, provider, facility, system and/or community factors.



Source: Berg CJ, Harper MA, Atkinson SM, Bell EA, Brown HL, HageML, et al. Preventability of pregnancy-related deaths: results of a state-wide review. *ObstetGynecol*2005;106:1228–34.

Selected Recommendations

For **Hospitals and Health Systems**, MMRC recommends

- Describe the process for initiating transport to a facility with an appropriate level of maternal care

For Health Care Providers

- *Cardiovascular disease*, especially as related to ensuring evaluation for cardiac symptoms and coordinated referral to an appropriate medical specialist, such as a cardiologist, during prenatal and postpartum period
- Collaborate with pregnant and postpartum patients with substance use disorders to develop plans of safe care for postpartum patients and their infants after delivery.

Health Insurance Plans

- Continue reimbursement for telehealth regardless of patient or provider location within the state, including phone-based services, for clinical services not widely geographically available in Illinois.

State Agencies and Partners

Community-Based Organizations

Future?

- *No guarantee of continued interest.*
- *Depends on political, clinical and community will going forward.*

Black Maternal Health Week

April 11 - 17, 2021



BLACK MAMAS MATTER:
CLAIMING OUR POWER, RESILIENCE & LIBERATION

Join us April 11-17 for a week of activism and community building for Black Mamas! In solidarity with National Minority Health Month and the International Day for Maternal Health and Rights, **Black Mamas Matter Alliance** founded BMHW to raise awareness, inspire activism, and strengthen organizing for Black maternal health. Join the conversation: **#BMHW21** and **#BlackMaternalHealthWeek**



www.blackmamasmatter.org/bmhw

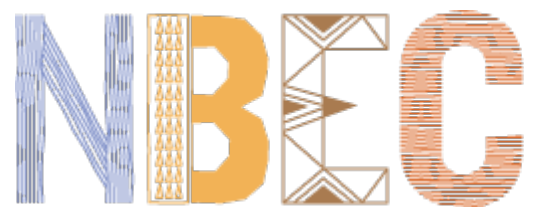
10 YEARS



2010

2020

EVERY MOTHER COUNTS



NATIONAL BIRTH EQUITY COLLABORATIVE



ALLIANCE FOR INNOVATION ON MATERNAL HEALTH

NATIONAL MATERNAL HEALTH WEEK

MAY 5th-12th, 2019



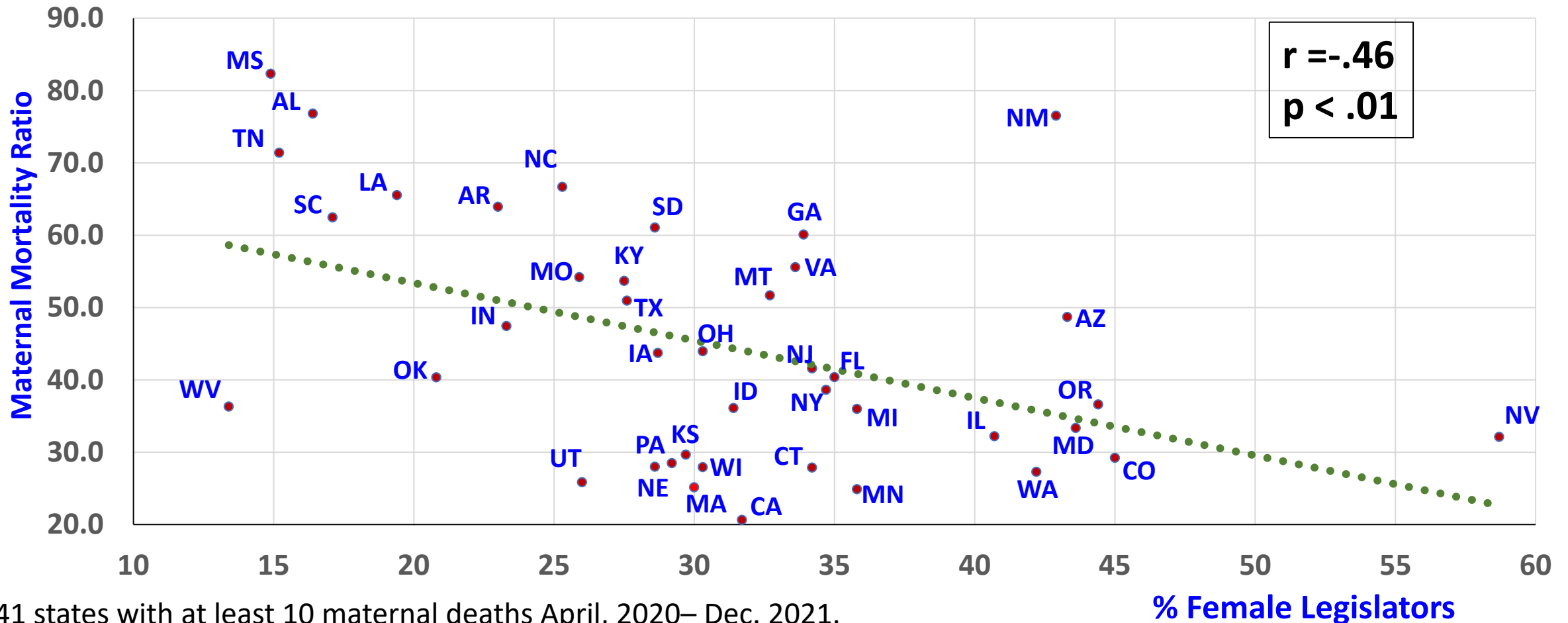
#MarchforMoms

#BeyondMothersDay

- Promote State & Federal Legislative Efforts to Improve Maternal Health
- Drive Media Attention on State of Maternal Health
- Seek City, State and National Proclamations
- Organize Visits in DC on Capitol Hill May 10th
- Rally on National DC Mall on May 11th
- Livestream the Rally on Facebook Live
- Curate and Promote Daily Themes Related to Maternal Health

www.birthbythenumbers.org

Pregnancy Related Mortality (per 100,000 births) 2020-2021* and % Female State Legislators 2021



* 41 states with at least 10 maternal deaths April, 2020– Dec. 2021.

% Female Legislators

Sources: % Female Legis – Nat’l Conf State Legisl.; Pregnancy Related Mortality – CDC Wonder

www.birthbythenumbers.org



www.birthbythenumbers.org



Gene

EMAIL: birthbynumbers@gmail.com

FACEBOOK: www.facebook.com/BirthByTheNumbers