

# IT'S ABOUT MORE THAN MATERNAL MORTALITY

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Boston University School of Public Health, Boston, MA*

NNEPQIN Winter Conference  
March 6, 2025  
Online





# Collaborators



# Outline

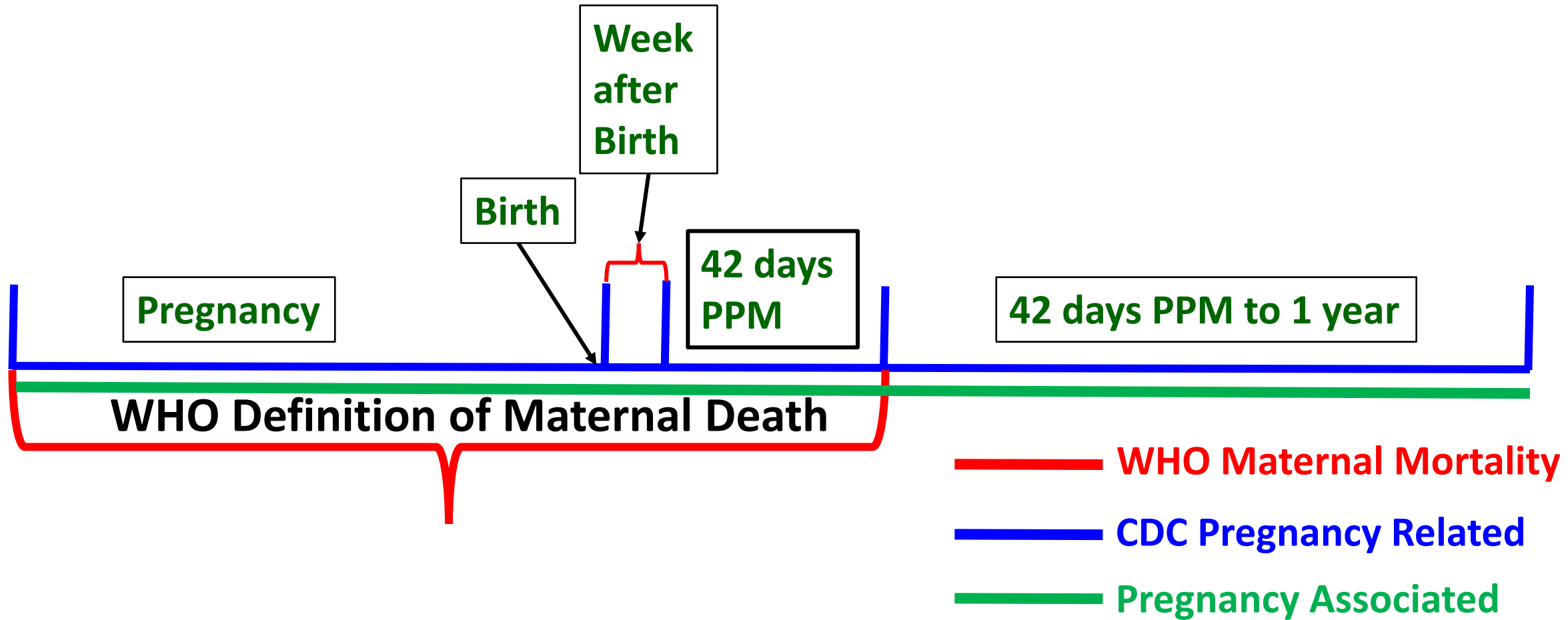
- Definitions & Measures
- New England Context
- Why is it so hard to measure maternal mortality?
- Where we stand now
- It's about women's health
- Where do we go from here?

***NOTE: TALK IS VERY HEAVY ON NUMBERS, GOES QUICKLY AND SPEAKER HAS A CHARMING LAWRENCE, MASS. ACCENT.***

# 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*.

# Timeline of Maternal Mortality Definitions

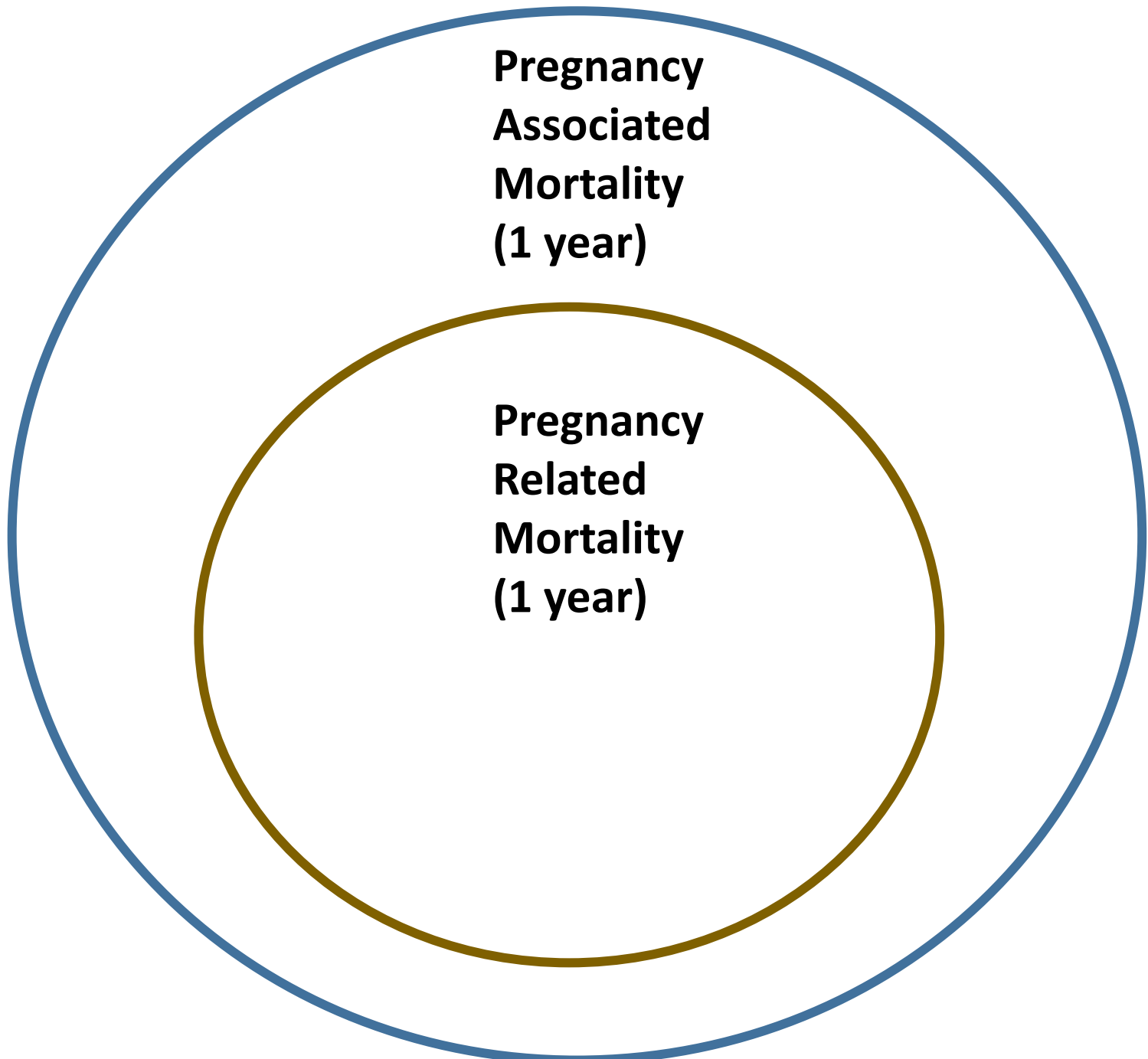


PPM – postpartum –period after the birth

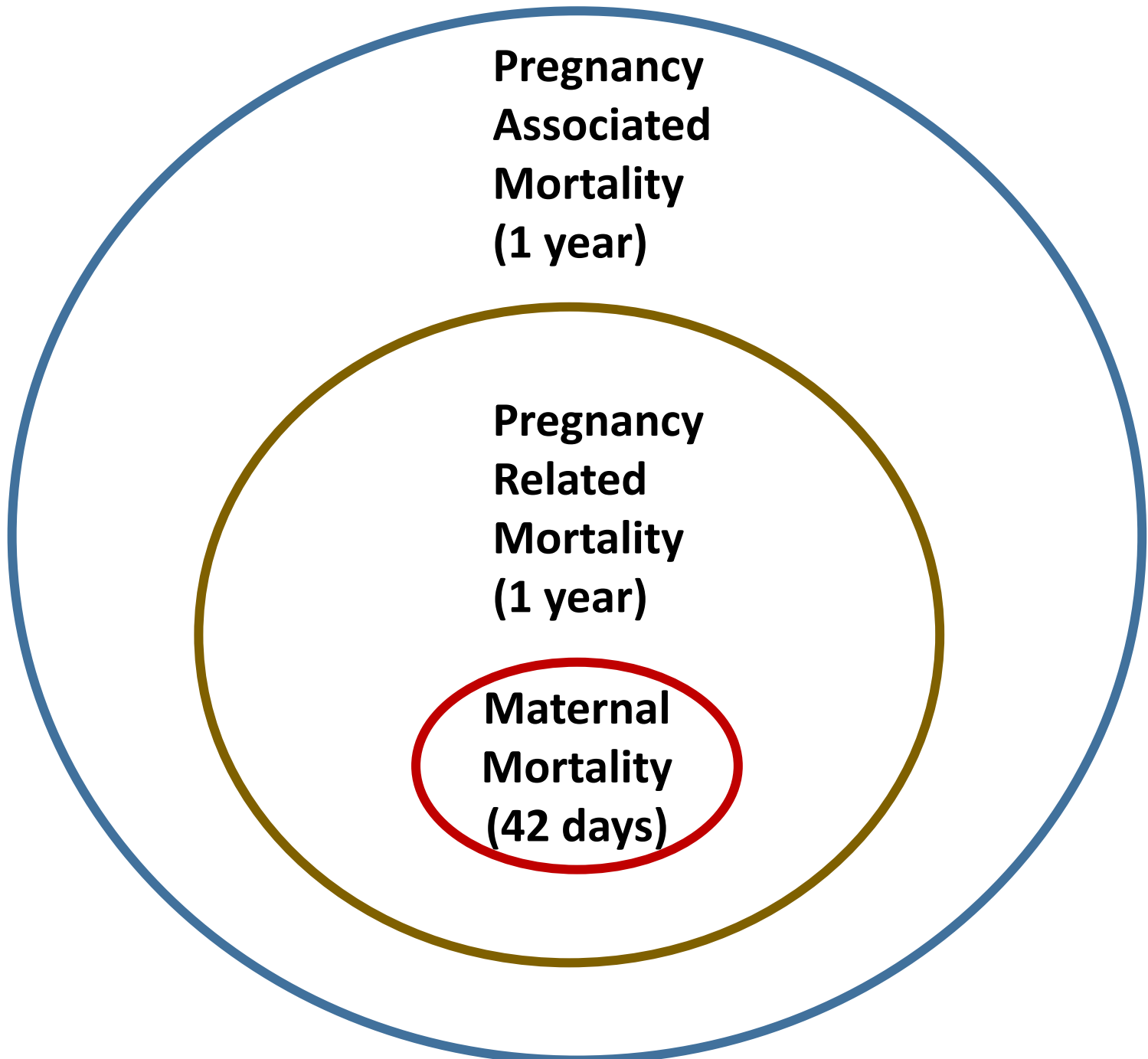


**Pregnancy  
Associated  
Mortality  
(1 year)**

**Pregnancy  
Associated  
Mortality:  
All Deaths women  
of reprod. age  
pregnancy to 1  
year ppm**



**Pregnancy  
Related  
Mortality:  
All Deaths  
women of  
reprod. age  
pregnancy to  
**1 year ppm**  
Related to the  
pregnancy**



**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**





## 3 Different U.S. Sources & Different Measures

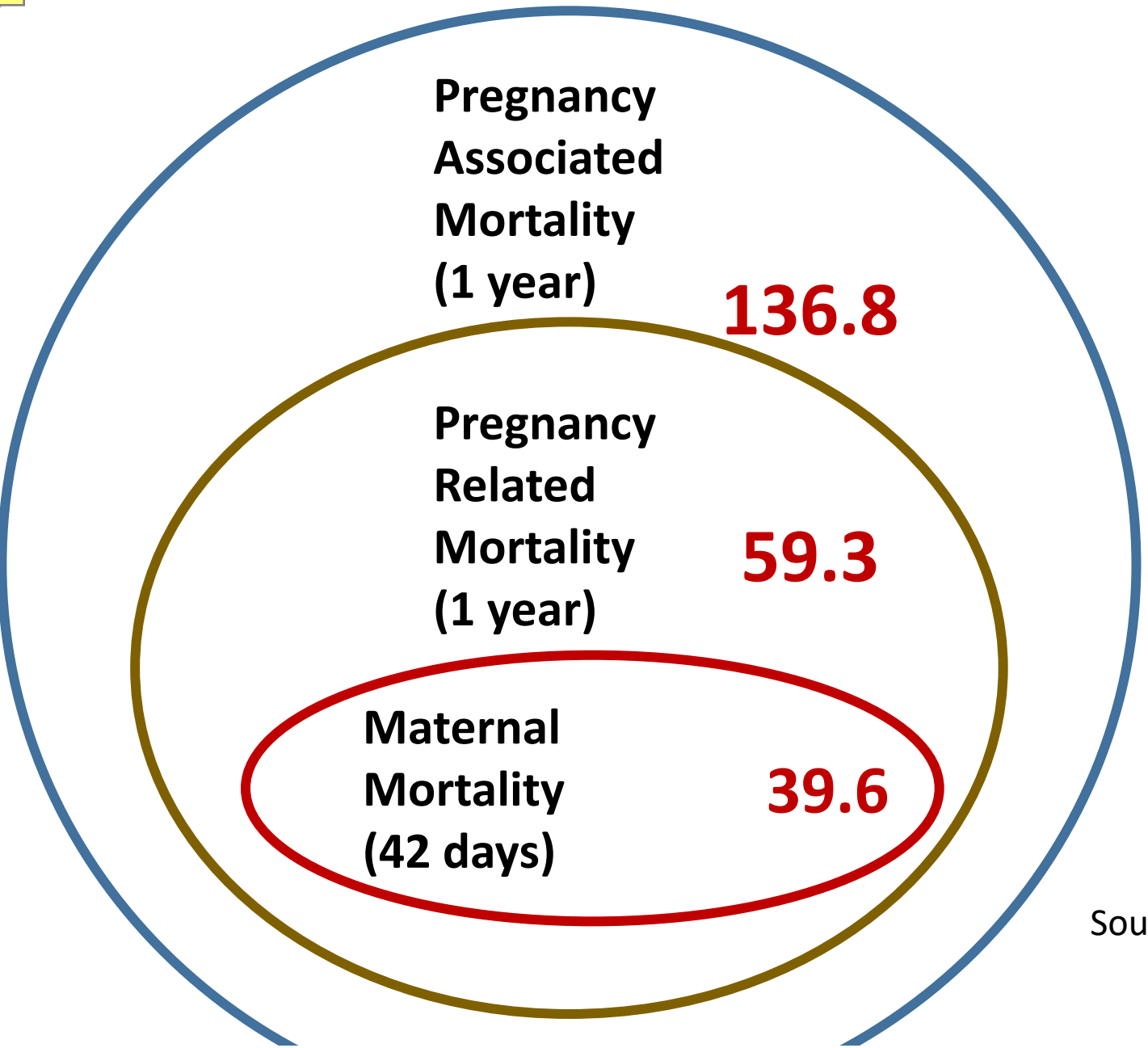
- **U.S. National Vital Stat. System** – Maternal Mortality
- **CDC Pregnancy Related Mortality System** – Pregnancy Related Mortality
- **State Maternal Mortality Review Committees** – Pregnancy Associated, Pregnancy Related & Maternal Mortality depending on states, but primarily Pregnancy Related Mortality

# 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



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



Using NVSS Data on Tenn.  
**Maternal Mortality** for 2020-2022:  
124 Deaths; 242,671 births  
Rate – **51.1/100,000**

Sources: *Maternal Mortality in Tennessee 2024* & NVSS.

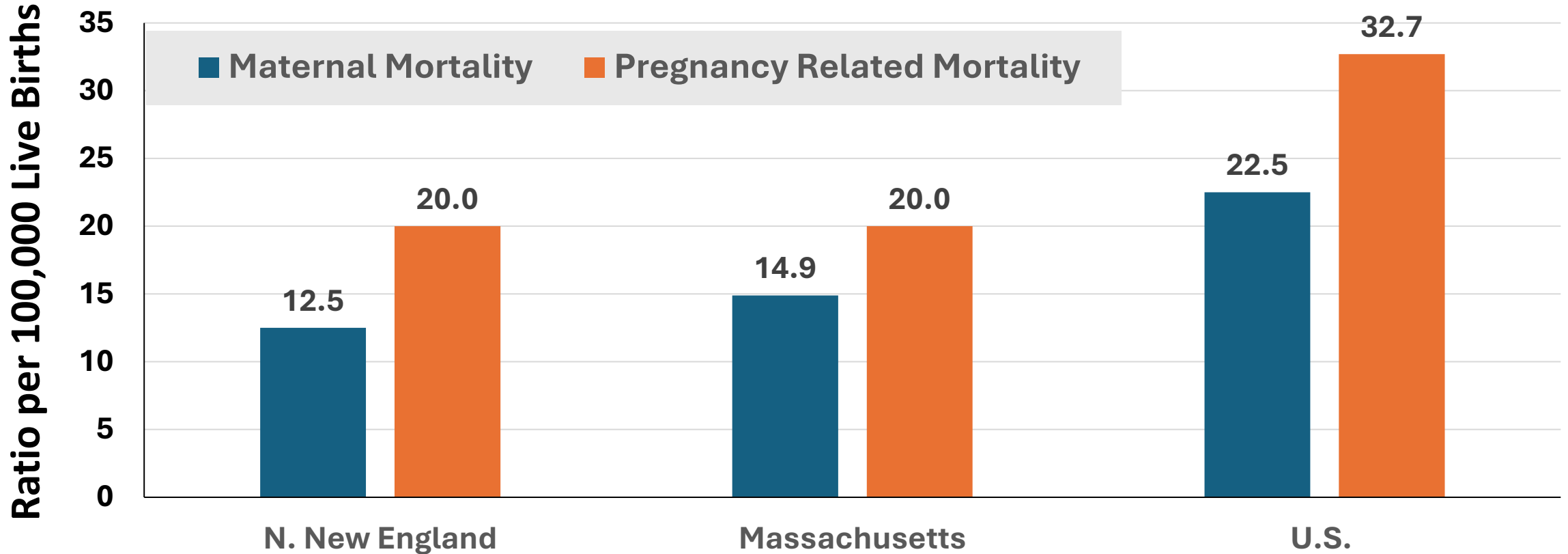
**Mortality Rates from the Tenn. MMRC. per 100,000 births, 2020-22**

# **The New England Context**

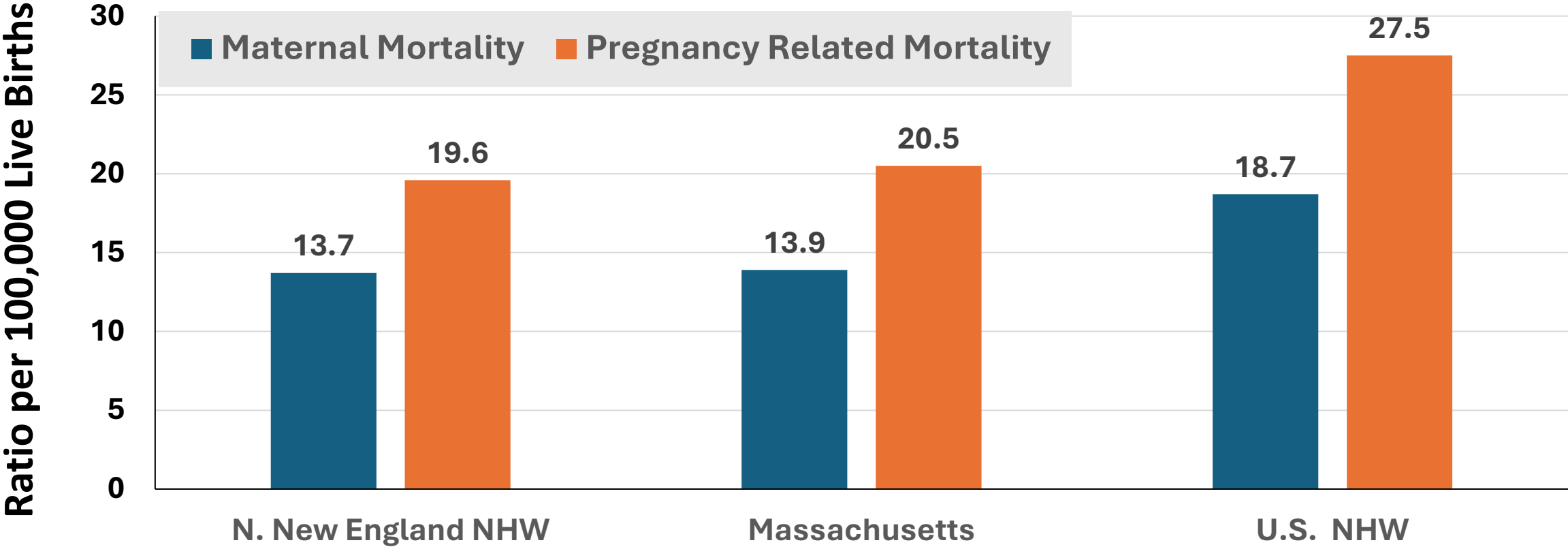
**Aren't we better than everyone else?**  
**(sort of)**



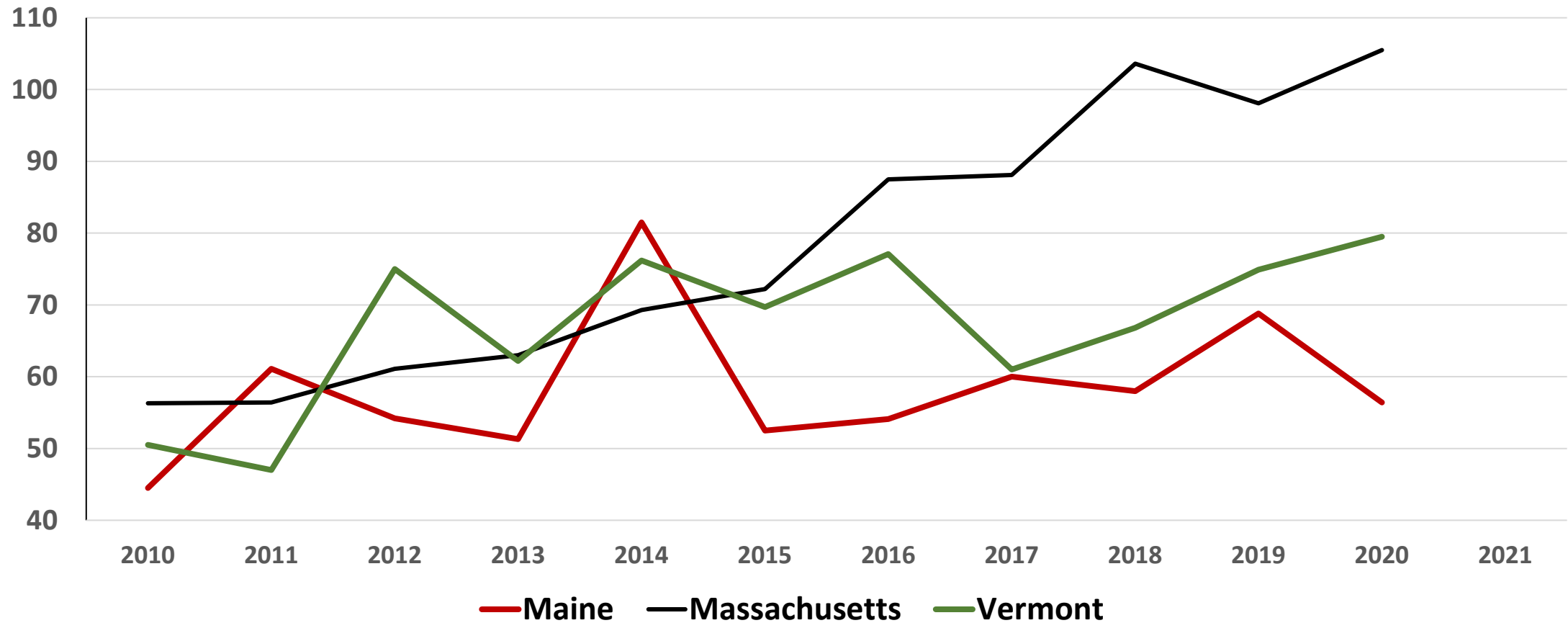
# Maternal Deaths, 2018-2023, Northern New England (ME, NH, VT), Mass. & U.S.



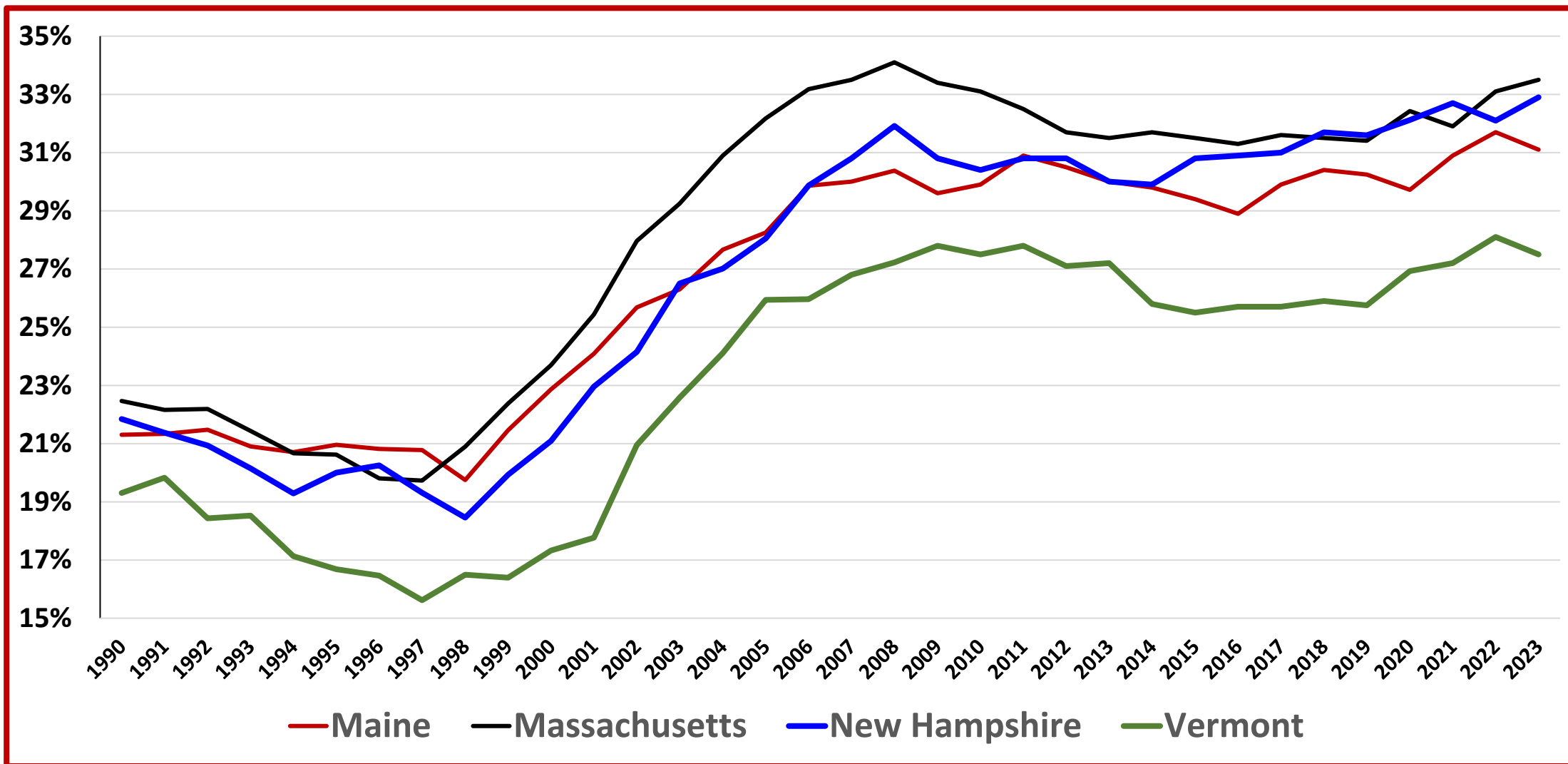
# Maternal Deaths, 2018-2023, N. New England, & U.S. Non-Hispanic White



# SMM Rates (per 10,000 births) Maine, Massachusetts, & Vermont, 2010-2021

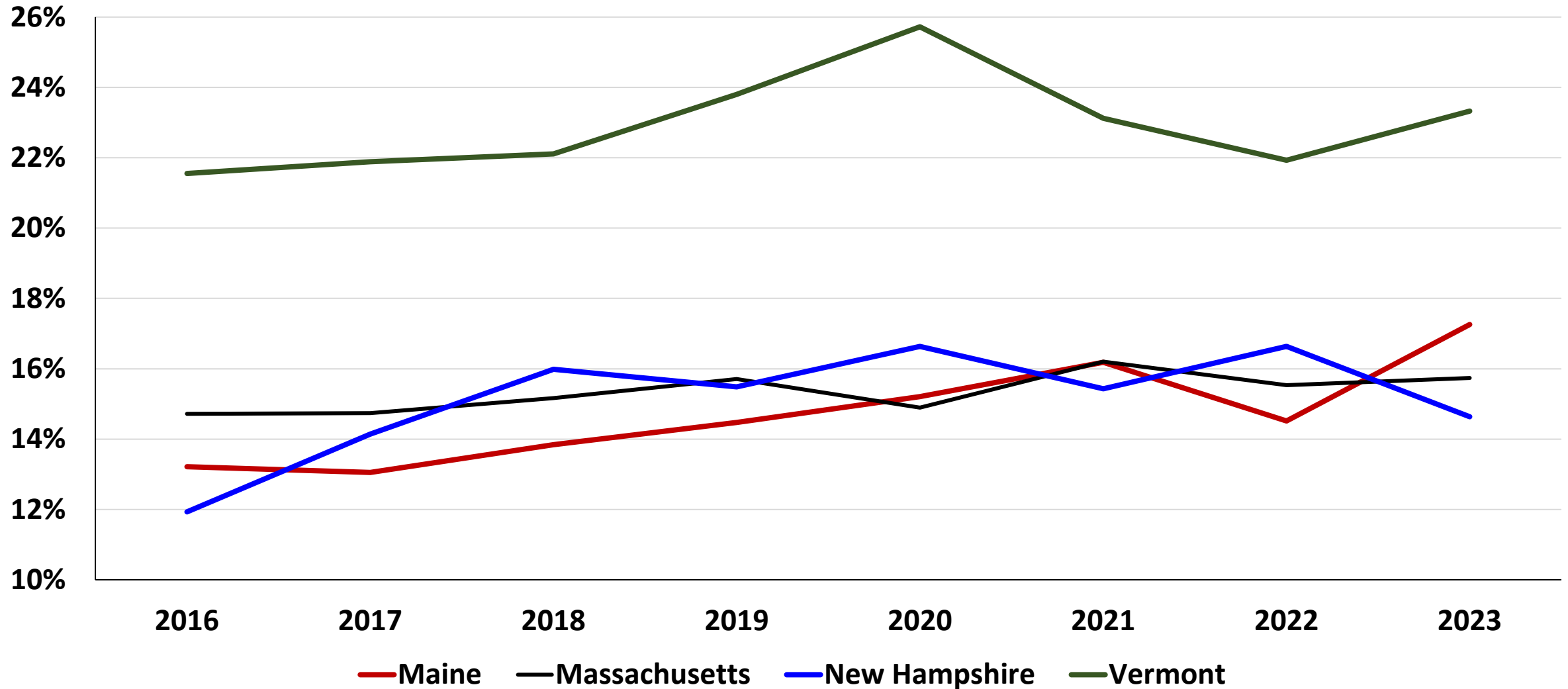


# Overall Cesarean Rates Maine, Massachusetts, New Hampshire & Vermont, 1990-2023

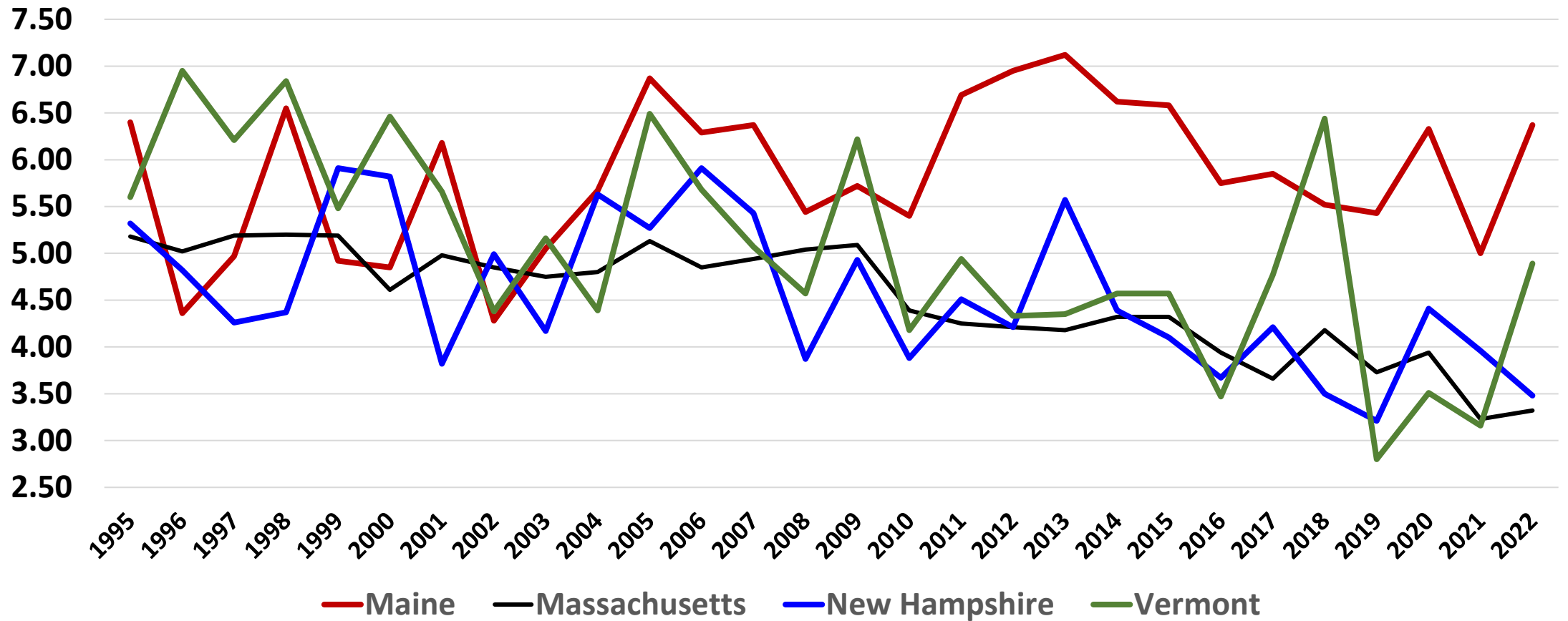




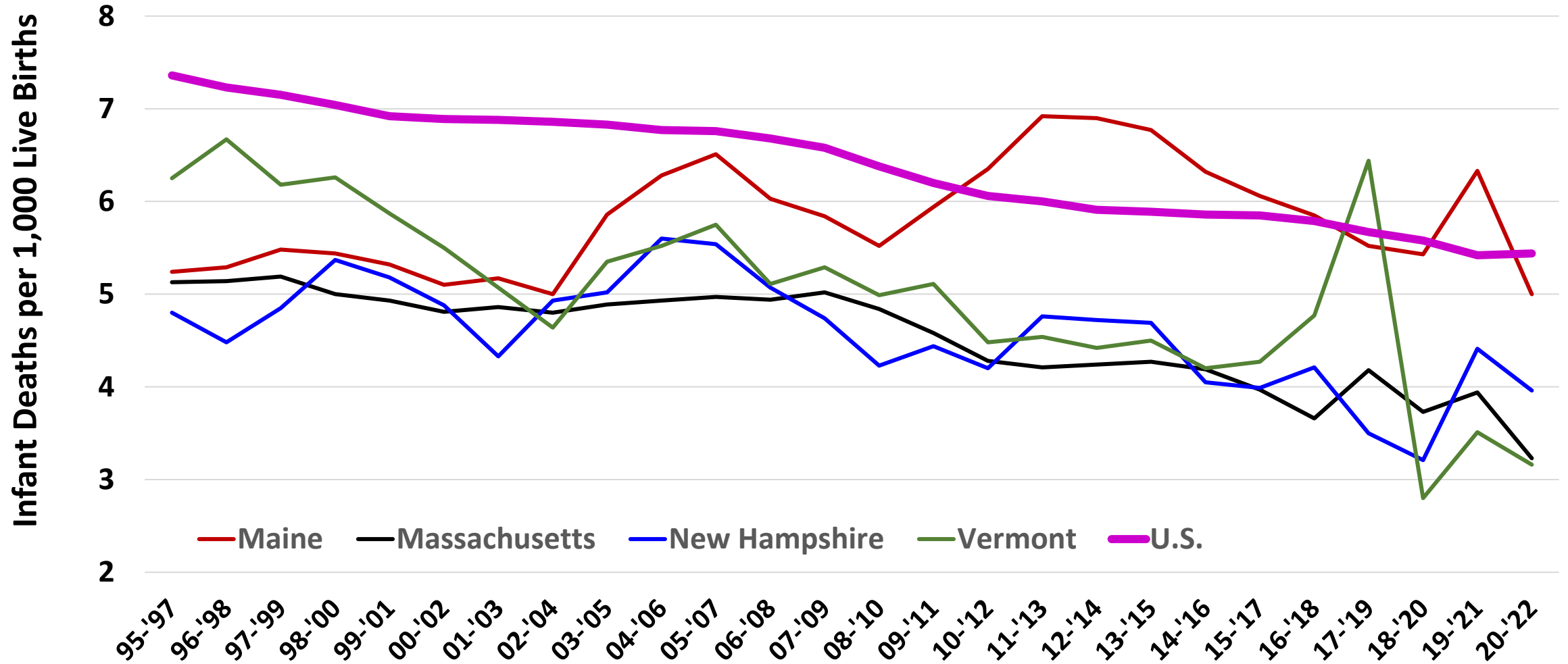
# VBAC Rates Maine, Massachusetts, New Hampshire & Vermont, 2016-2023



# Infant Mortality (per 1,000 births), Maine, Massachusetts, New Hampshire, Vermont & U.S., 1995-2022



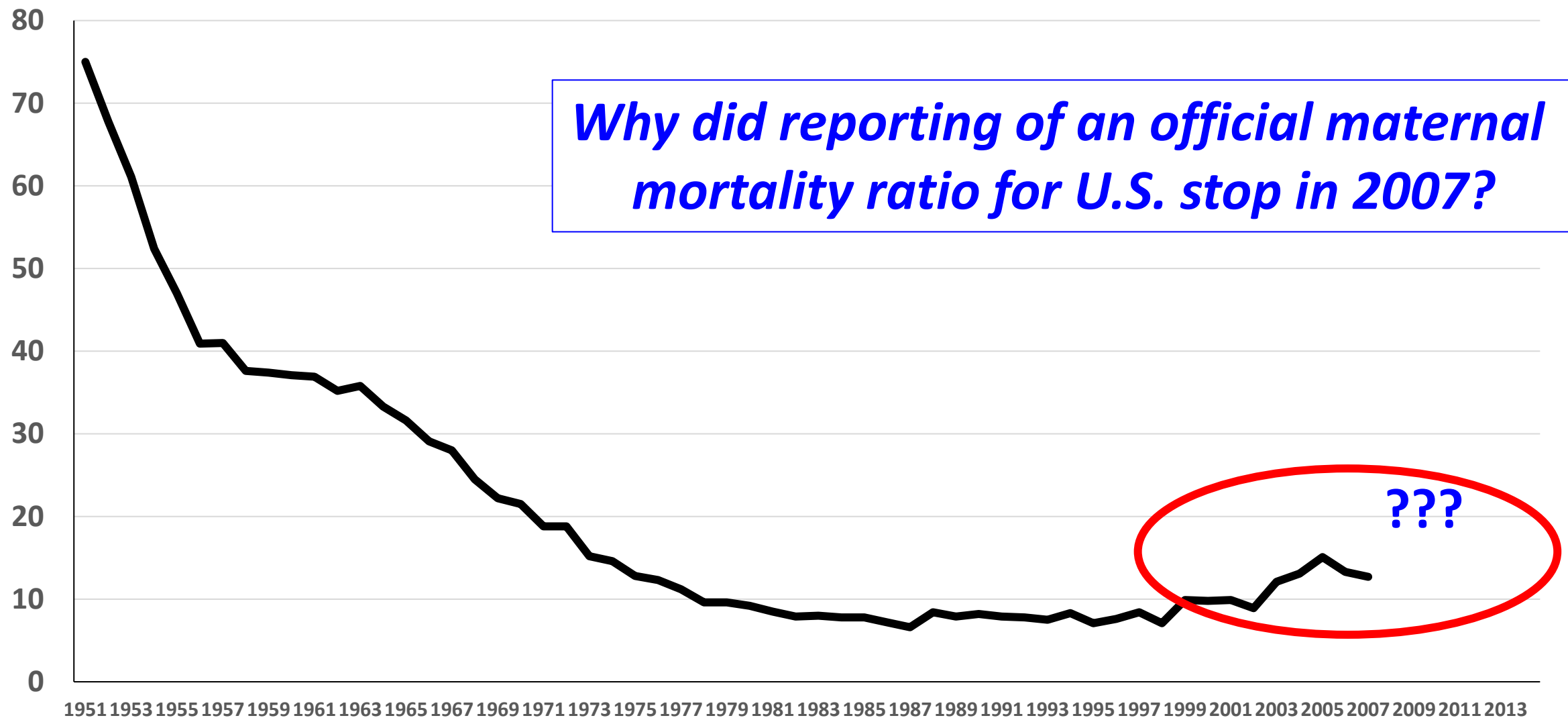
# Infant Mortality (per 1,000 births), Maine, Mass., New Hampshire, Vermont & U.S., 3 yr moving ave. 1995-2022



**Why is it so hard to measure  
maternal mortality?**



# U.S. Maternal Mortality Ratio (per 100,000 live births) , 1951-2007





***How did the U.S. get to the point  
where they stopped publishing a  
maternal mortality rate?***

***Efforts to avoid poor case  
ascertainment led to over-  
ascertainment***



# The Case of the Pregnancy Checkbox

*“This difficulty [in measuring maternal mortality] would be solved easily if universal birth and stillbirth registration was practiced and if death certificates required a statement as to the association of the puerperal state.”*

*Committee on Maternal Welfare. Maternal Mortality in Philadelphia 1931-1933 (1934)*

# To improve case identification:

## *U.S. Standard Pregnancy Question, 2003 (sort of)*

Checkbox format:

IF FEMALE:

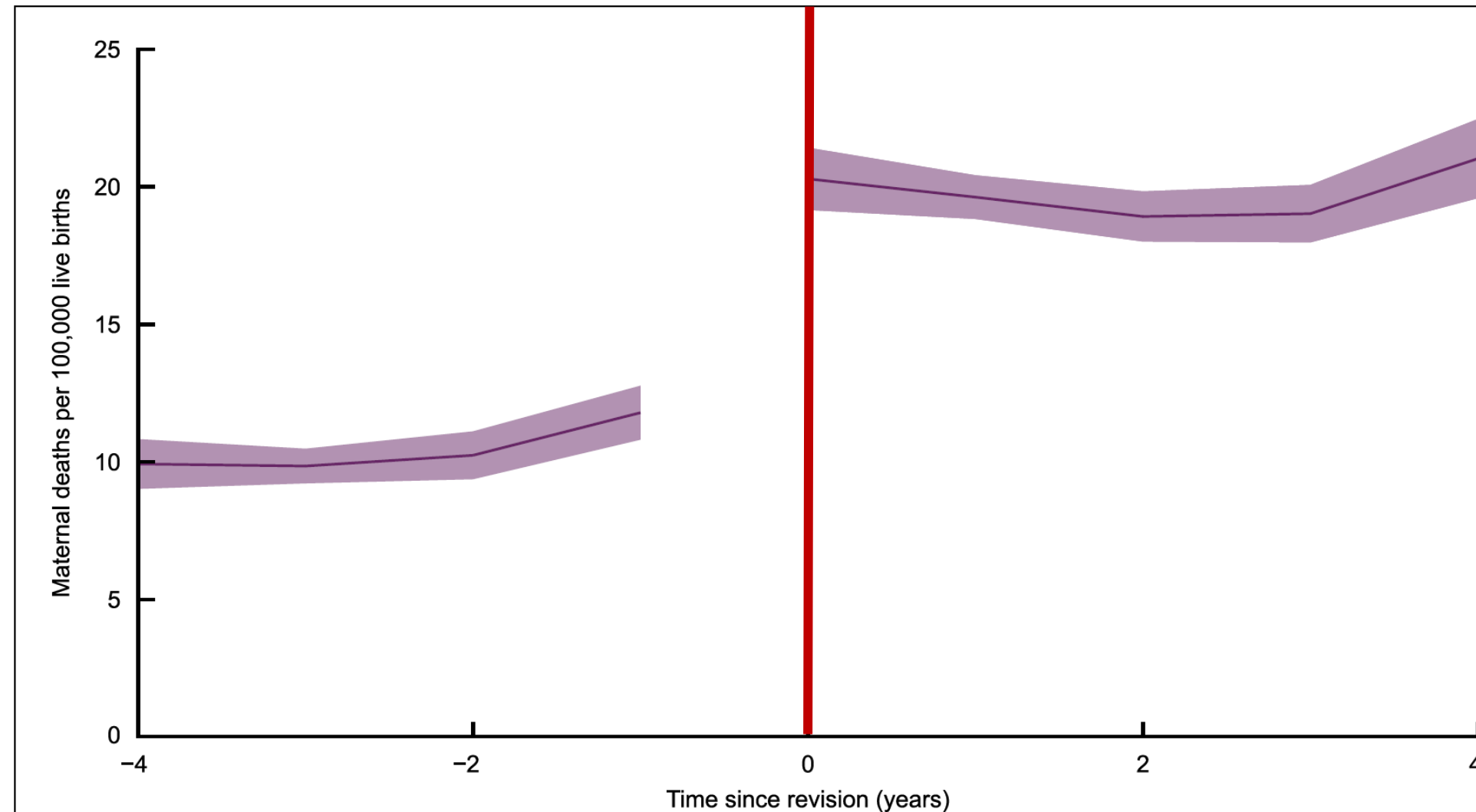
- Not pregnant within past year
- Pregnant at time of death
- Not pregnant, but pregnant within 42 days of death
- Not pregnant, but pregnant 43 days to 1 year before death
- Unknown if pregnant within the past year

*Meant to solve 2 problems:*

- (1) Most states had no such question; and*
- (2) Different questions used in different states that did ask about pregnancy status.*

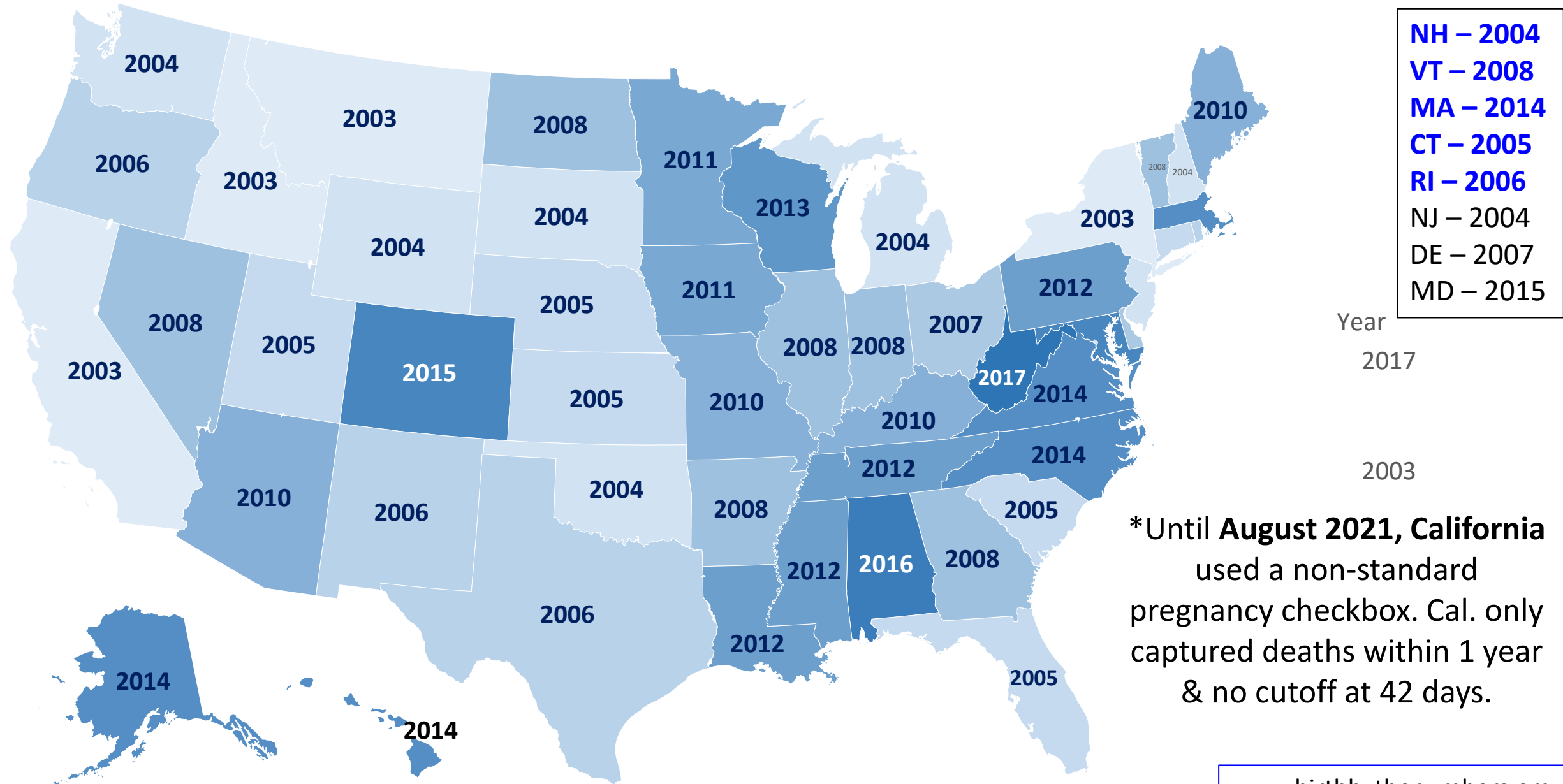
# NCHS Analysis of the Impact of Checkbox

Figure 1. Average change in maternal mortality rates associated with the pregnancy checkbox implementation: United States, 2003–2017



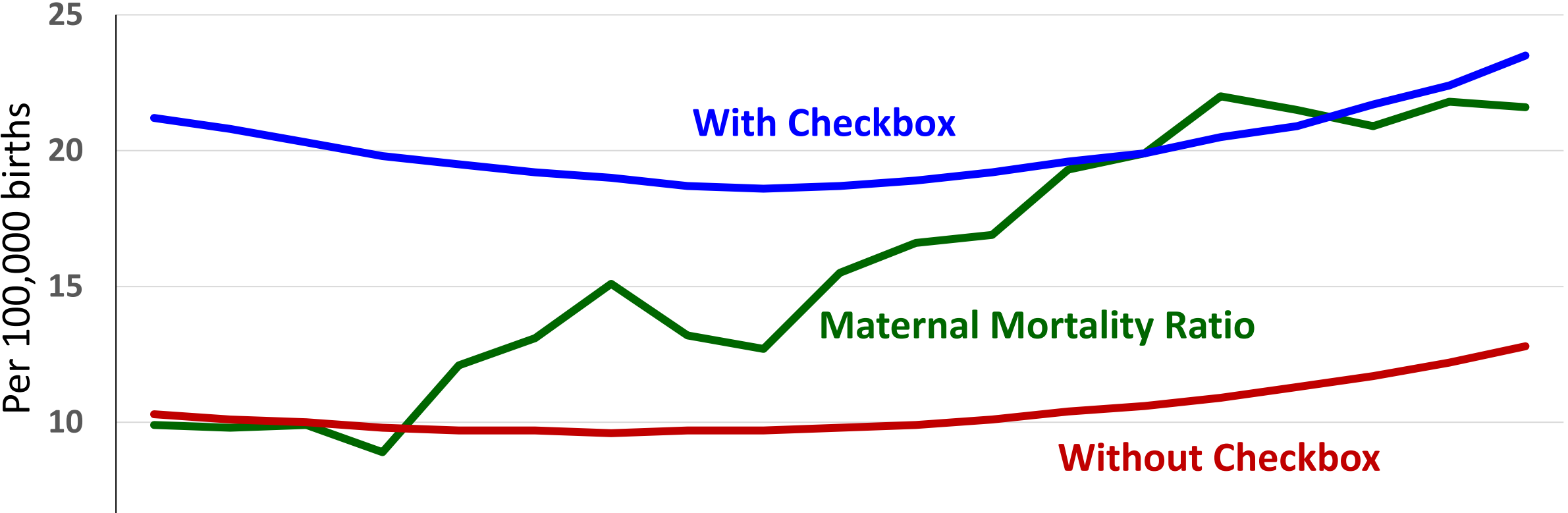
Source: Rossen LM, et al. *The impact of the pregnancy checkbox, 1999–2017*. NCHS. Vital Health Stat 3(44). 2020.

# Staggered adoption of 2003 revisions by states (2003-17)





# Observed and predicted maternal mortality ratios: United States, 1999–2017



5	<b>States with Checkbox</b>	4	11	18	22	24	31	31	35	37	41	42	47	49	50	51			
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017

Source: Rossen LM, et al. *The impact of the pregnancy checkbox, 1999–2017*. NCHS. Vital Health Stat 3(44). 2020.



# Number of births and deaths with positive pregnancy responses in the checkbox: United States, 2013

Age	Births	Pregnancy Associated Deaths
40-44	134,540	145
45-49	10,329	89
50-54	780	148
55-59	74	33
60-64	7	51
65-69		45
70-74		51
75-79		46
80-84		42
85+		147

331 cases of positive pregnancy checkbox in deaths of women 65+

## HOW CAN THIS HAPPEN?

1,026,940 DEATHS  
WOMEN 65+ IN 2013

331 IS A MISTAKE RATE  
OF 0.03% OR **1 IN 3,103**  
**CASES**

NOTE: Alabama, Alaska, Colorado, Hawaii, Massachusetts, North Carolina, Virginia, and West Virginia did not have the standard checkbox in 2013.



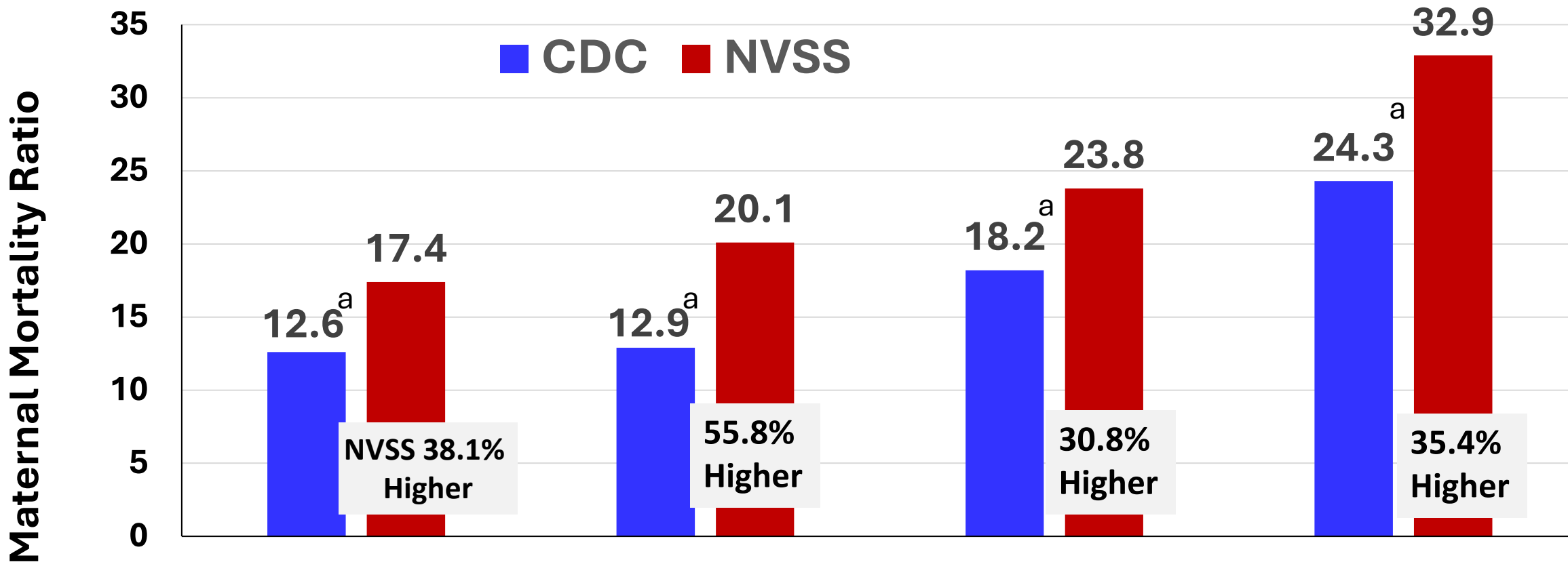
# It's Never Simple: Impact of the Checkbox – Worse *and* Better Ascertainment

- While the checkbox contributed to errors, a Four MMRC Committee study showed that the *checkbox also improved identification of pregnancy-related deaths*.
- *Without the pregnancy checkbox, states would have missed approximately:*
  - *50% of pregnancy-related deaths that occurred during pregnancy*
  - *11% of pregnancy-related deaths that occurred within 42 days of the end of pregnancy, and*
  - *8% of pregnancy-related deaths that occurred within 43 days to 1 year of the end of pregnancy*

# 3 Systems – 3 Slightly Different Measures

	CDC – National Vital Statistics System (NVSS)	CDC – Pregnancy Mortality Surveillance System (PMSS)	State and Local Maternal Mortality Review Committees (MMRCs)
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# Comparing CDC & NVSS Estimates of U.S. Maternal Mortality, 2018 – 2021



**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.

# U.S. Maternal Mortality in Different Measurement Systems

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

# Summarizing The Measurement Problem

- The adoption of the checkbox was understandable but has clearly led to a rise in false positives and an overestimation of maternal deaths. However, it has also identified cases during pregnancy that wouldn't otherwise be found.
- May be best to consider the NVSS data involving the checkbox as the **first look** at maternal mortality in the US since their data is much more timely than other systems.
- *For a more accurate assessment of the state of maternal mortality, we should look at the **CDC Pregnancy Mortality Surveillance System** for national data and **state Maternal Mortality Review Committees** for state rates. However, they tend to be much slower (~2 years) in reporting.*

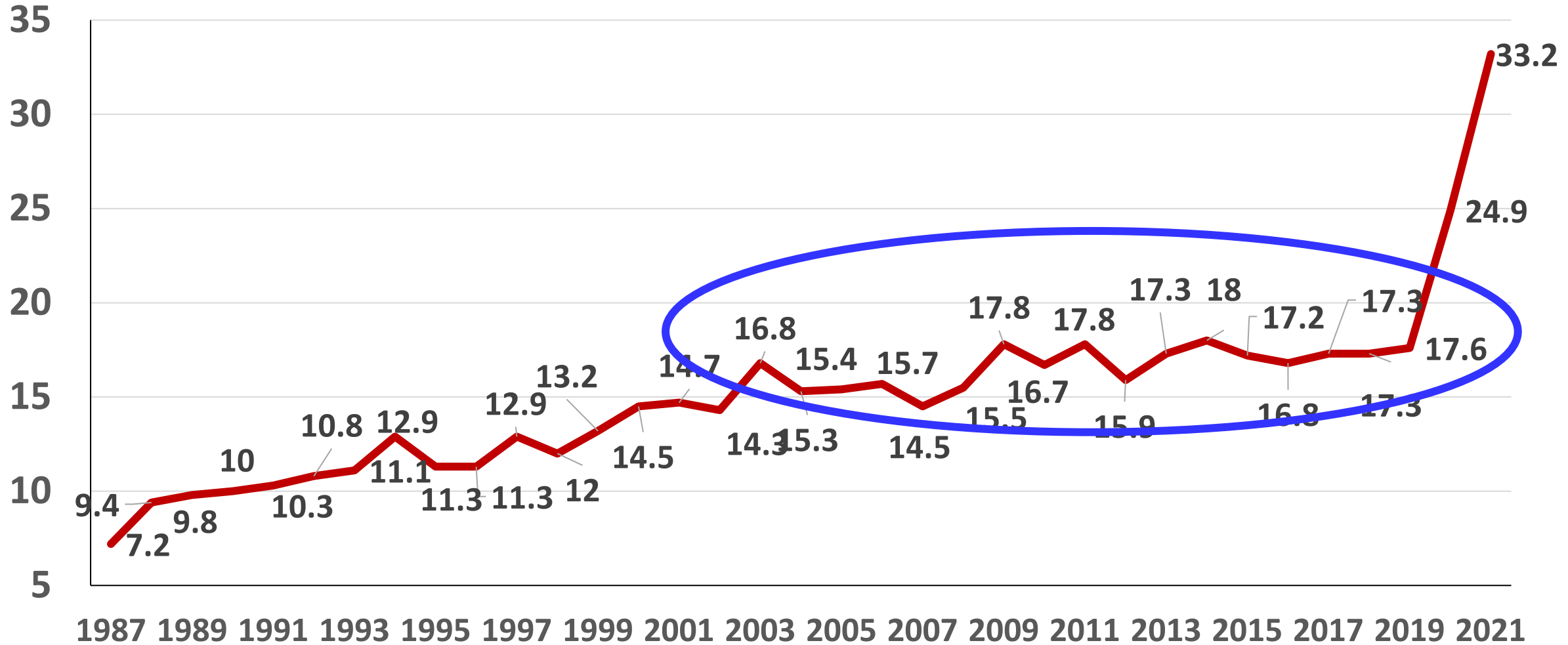
**Where we stand now overall  
and by subgroups**



# Our best existing measure

## Pregnancy Related Mortality, U.S., 1987-2021

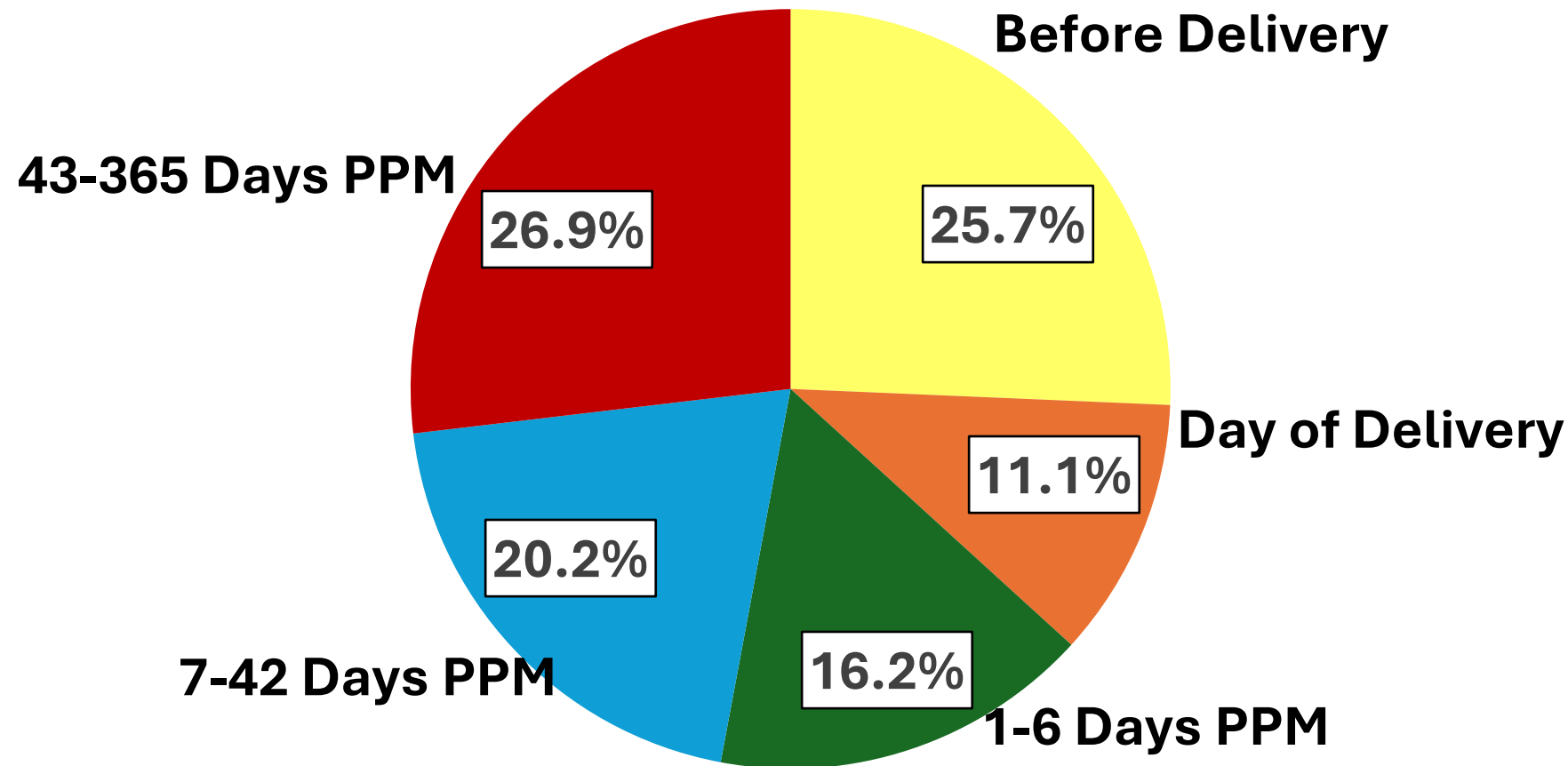
Pregnancy Related Mortality Ratio (per 100,000 births)



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

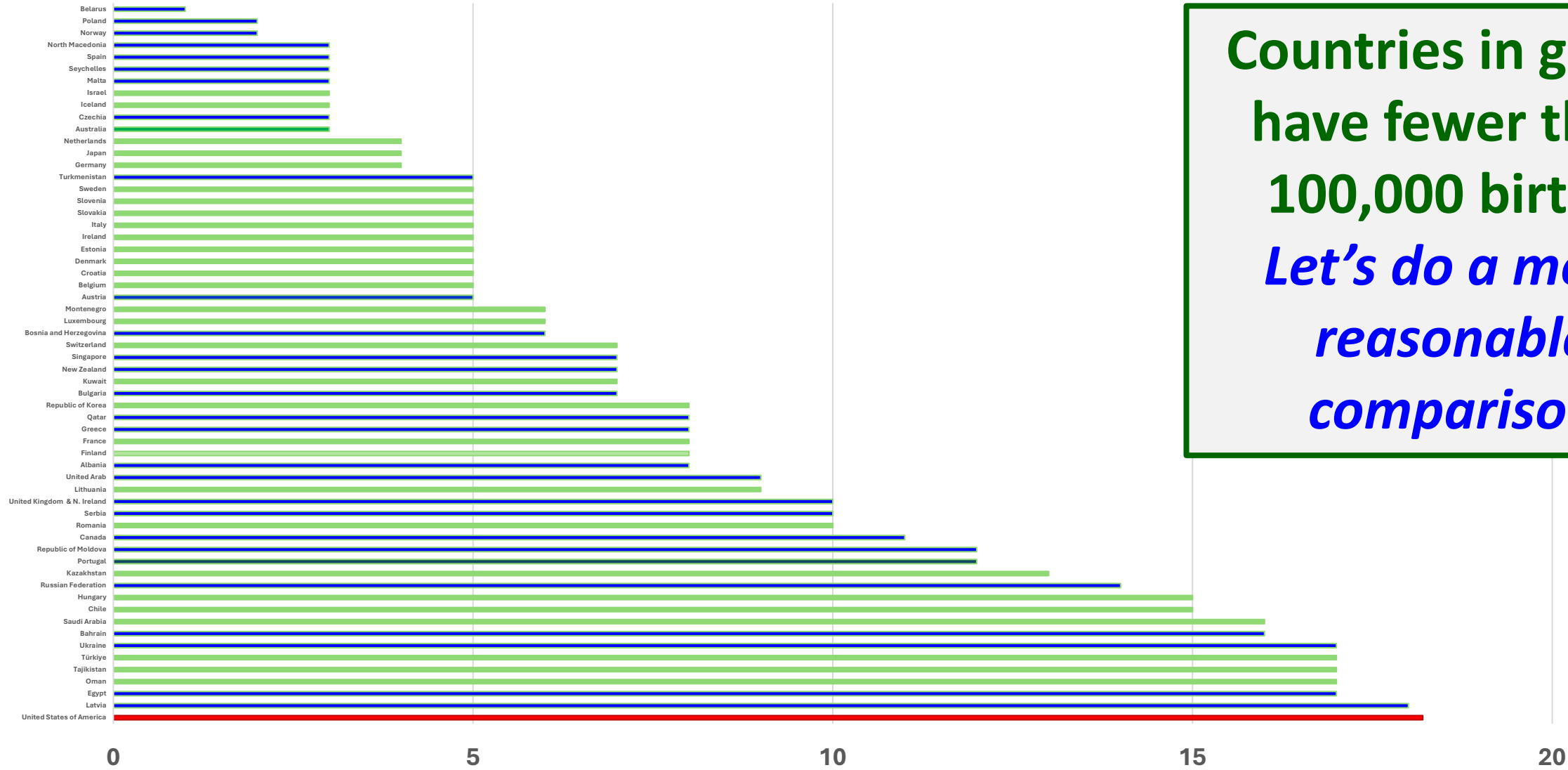


# Timing of Maternal Deaths (2020)



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

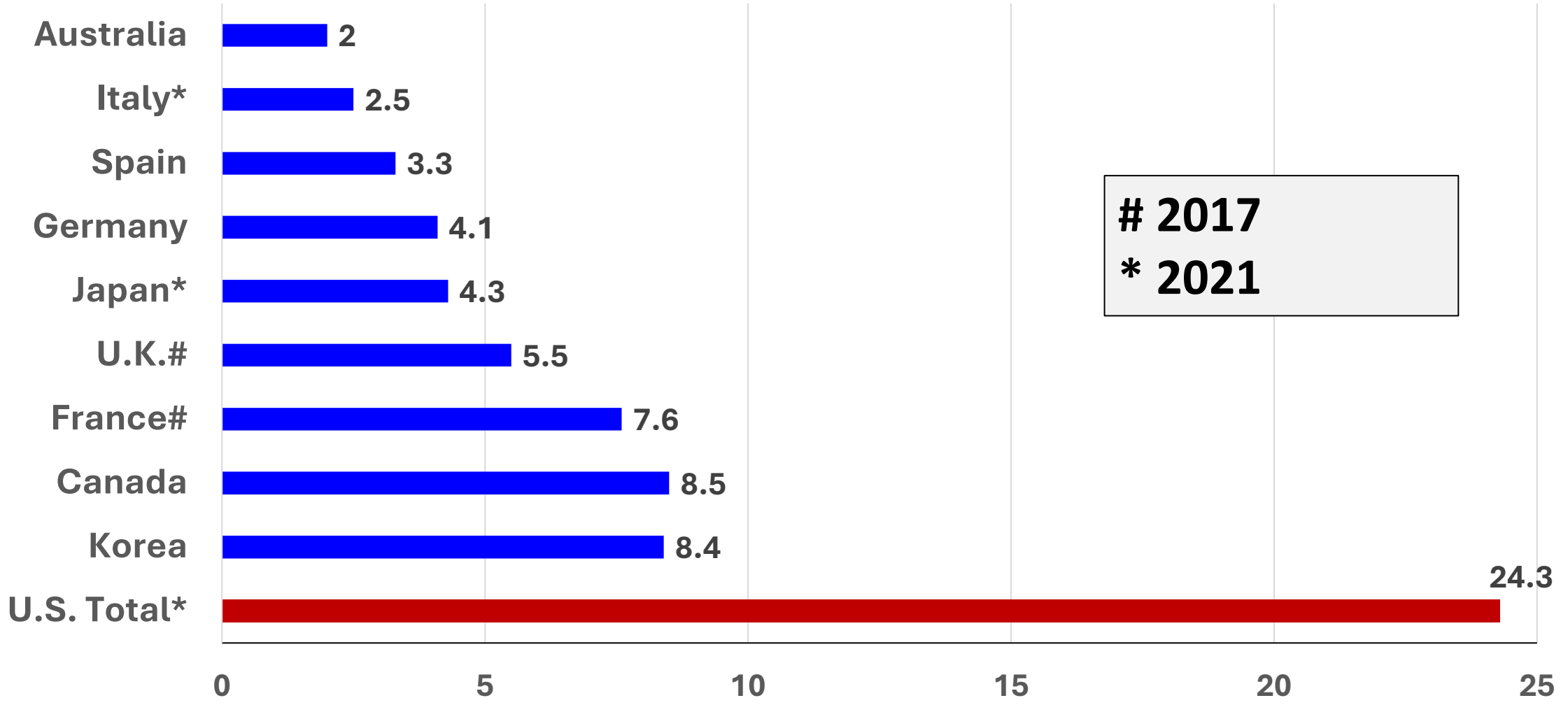
*Using the most conservative measure (PMSS) we have of U.S. maternal mortality*



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

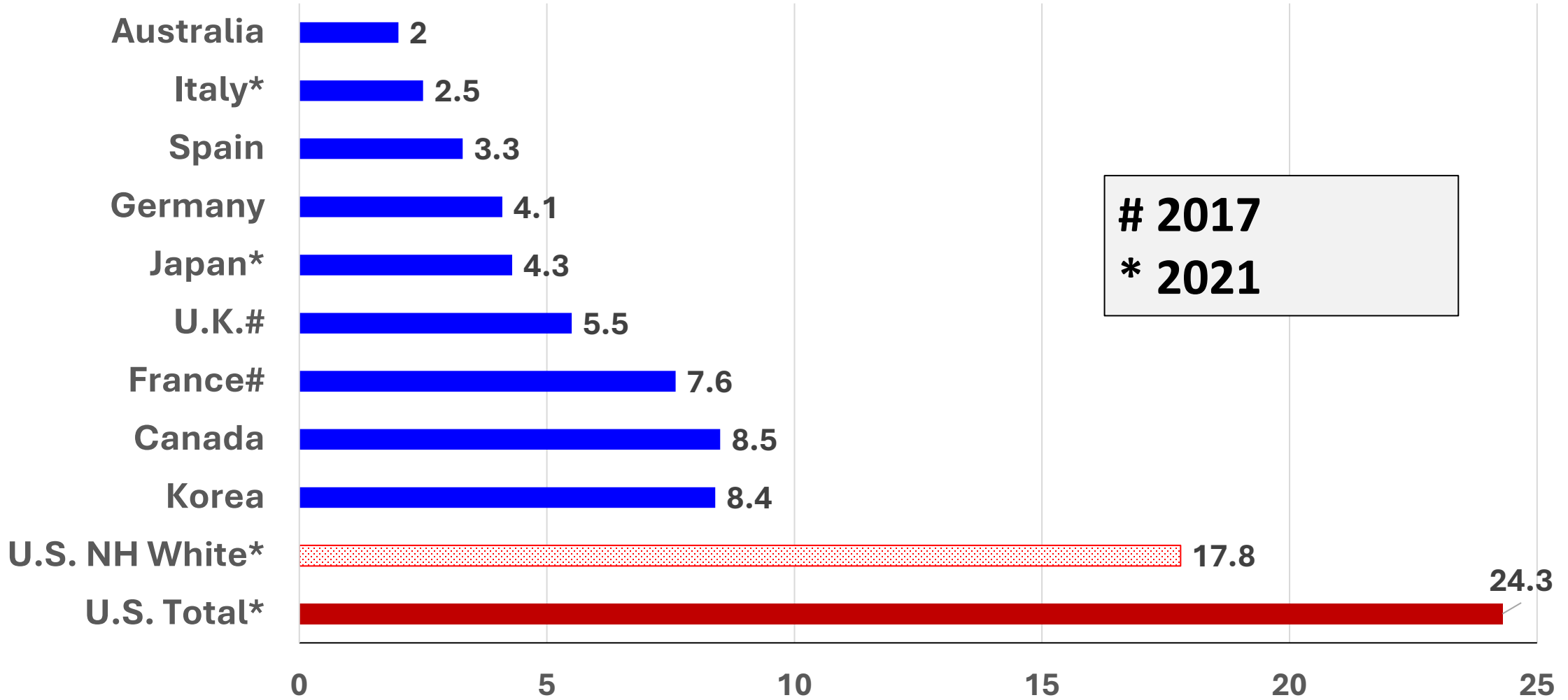


# U.S. Maternal Mortality Ratio (per 100,000 births)\* Compared to Industrialized Countries with 200,000+ births, 2021-22



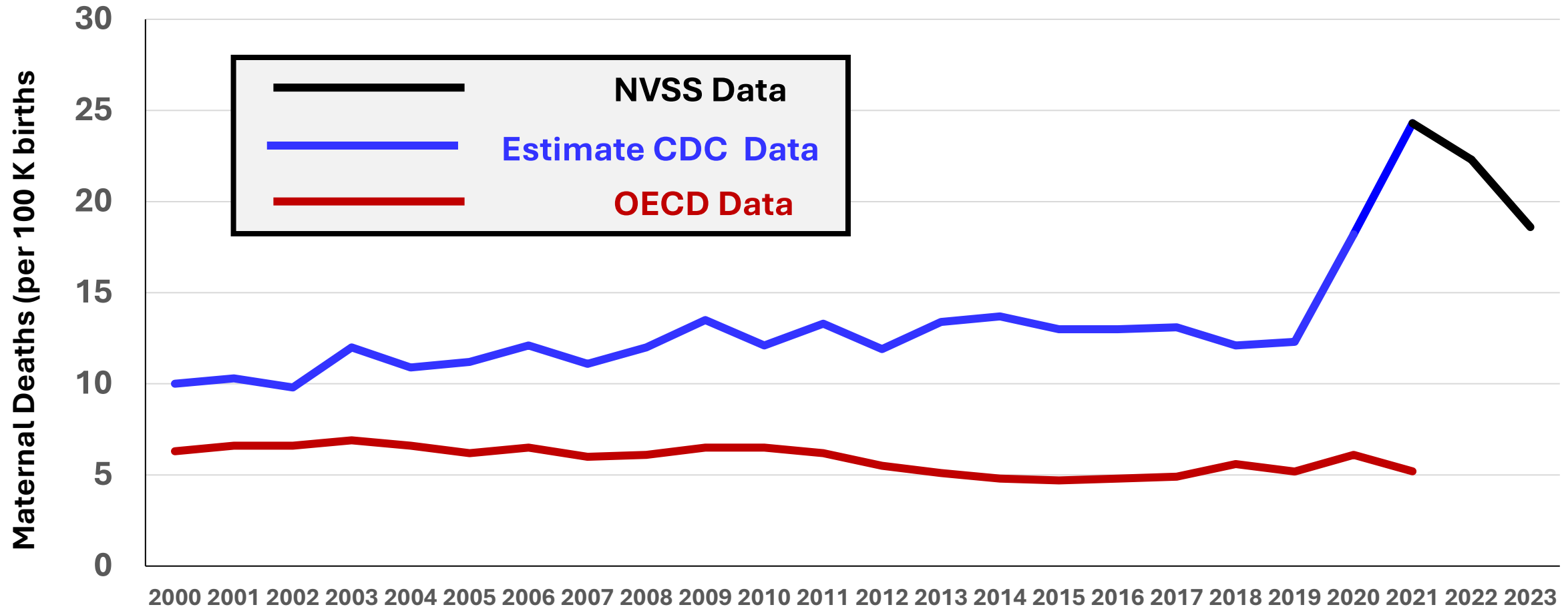


# U.S. Maternal Mortality Ratio (per 100,000 births)\* Compared to Industrialized Countries with 200,000+ births, 2021-22





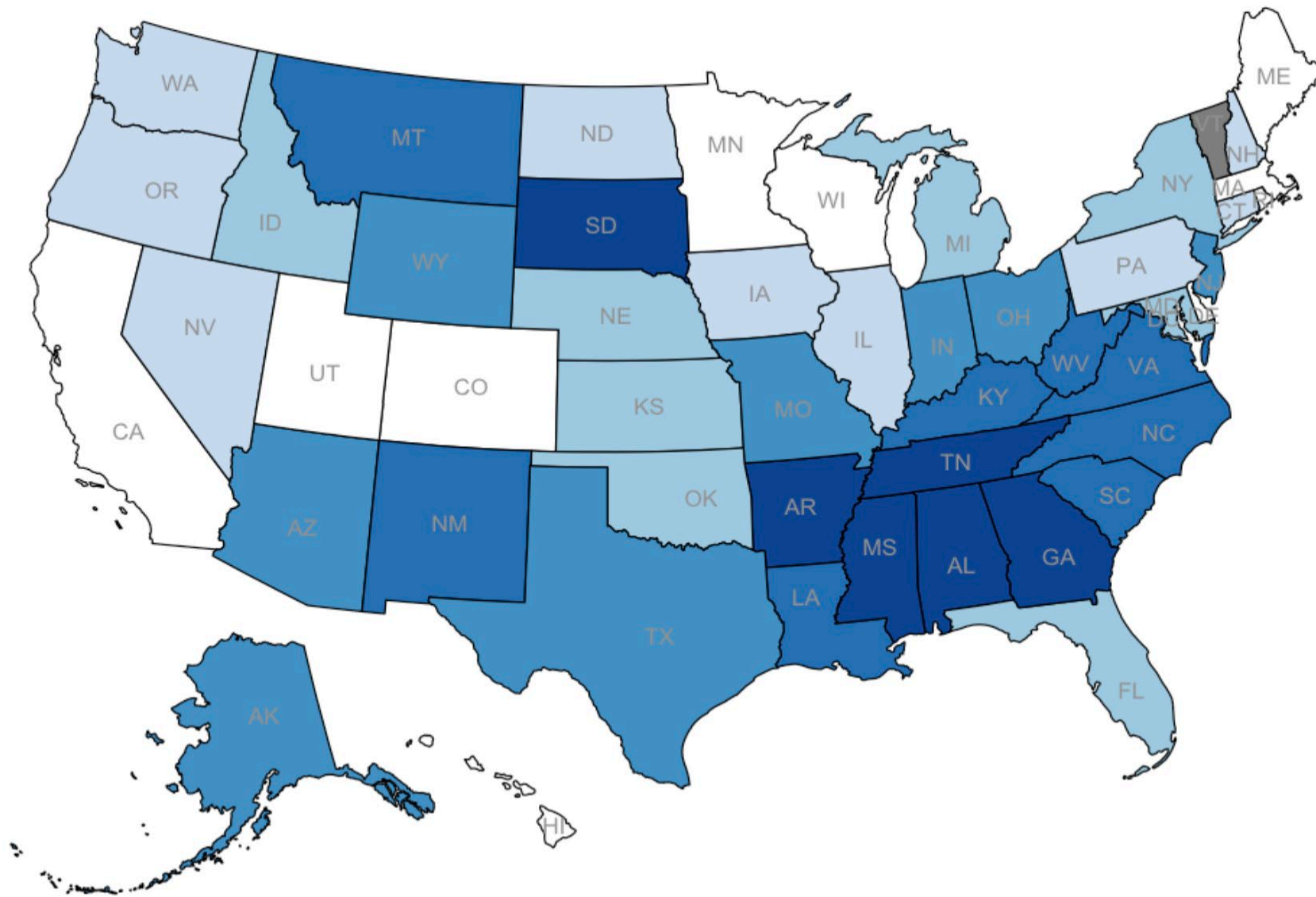
# *Maternal Mortality Ratio (per 100K births), 2000-2023, U.S. & Comparable Countries\**



\* 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

[www.birthbythenumbers.org](http://www.birthbythenumbers.org)



# Pregnancy Related Mortality<sup>#</sup> Ratios, U.S. States\*, 2018-22

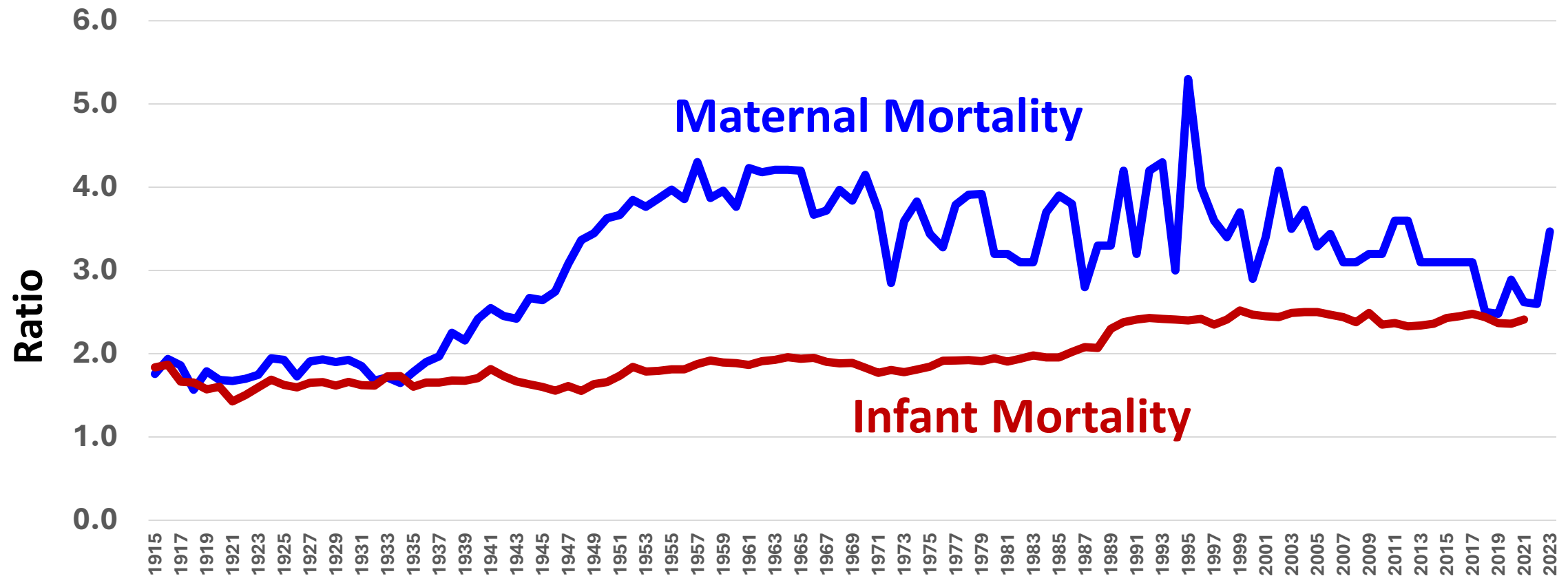
# Deaths during pregnancy through 1 year postpartum

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



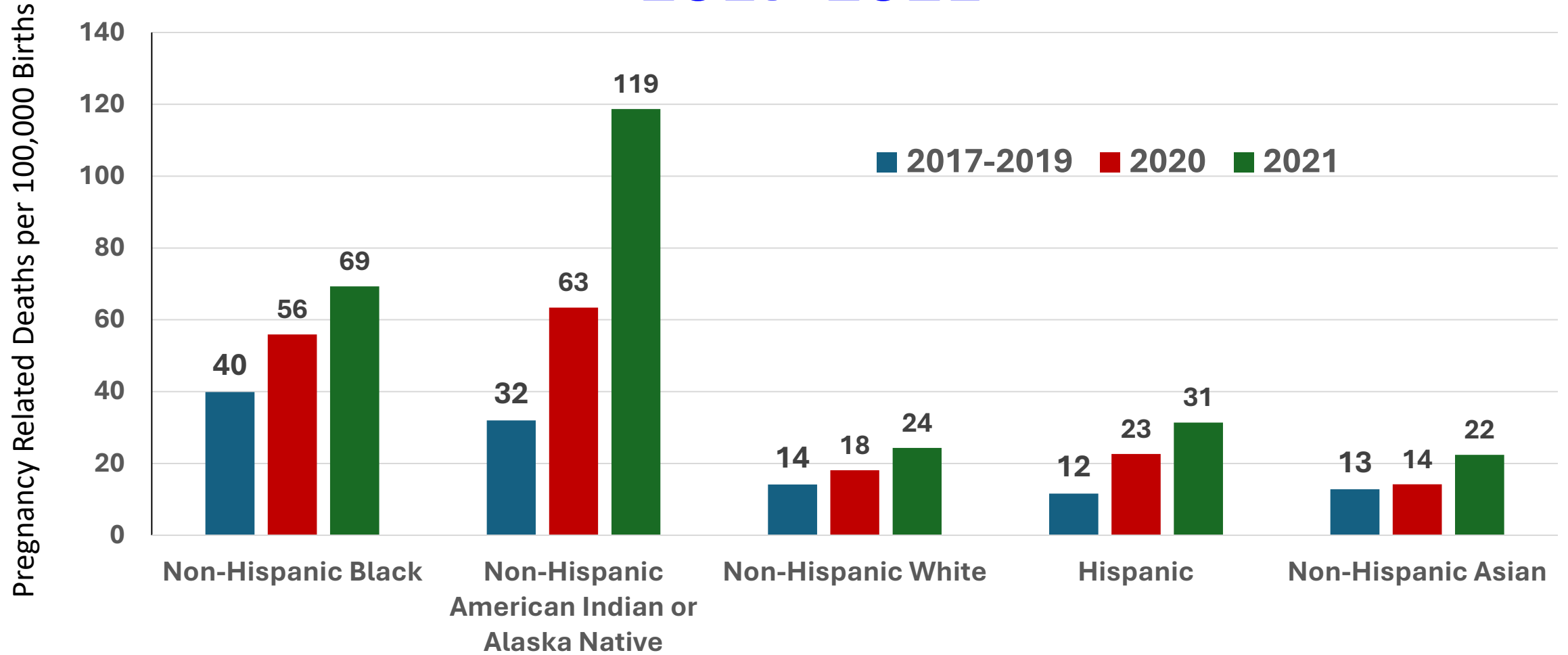


# Black to White Ratios, U.S. Infant & Maternal Mortality, 1915-2023



**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. Pregnancy Related Mortality by Race, 2017-2021

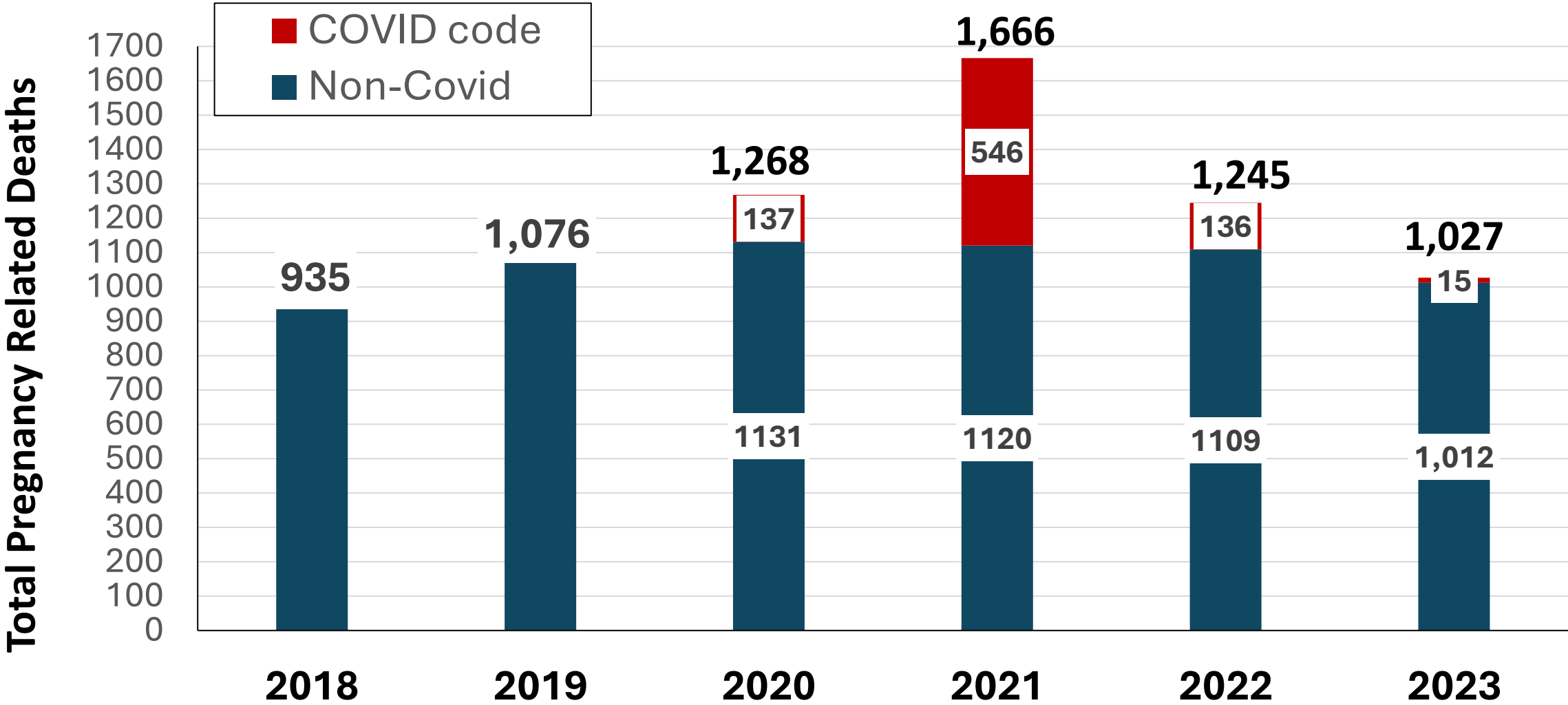


Source: CDC Pregnancy Related Mortality Surveillance System.

[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](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)



# COVID & Pregnancy Related\* Deaths, 2018-2023



\* Deaths during pregnancy and up to 1 year postpartum

Source: CDC Wonder. National Vital Statistics System (NVSS). Mortality File

Note: Note: The NVSS is the only data source that includes post-pandemic totals. It generally reports higher death totals than the CDC's Pregnancy Mortality Surveillance System. COVID is not listed as a primary cause of death, but as one of multiple causes.

**It's about women's health**

# Not just about maternal mortality

## National Vital Statistics Reports



Volume 73, Number 8

October 4, 2024

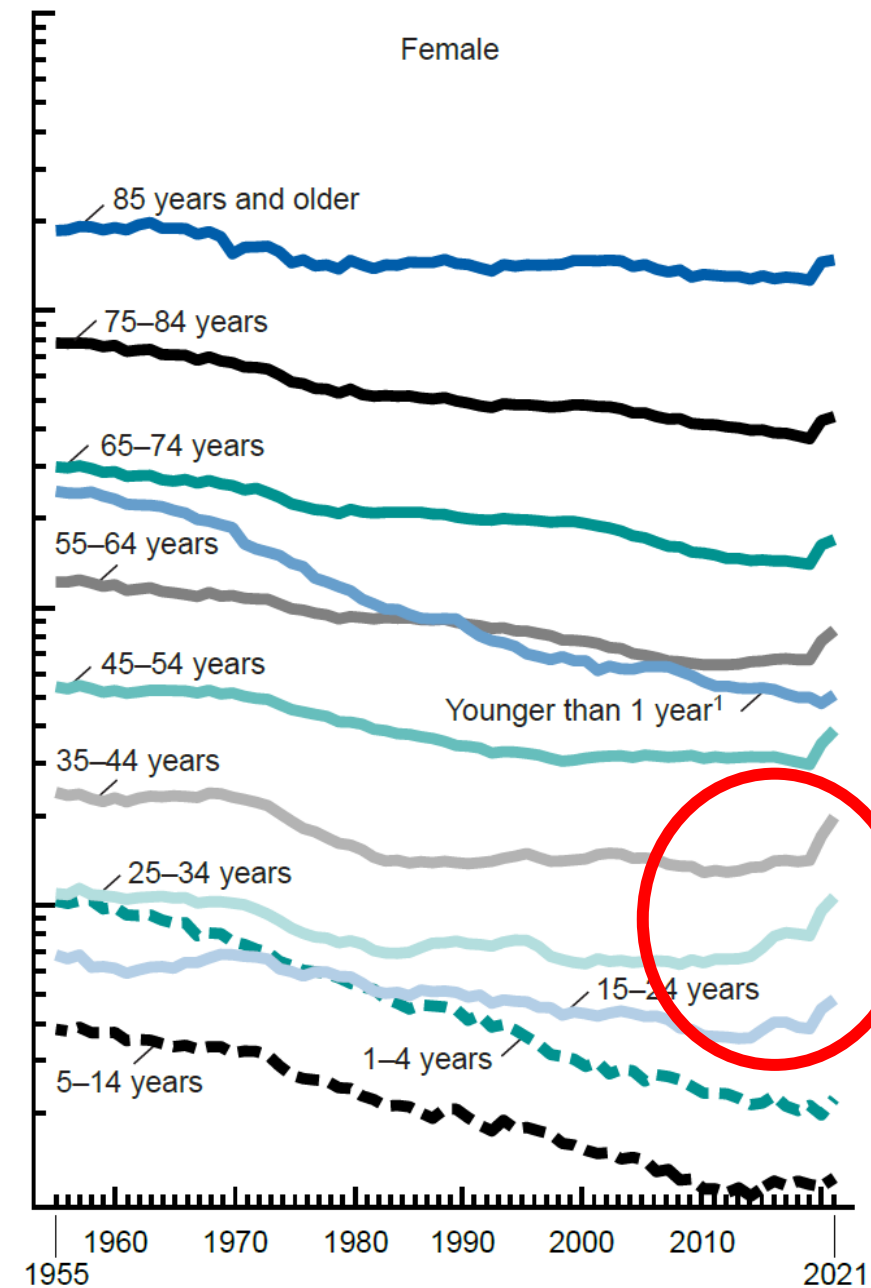
### Deaths: Final Data for 2021

#### STAT

Maternal deaths represent the canary in the coal mine for women's health

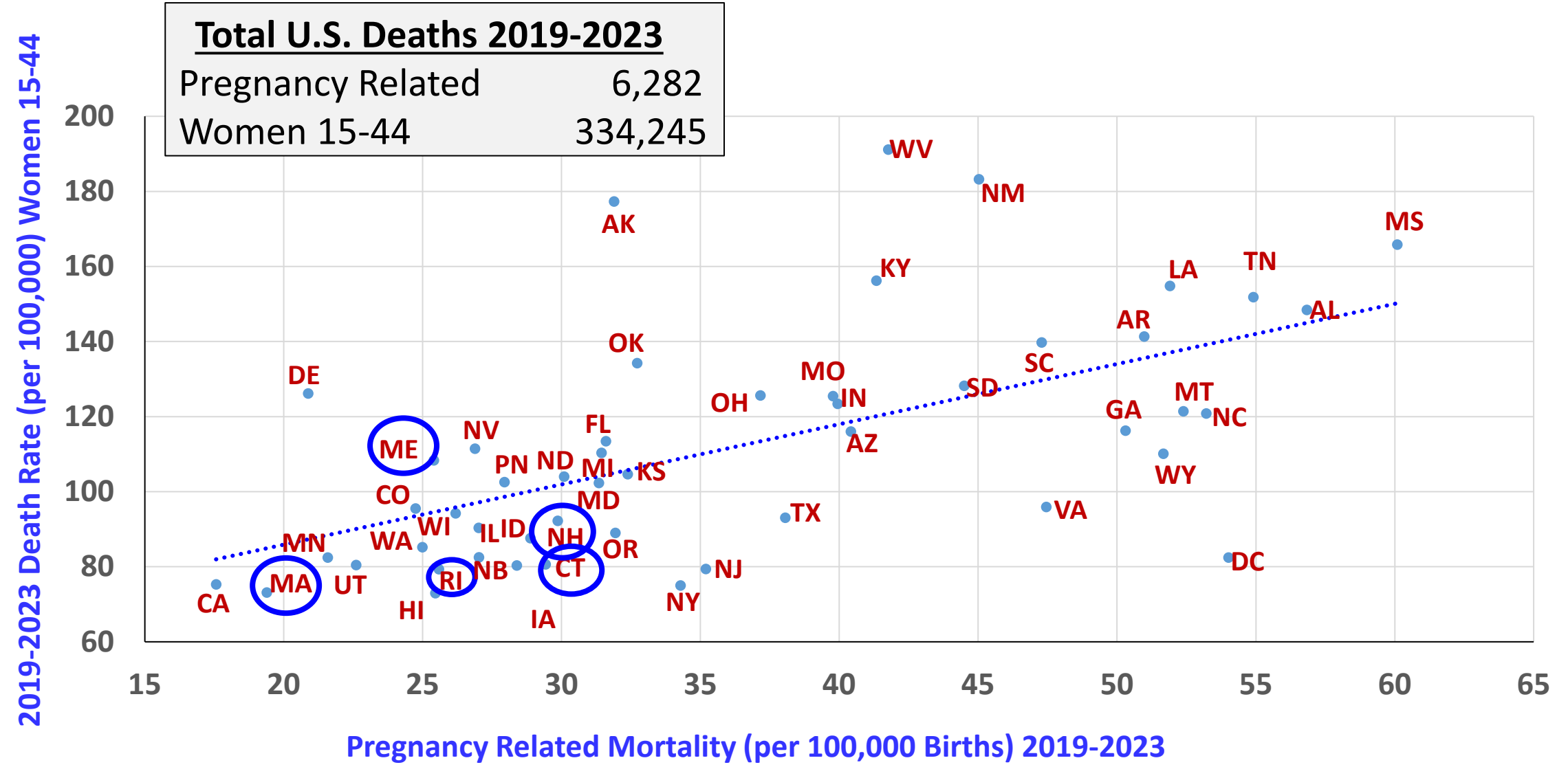
By Eugene Declercq and Neel Shah

August 22, 2018





# Relationship Between Pregnancy Related Mortality and Overall Death Rate for Women 15-44, U.S. States\*, 2019-2023



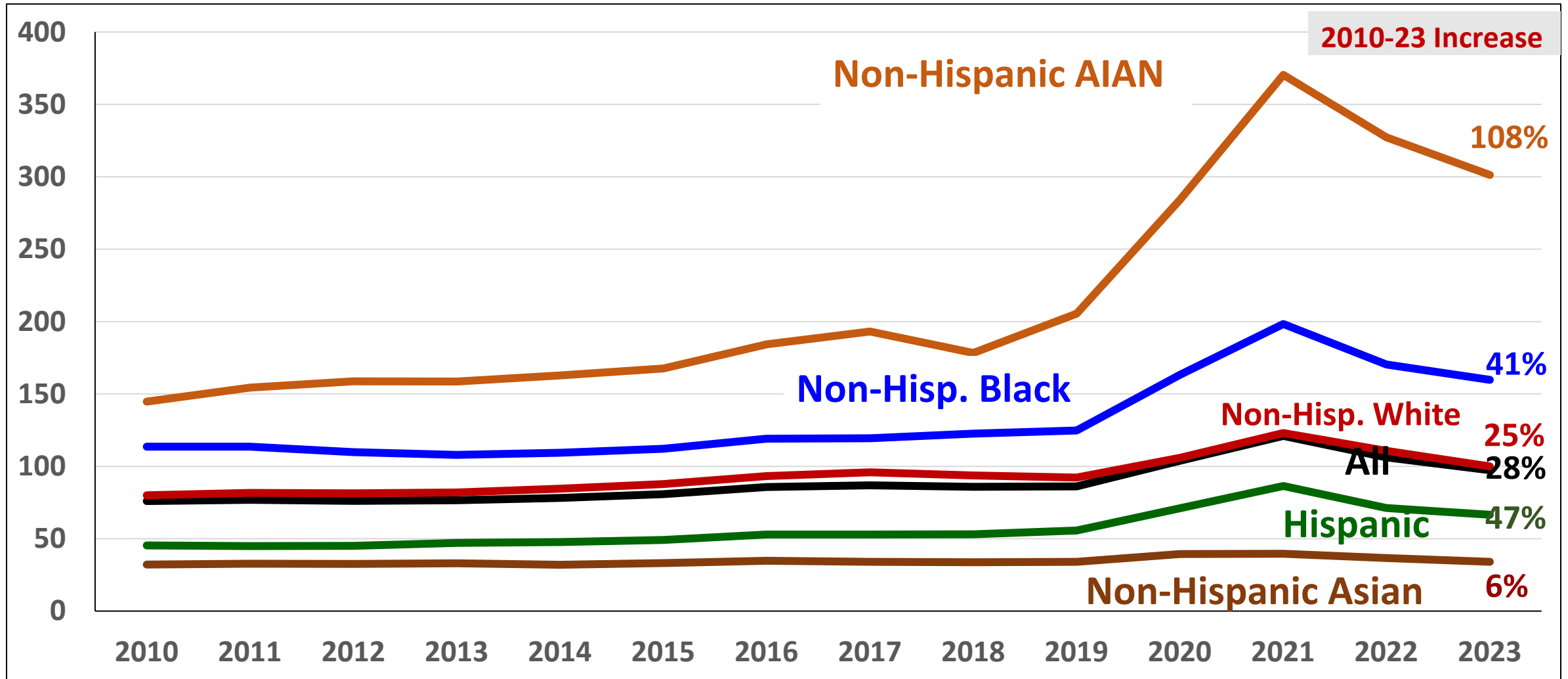
Source: CDC Wonder Mortality files

\* Excludes Vermont with < 10 Pregnancy Related Deaths



# The Problem is Bigger than Maternal Mortality

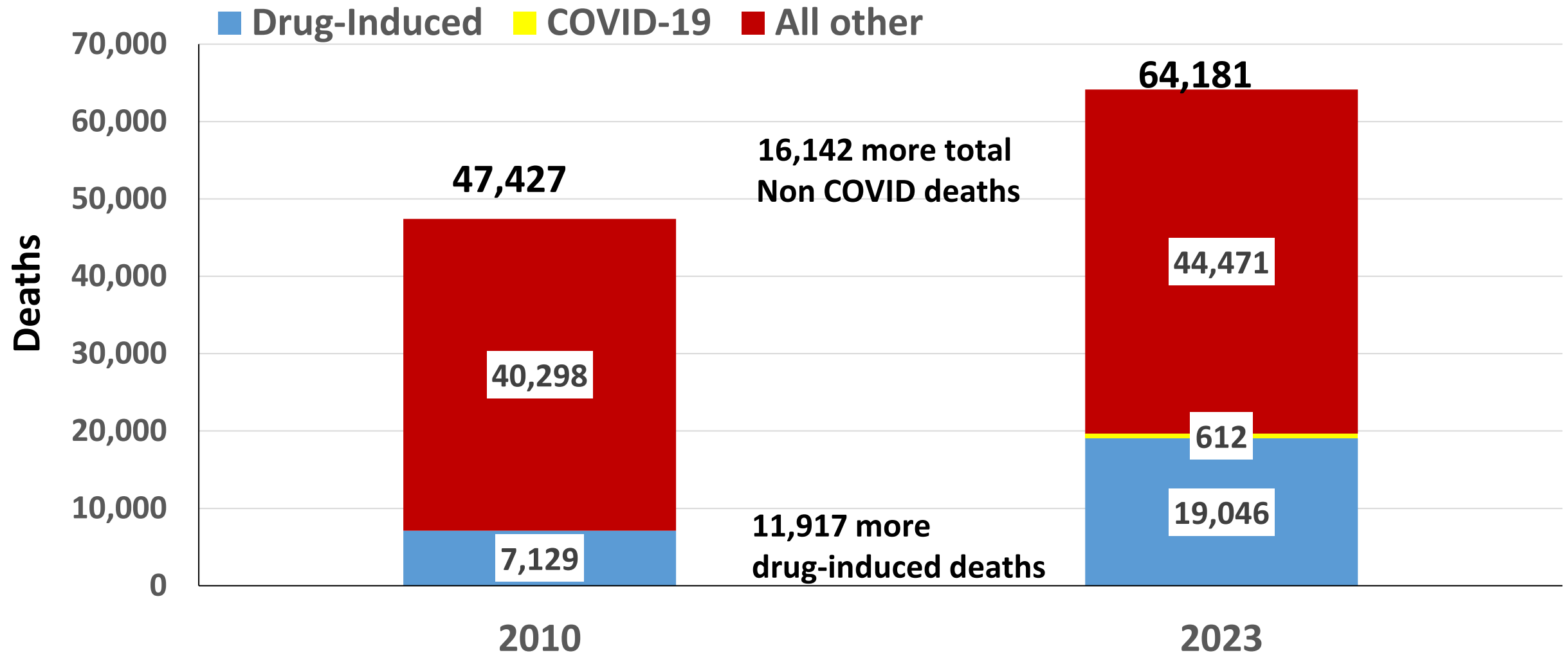
## Overall Deaths rates (per 100K), Females 15-44, 2010-2023



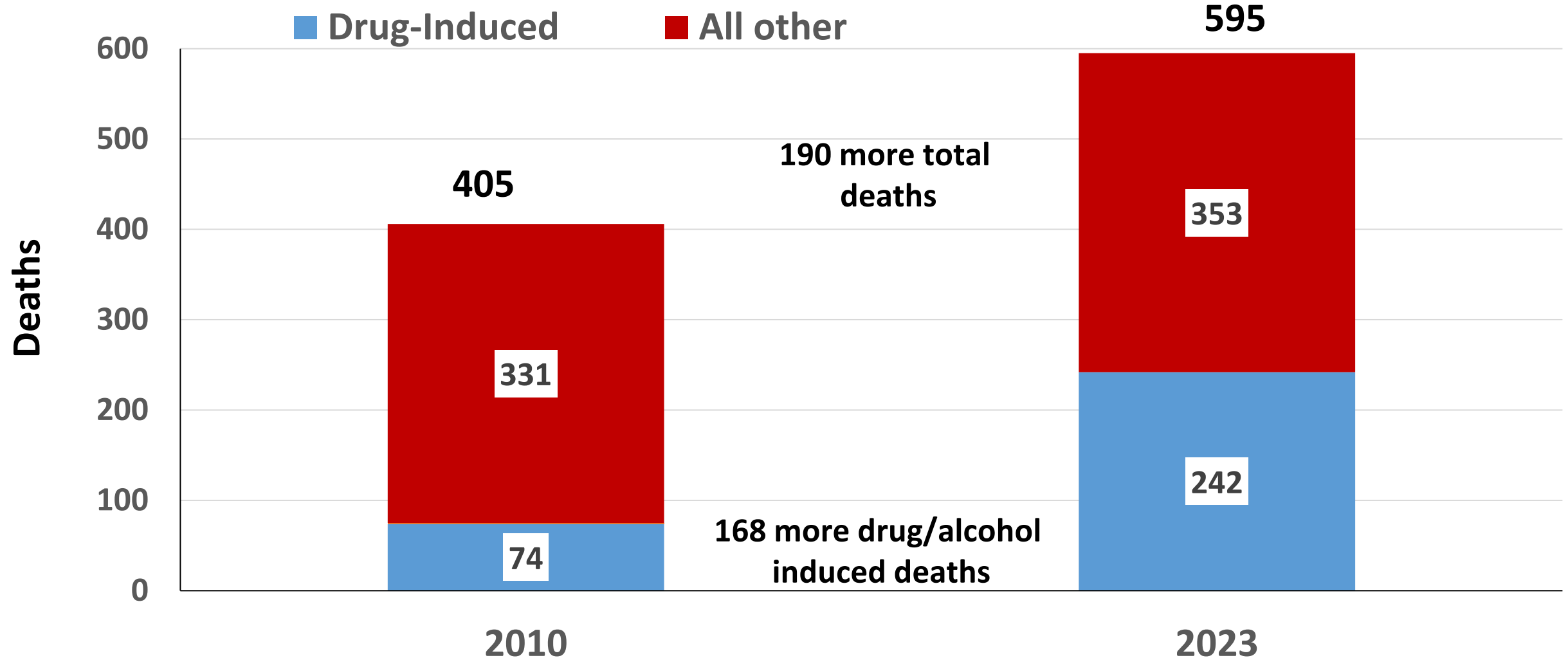
**All Female Deaths 15-44**  
**2010 -- 47,427; 2023 – 64,181 (COVID 612)**



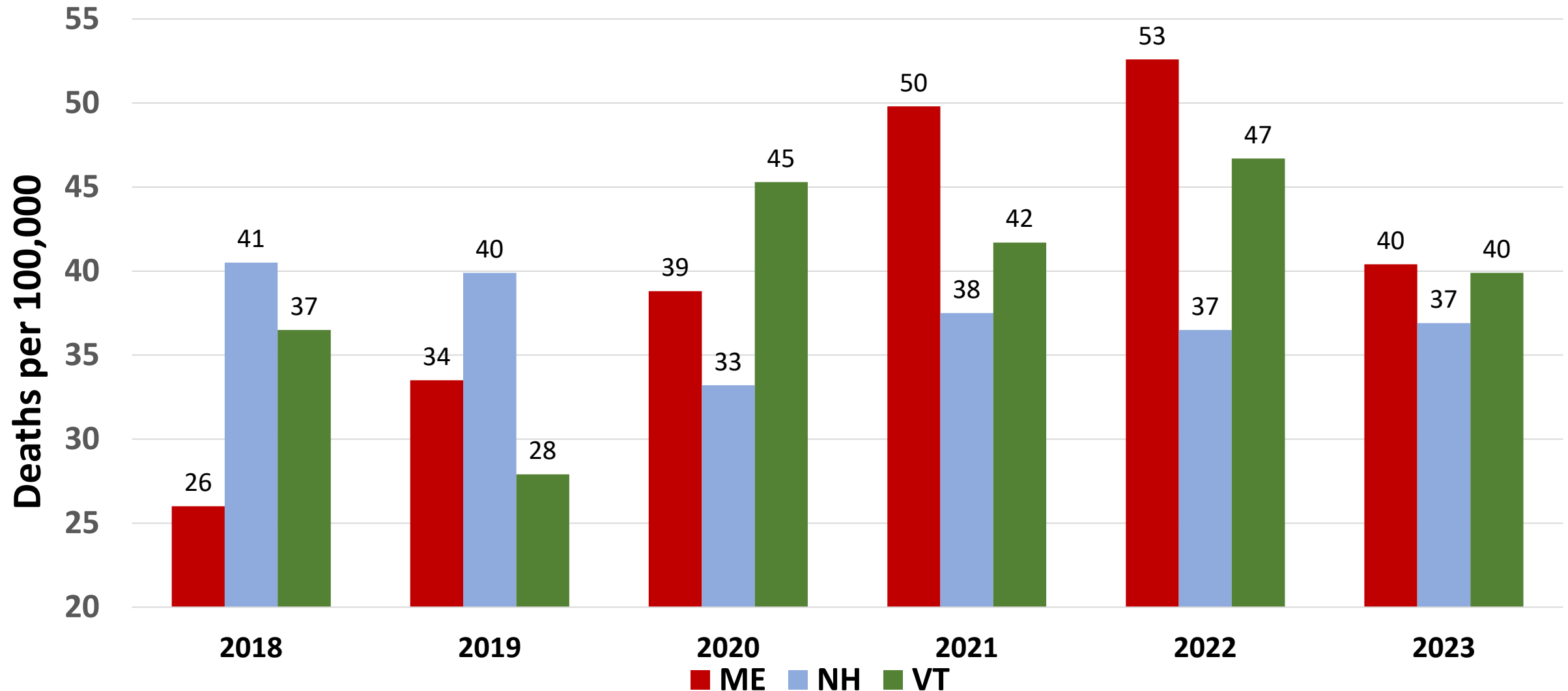
# Drugs/Alcohol were involved in 74 percent of the increase in non-COVID deaths of women ages 15 to 44 between 2010 and 2023.



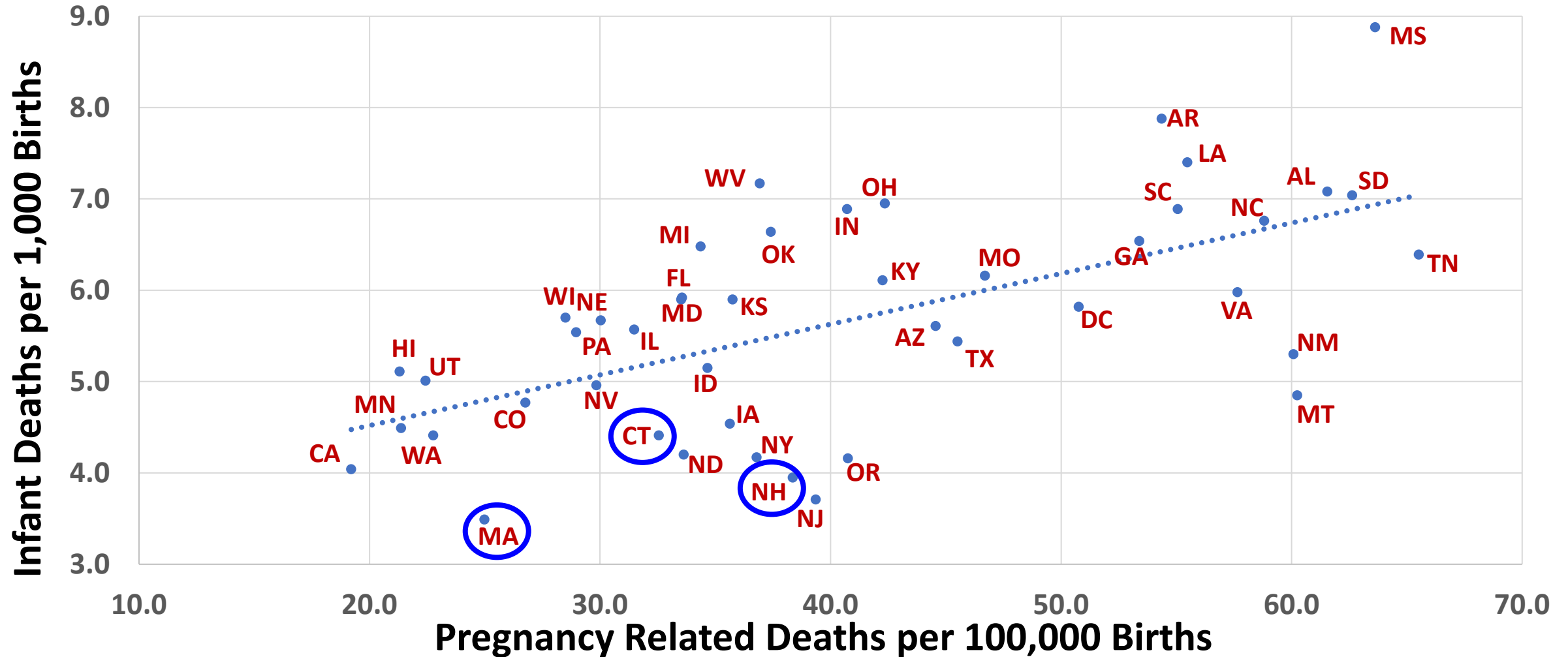
# Drugs/Alcohol were involved in 88 percent of the increase in non-COVID deaths of women ages 15 to 44 between 2010 and 2023 in Northern New England.



# Deaths (per 100,000) of women of reproductive age (15-44) for drug or alcohol as Underlying cause, ME, NH, VT 2018-2023



# States with higher pregnancy related death rates\* tended to have higher infant death rates, 2020-2022.



\* States with at least 10 pregnancy related deaths, 2020-2022

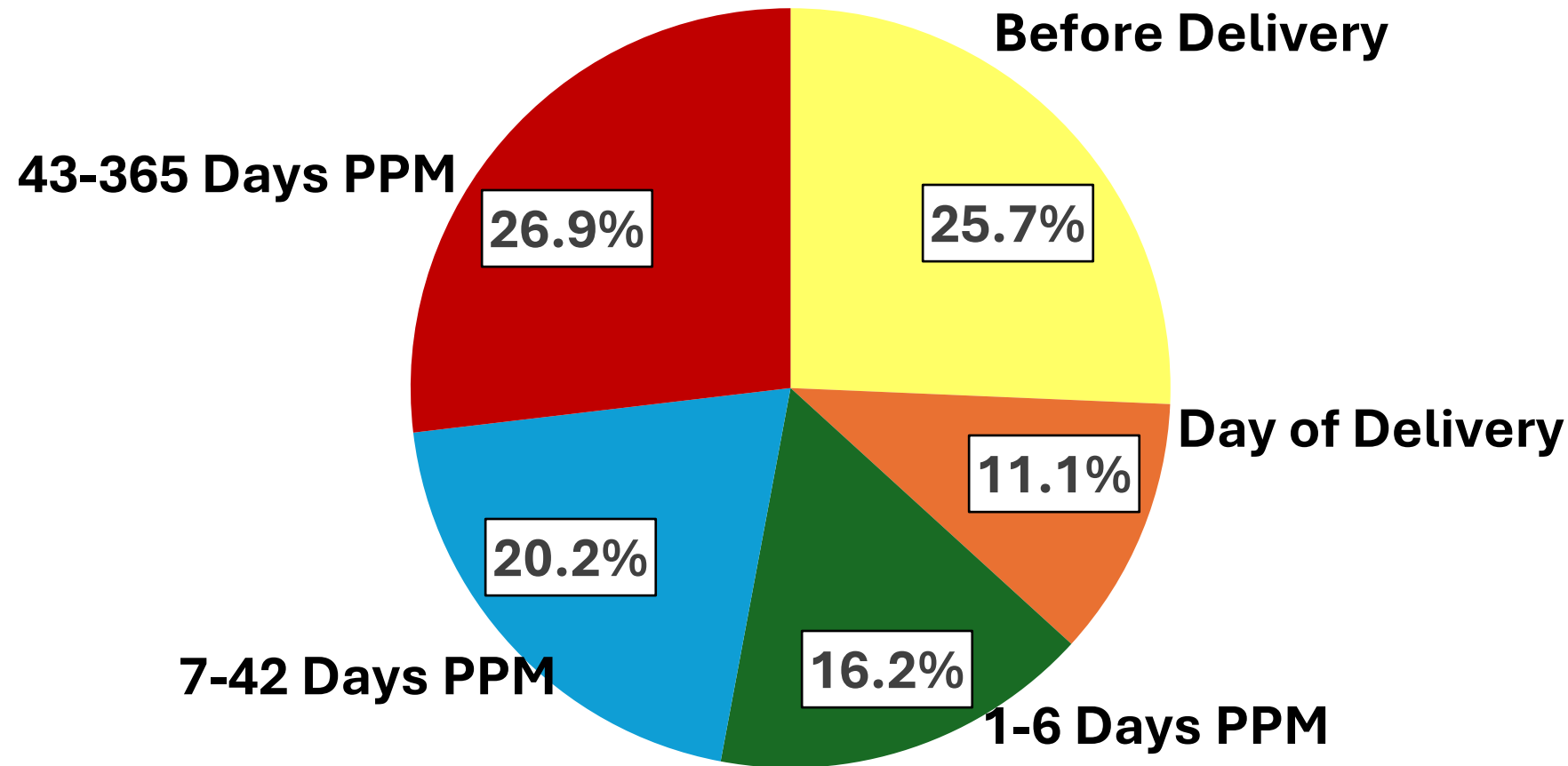
Sources: CDC Wonder Infant Mortality and Maternal Mortality Files

[www.birthbythenumbers.org](http://www.birthbythenumbers.org)

**Where do we go from here?**

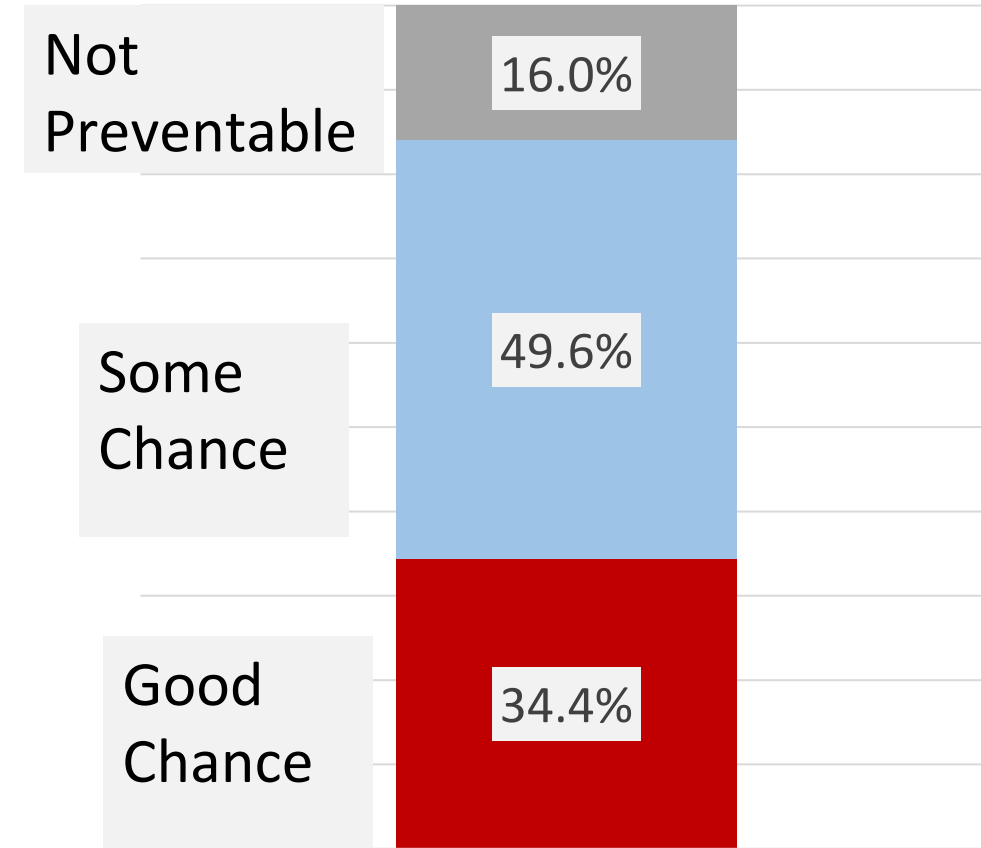
# Remember this? If deaths can occur over a 21 month period, community solutions needed

## Timing of Maternal Deaths (2020)



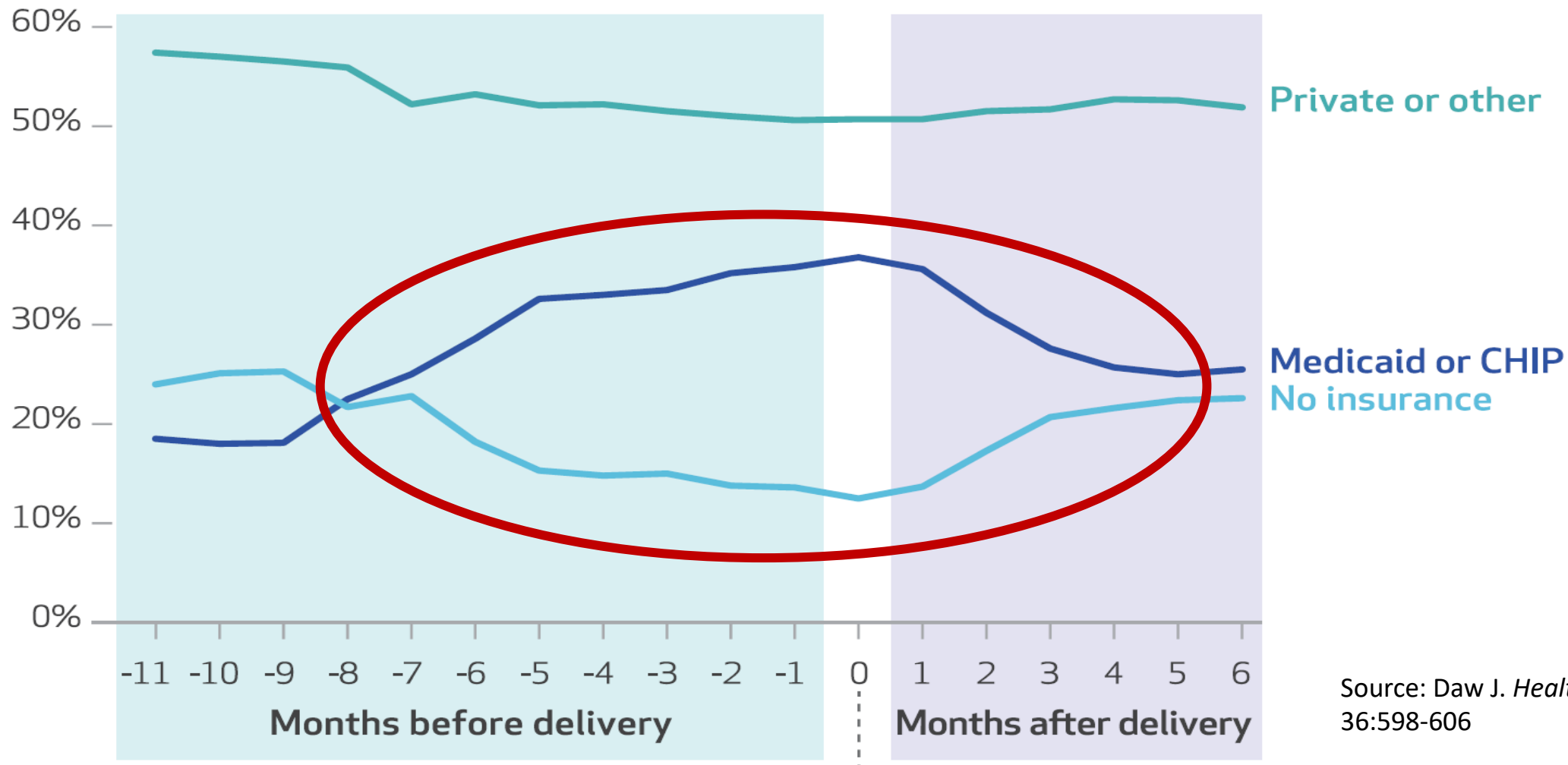
# Preventability

- **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.



# Keeping Women in the System

Percentages of women who gave birth in the period 2005-13, by health insurance type and month before or after delivery

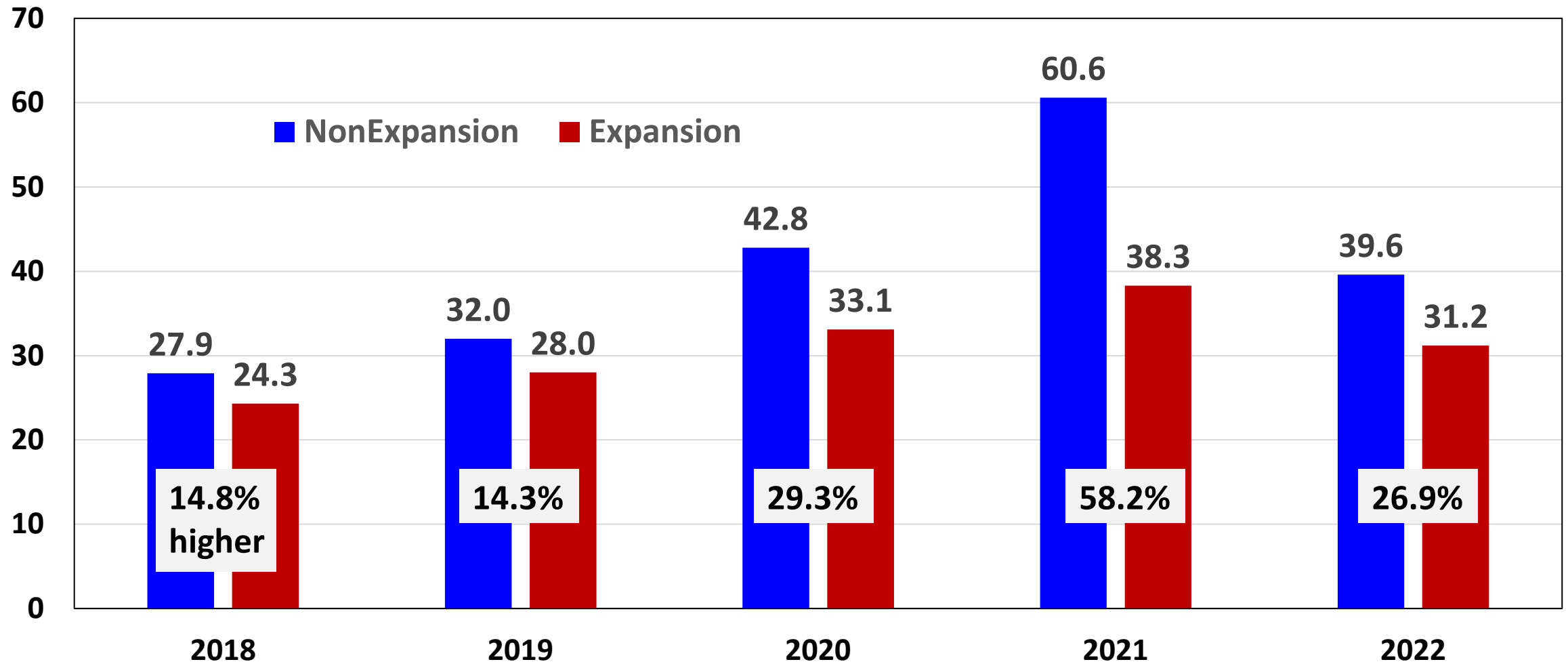


Source: Daw J. *Health Affairs* 2017; 36:598-606



# Making Sure they have Coverage

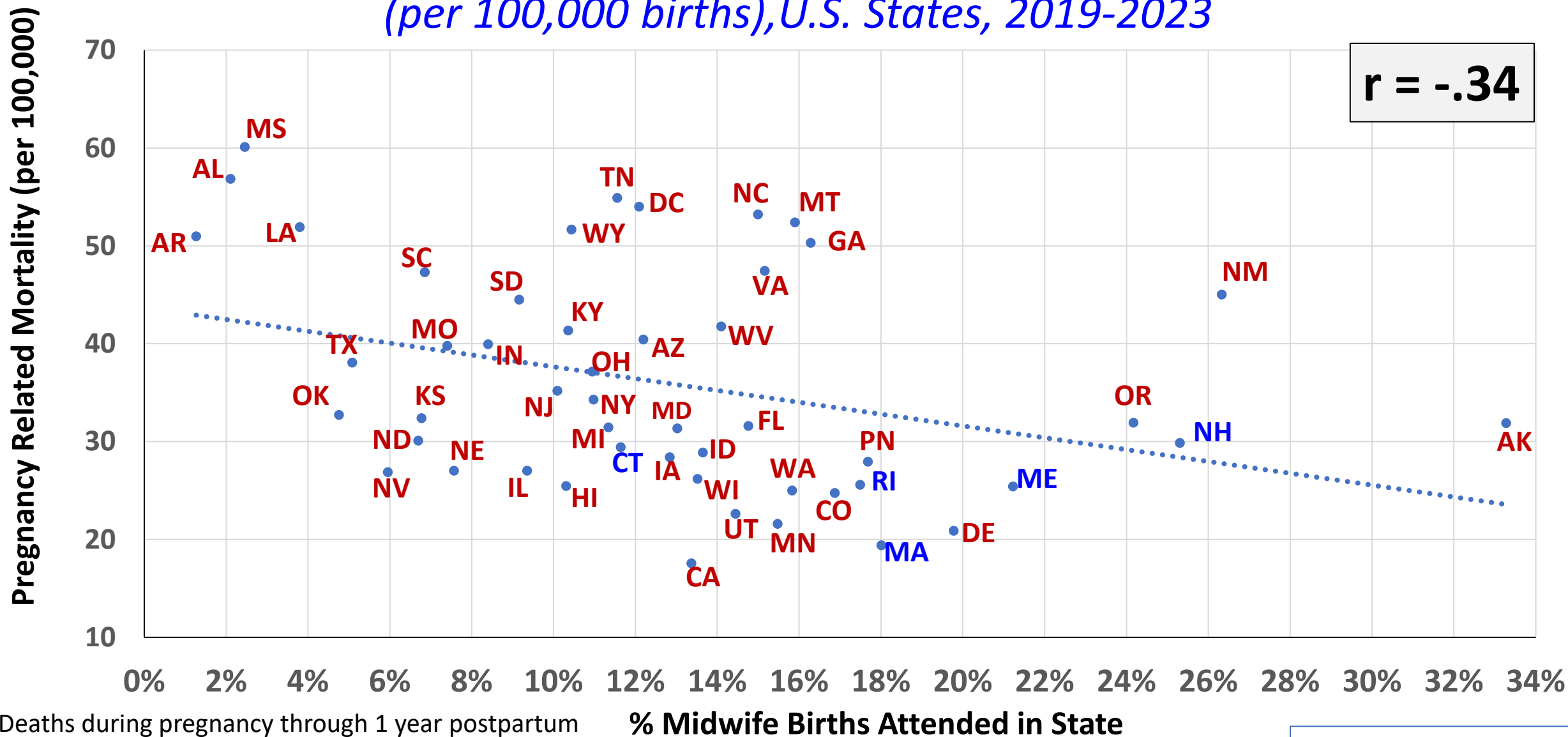
## Average Pregnancy Related Mortality in Medicaid Expansion and non-Expansion\* States, 2018-2022



\* Non-Expansion States in 2024: Alabama, Florida, Georgia, Kansas, Mississippi, South Carolina, Tennessee, Texas, Wisconsin, and Wyoming

# Making sure they have access to providers

Relationship Between % Midwife Attended Births & Pregnancy Related Mortality\*  
(per 100,000 births), U.S. States, 2019-2023



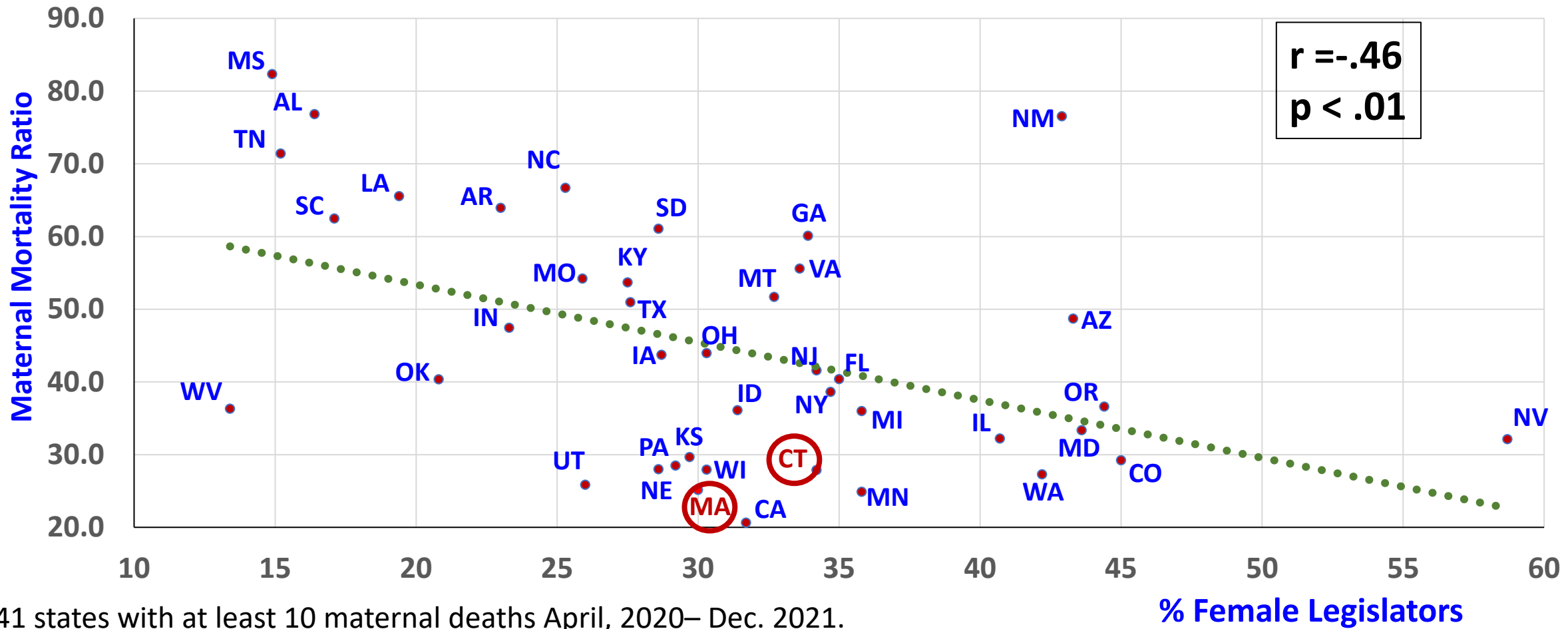
\* Deaths during pregnancy through 1 year postpartum

% Midwife Births Attended in State

Source: CDC Wonder Birth & Death Data (Vermont excluded with <10 deaths)

# Having a Supportive Policy Environment

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

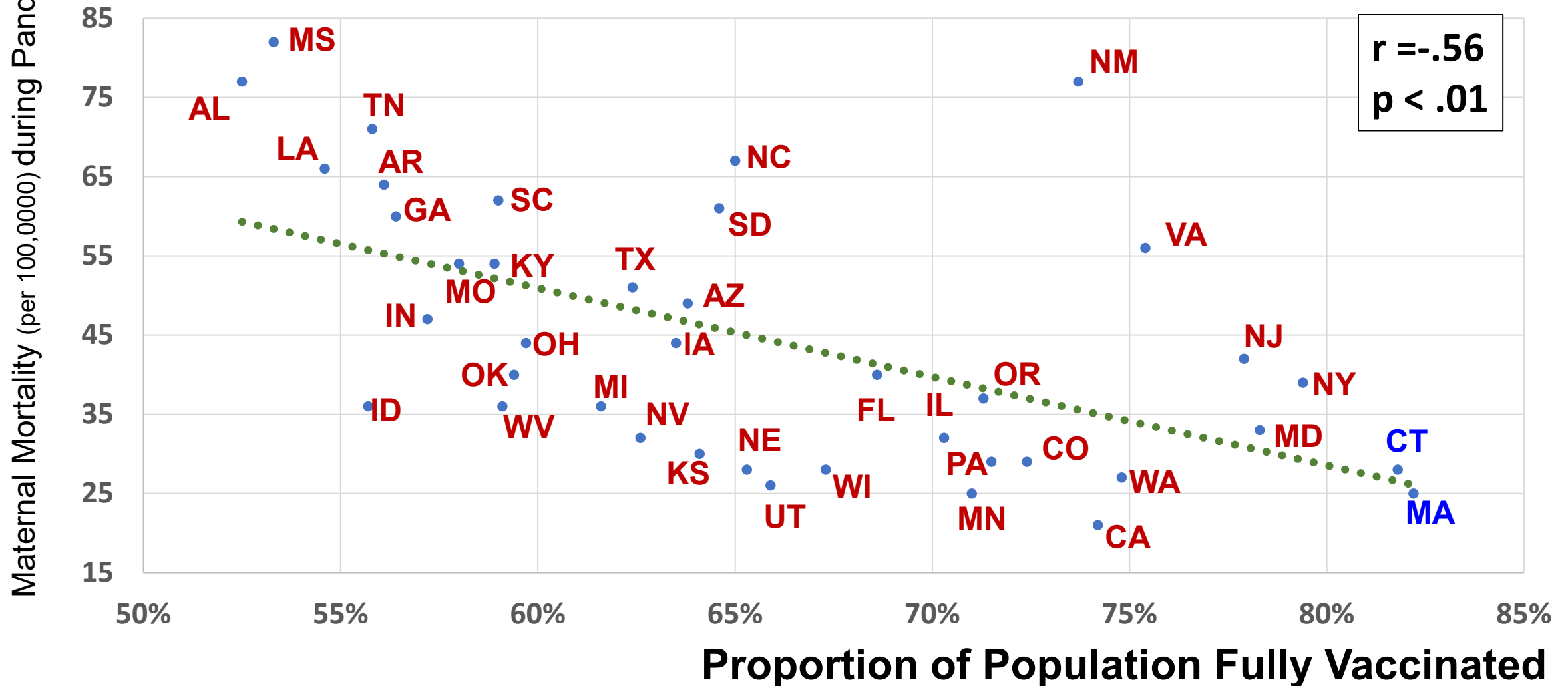


\* 41 states with at least 10 maternal deaths April, 2020– Dec. 2021.

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

# Ensuring a Strong Public Health Infrastructure and Communications System

State Pregnancy Related Mortality (per 100,000 births) (4/20-12/21) & Vaccination Rates



Sources: Vaccination NYTimes 10/20/22; Mat Mort: CDC Wonder

***Maternal mortality is not an unsolvable problem, but it can't all be solved in the hospital. We must build on the clinical progress we've made and turn to a community-based focus on women's health.***





Sam

Lee

Maya

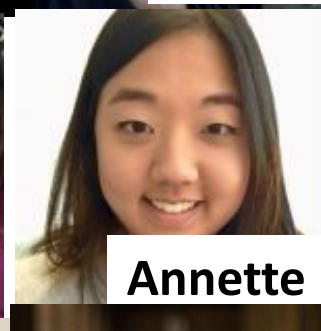
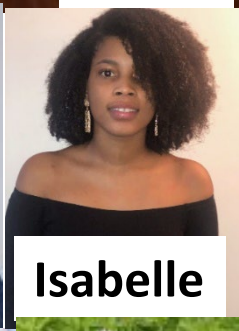
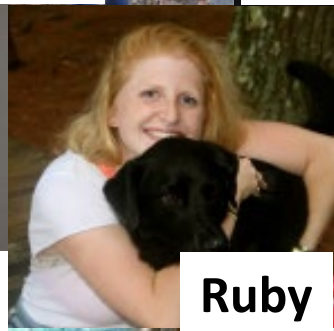
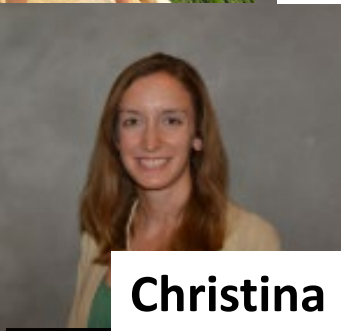
Corey

Lucy

Staige

Sheridan

Jessica



Jordy

Kyla

Christina

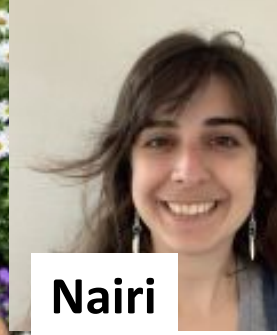
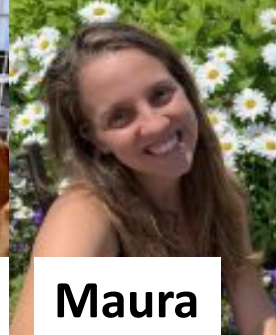
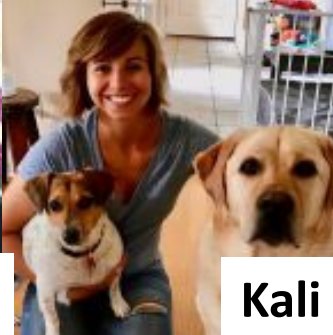
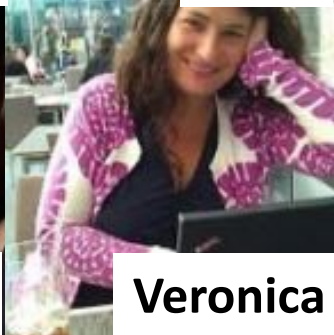
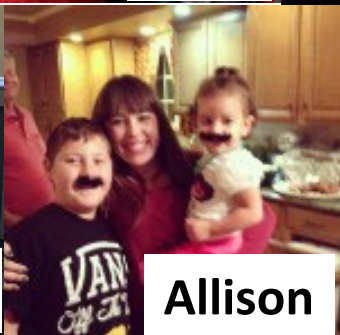
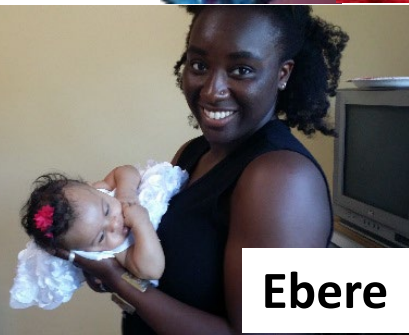
Ruby

Brittany

Isabelle

Katie

Annette



Ebere

Allison

Sarah

Veronica

Kali

Maura

Nairi

Juliana

[www.birthbythenumbers.org](http://www.birthbythenumbers.org)



Gene

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