

# Maternal Mortality Part 1

*The context for understanding U.S. maternal mortality – how it's measured and historical trends (through 2007)*

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**February, 2025**



# **1. Definitions – the multiple measures of maternal death**

First a quick side trip into the terms **rate** and **ratio**, both of which are used with maternal mortality. If you don't find that discussion enthralling, you:

(a) are a normal human being; and

(b) can skip to slide 11 and wonder what you missed.

# Is Maternal Mortality a Ratio or a Rate?

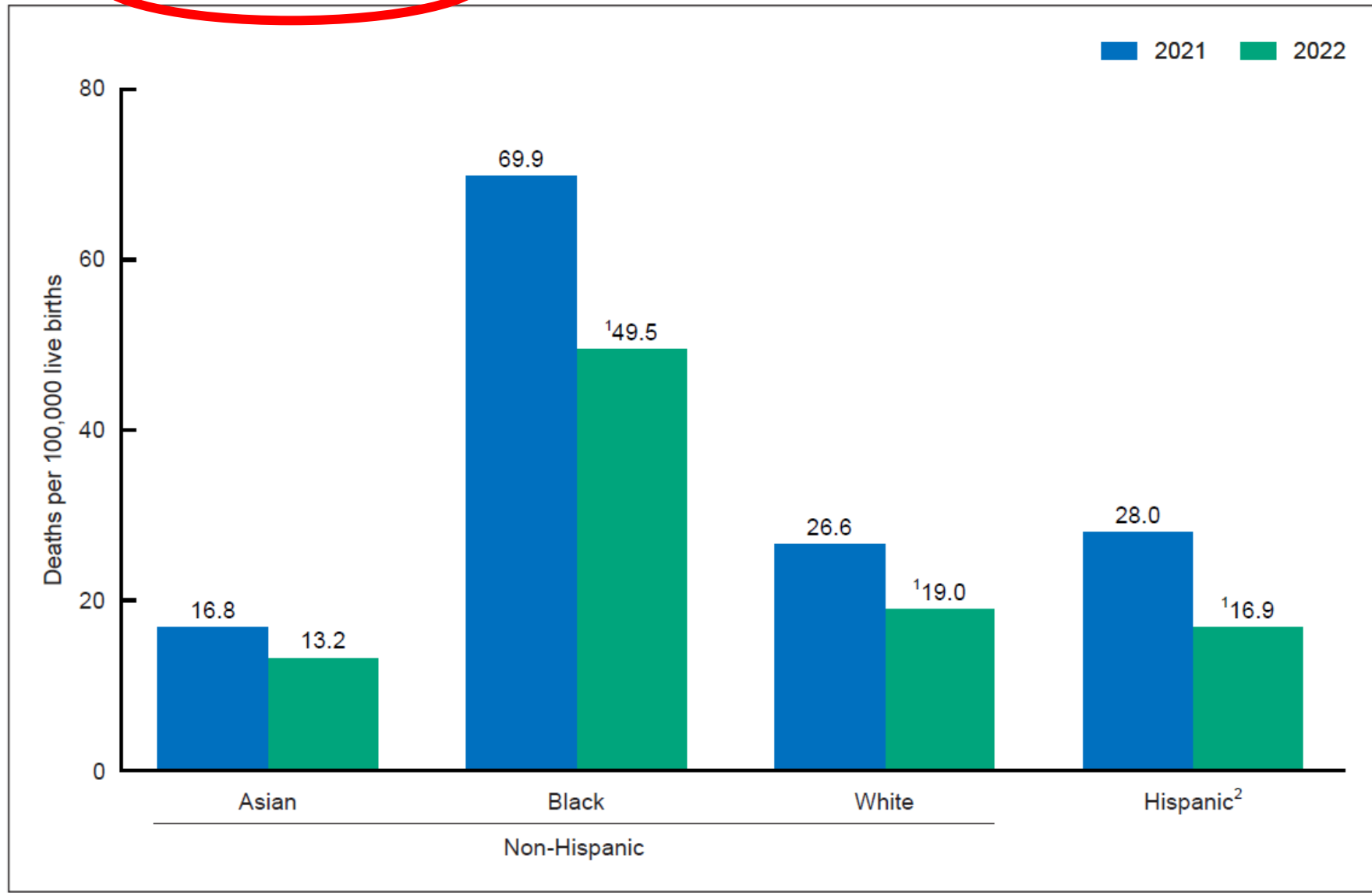
- *WHO reports maternal mortality as a ratio, while the U.S. National Vital Statistics System reports maternal mortality as a rate. What's the difference?*

- **Maternal Mortality Ratio:**

$$\frac{\text{Deaths during pregnancy up to 42 days ppm}}{\text{Live Births}}$$

It is a ratio because all the cases in the numerator (e.g. death during early pregnancy) are not necessarily included in the denominator.

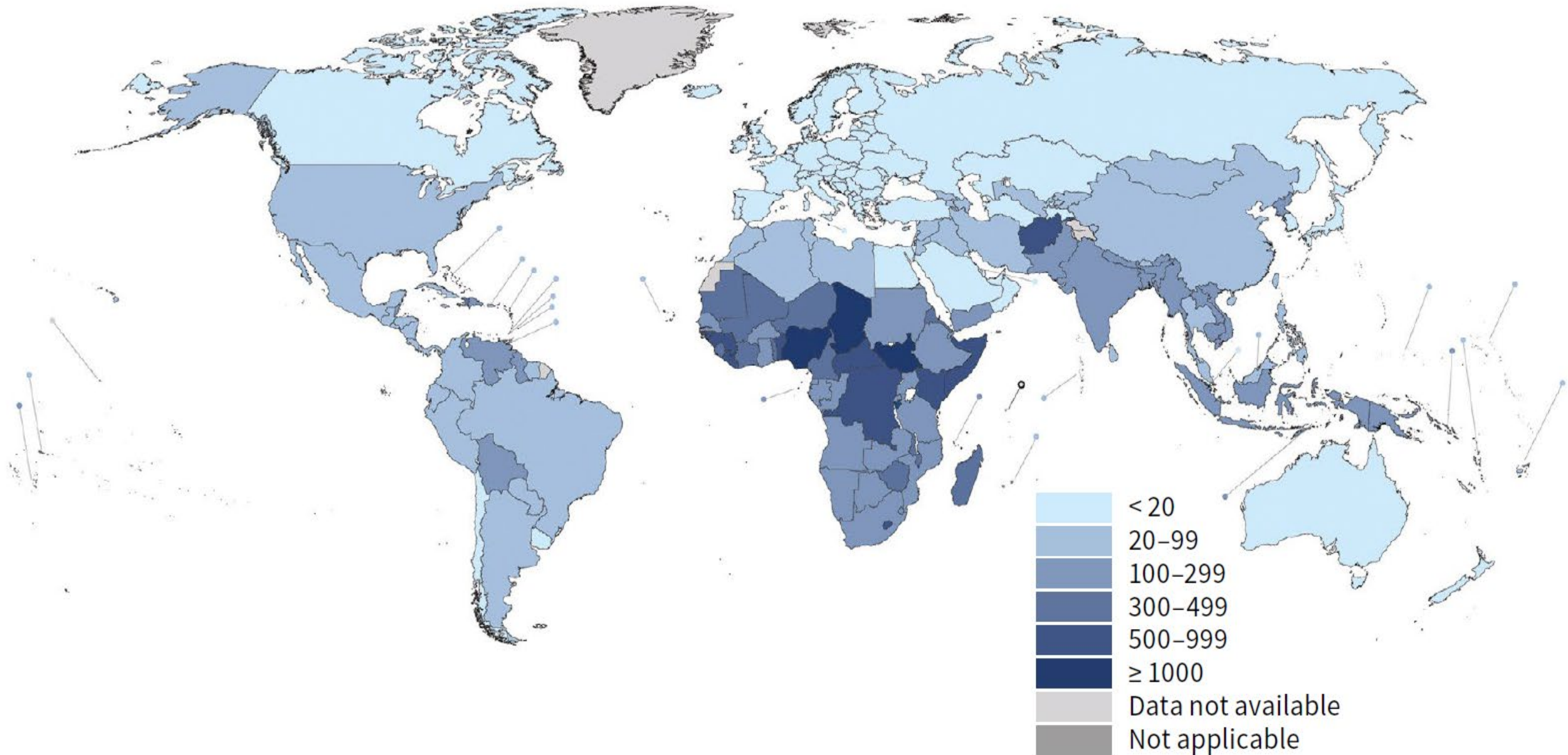
Figure 2. Maternal mortality rate, by race and Hispanic origin: United States, 2021 and 2022



Source: Hoyert DL. Maternal mortality rates in the United States, 2022. NCHS Health E-Stats. 2024.

DOI: <https://dx.doi.org/10.15620/cdc/152992>

**Fig. 4.1 Maternal mortality ratio (MMR) estimates, by country, 2020**



Source: WHO (2023). *Trends in maternal mortality 2000 to 2020*.



# Is Maternal Mortality a Ratio or a Rate?

- **Rate**: # of events / total persons at risk in the population (usually % or number per 1,000 or, in the case of maternal mortality – 100,000)
- **Ratio**: # of events (or persons) / some *comparable* cohort of people or events



# Is Maternal Mortality a Ratio or a Rate?

- **RATE:** The frequency of an event in a population. All the cases in the numerator are included in the denominator

## Example:

*Teen Birth Rate*

Births to women 15-19

All women 15-19

- **RATIO:** simply divides one number by another – all the cases in the numerator are not included in the denominator

## Example:

*Maternal Mortality Ratio\**

Maternal Deaths

Live Births

\* For this to be a rate, the denominator needs to be pregnancies





## So, why do we use maternal mortality ratios internationally?

*Because most countries don't have clear measurement of the total number of pregnancies, but do have some record of total births.*

## Why does the U.S. use the term “rate” when it's really a ratio?

*Because people get confused by the term “ratio” and don't want to have to review the past 7 slides*



# The three widely used definitions of maternal mortality:

**1. Pregnancy associated death**

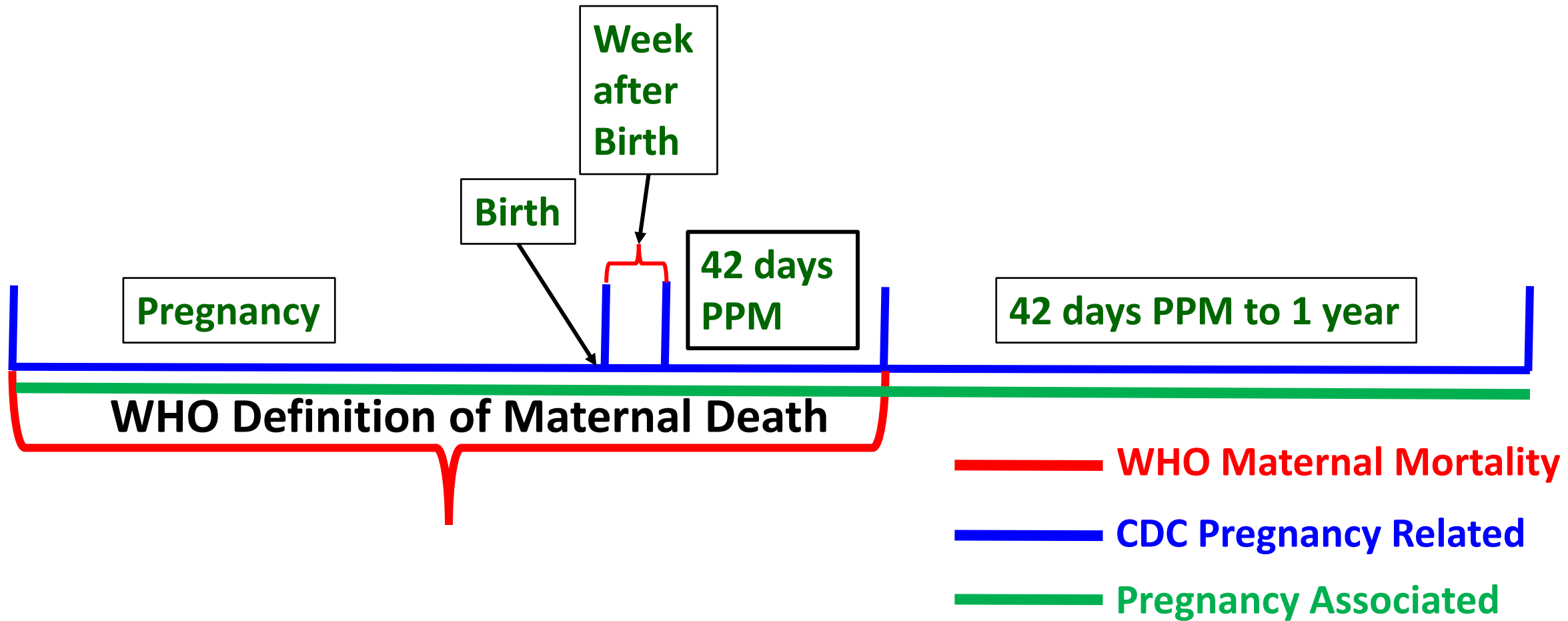
**2. Pregnancy related death**

**3 Maternal mortality**

# 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

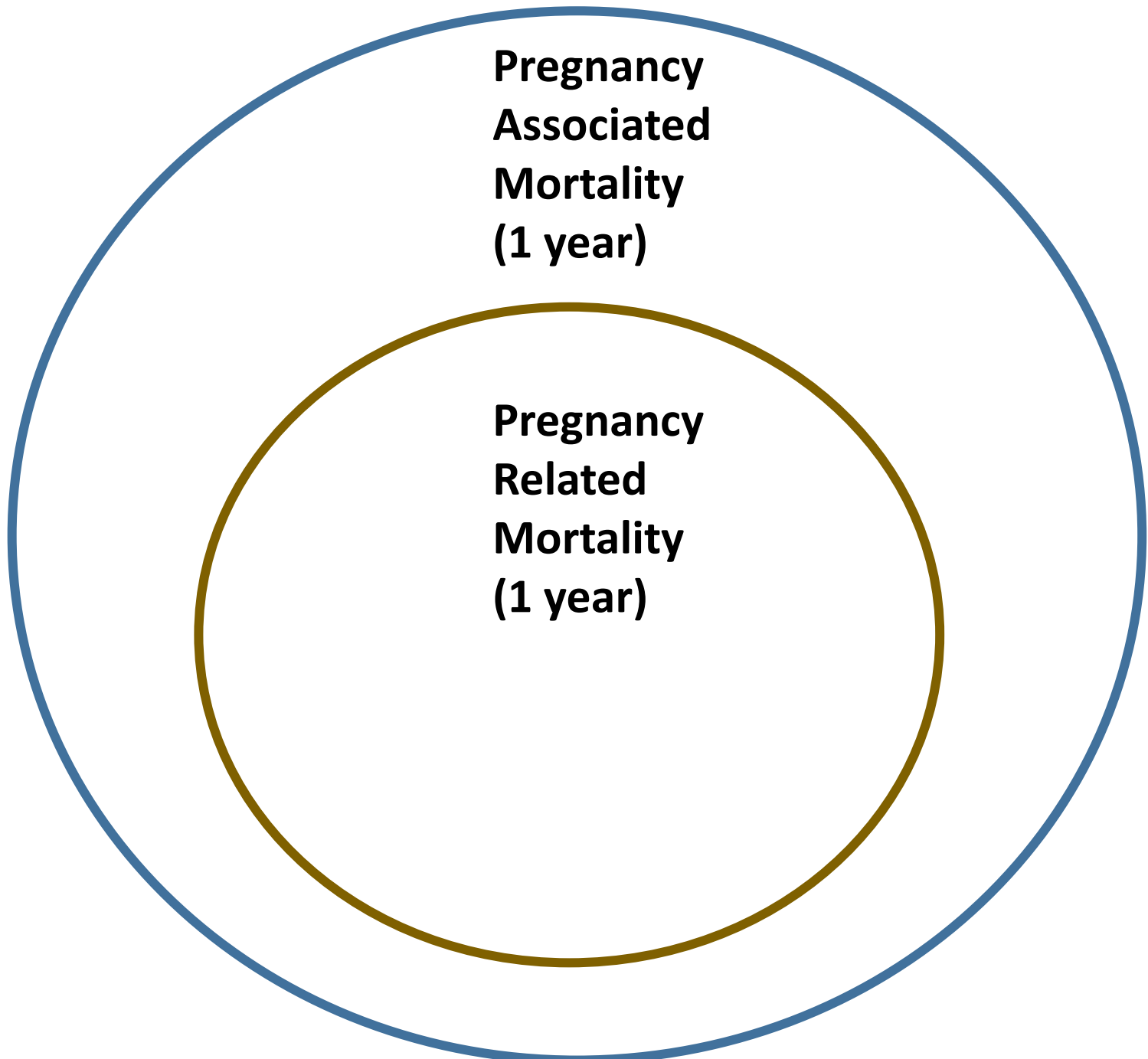


PPM – postpartum –period after the birth

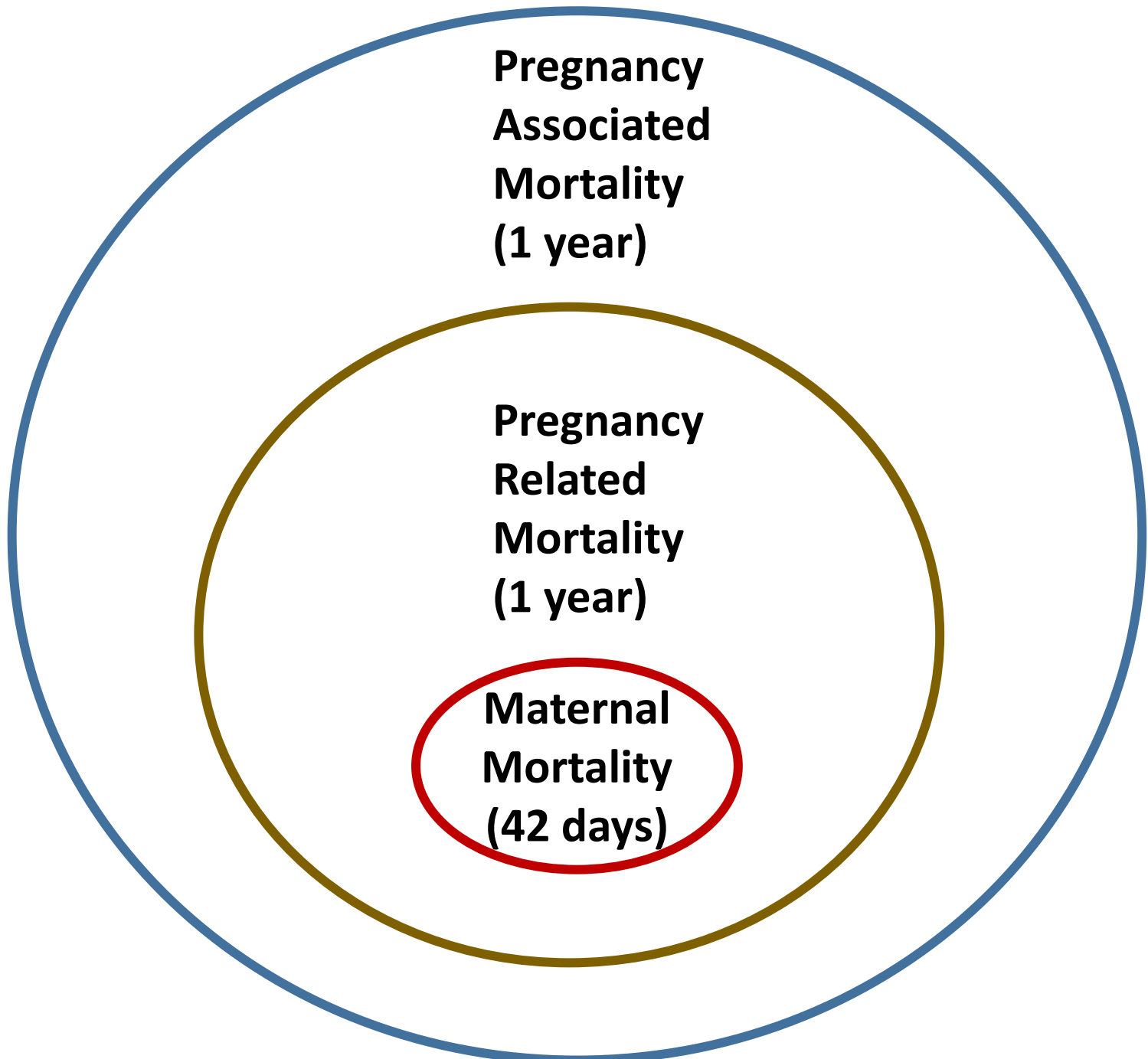


**Pregnancy  
Associated  
Mortality  
(1 year)**

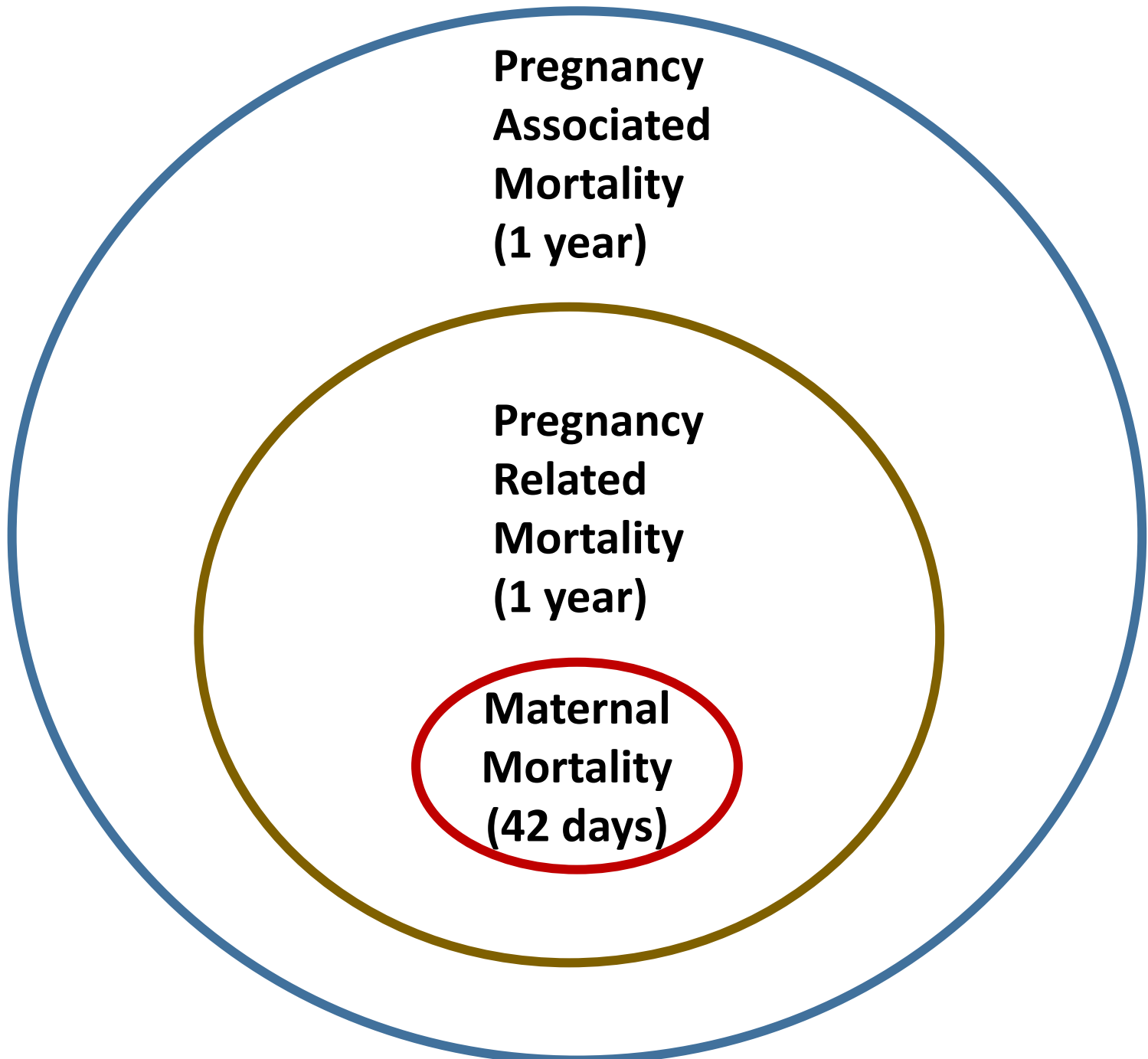
**Pregnancy  
Associated  
Mortality:  
All Deaths women  
of reprod. age  
pregnancy to 1  
year ppm**



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



**Maternal Mortality:**  
All Deaths women of reprod. age pregnancy to **42 days ppm Related to the pregnancy**



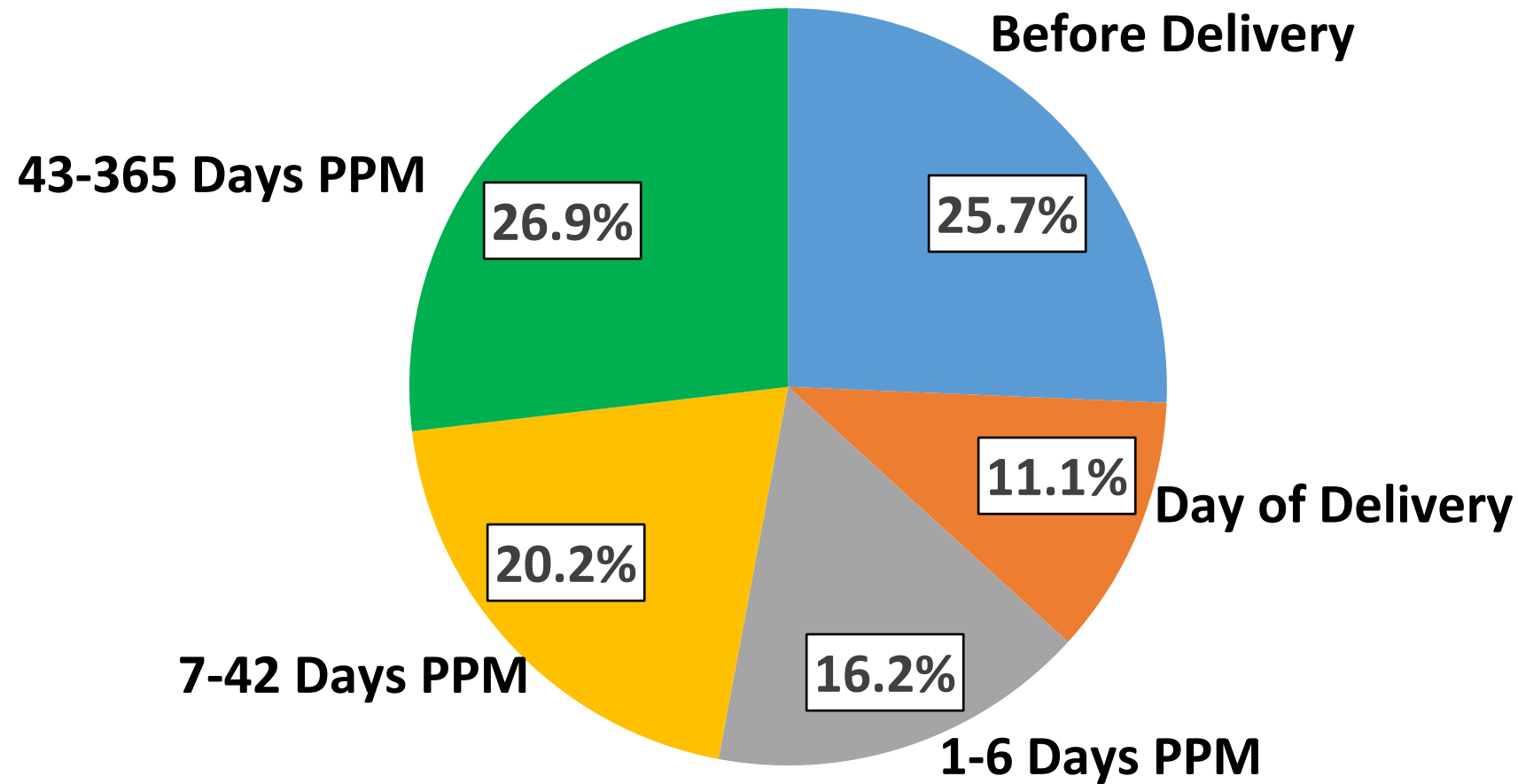
**Pregnancy Associated Mortality:** Deaths during pregnancy and up to 1 year postpartum

**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



# Timing of Maternal Deaths (2020)





## 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	<b>ICD- 10 codes</b>	<b>Medical epidemiologists</b>	<b>Multidisciplinary committees</b>
Terms	<b>Maternal death</b>	<b>Pregnancy associated,</b> (Associated and) <b>Pregnancy related,</b> (Associated but) Not pregnancy related	<b>Pregnancy associated,</b> (Associated and) <b>Pregnancy related,</b> (Associated but) Not pregnancy related
Measure	<b>Maternal Mortality Rate - # of Maternal Deaths per 100,000 live births</b>	<b>Pregnancy Related Mortality Ratio - # of Pregnancy Related Deaths per 100,000 live births</b>	<b>Pregnancy Related Mortality Ratio - # of Pregnancy Related Deaths per 100,000 live births</b>
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



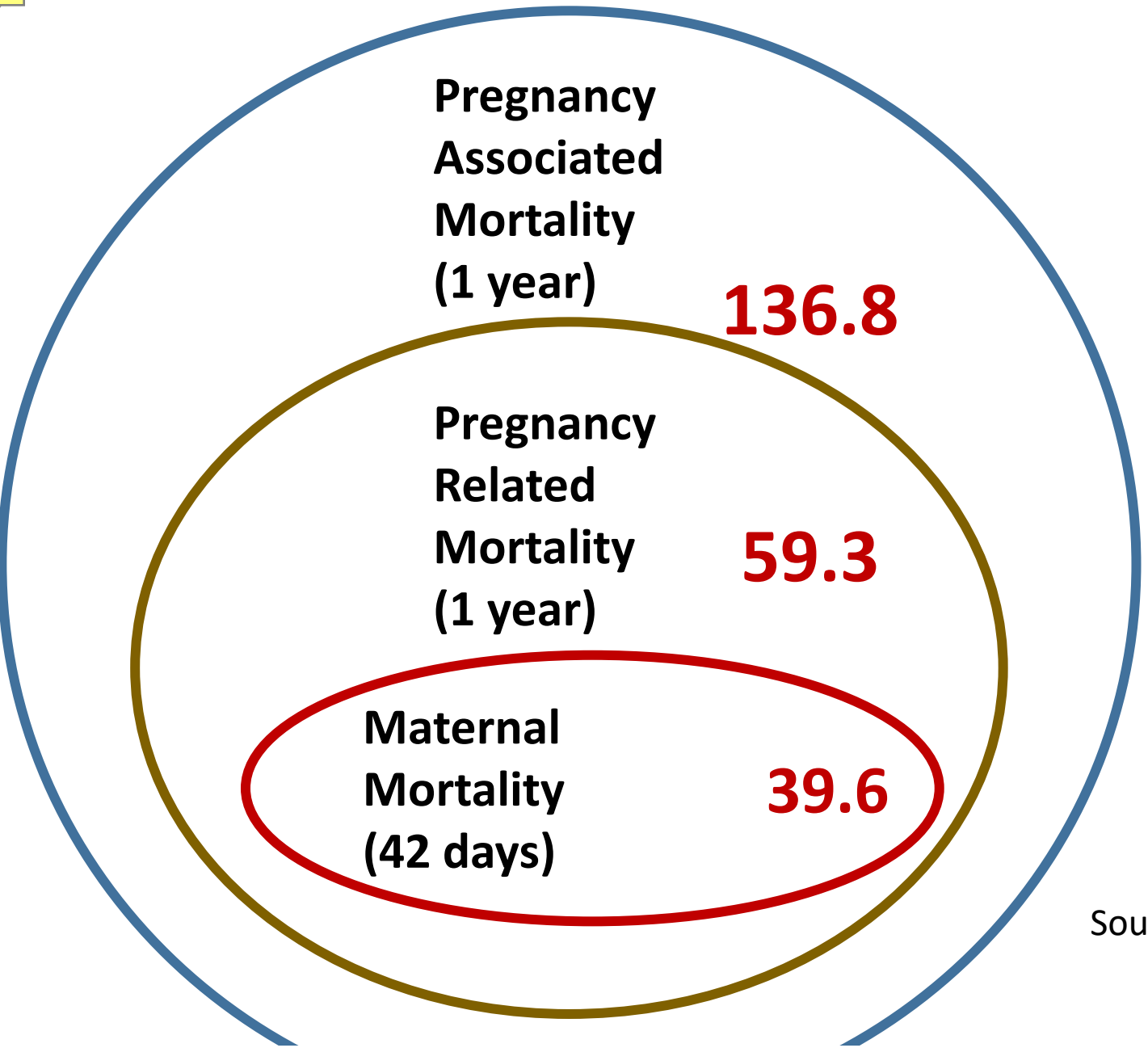
# What difference does going out to a year instead of 42 days make?

Measure	Definition	Source	Difference in using 42 days or one year period : Tennessee (2020-22) *
Maternal Mortality (ratio per 100,000 births)	the death of a woman <i>while pregnant or within 42 days of termination of pregnancy</i> , irrespective of the duration and site of the pregnancy, from any cause <i>related to or aggravated by the pregnancy</i> or its management but not from accidental or incidental causes.	National Vital Statistics System	<b>39.6</b>
Pregnancy Related Mortality (ratio per 100,000 births)	the death of a woman <i>during pregnancy or within one year</i> of the end of pregnancy <i>from a pregnancy complication, a chain of events initiated by pregnancy</i> , or the aggravation of an unrelated condition by the physiologic effects of pregnancy	CDC Pregnancy Related Mortality Surveillance System	<b>59.3</b>

\* Source: Conn. MMRC.(2022) *Pregnancy Related Deaths in Connecticut 2015-2020.*



# 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.

# Illinois Maternal Morbidity and Mortality Report

October 2023

## Maternal Mortality in Colorado 2016-2020

## Louisiana Pregnancy-Associated Mortality Review

## Washington State Maternal Mortality Review Panel: Maternal Deaths 2017-2020

February 2023

### FLORIDA DEPARTMENT OF HEALTH

Florida's Maternal Mortality Review Committee 2020

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October 2022

Florida HEALTH

## 2017-2021 Pregnancy Associated Mortality Review Published 2024



## NORTH CAROLINA Maternal Mortality Review Report

## Texas Maternal Mortality and Morbidity Review

Committee and Department of State Health Services Joint Biennial Report 2022

## 2024 Pennsylvania Maternal Mortality Review Annual Report

### Maternal Mortality Review

A Report on Maternal Deaths in Washington 2014-2015



# Historical Trends in U.S. Maternal Mortality

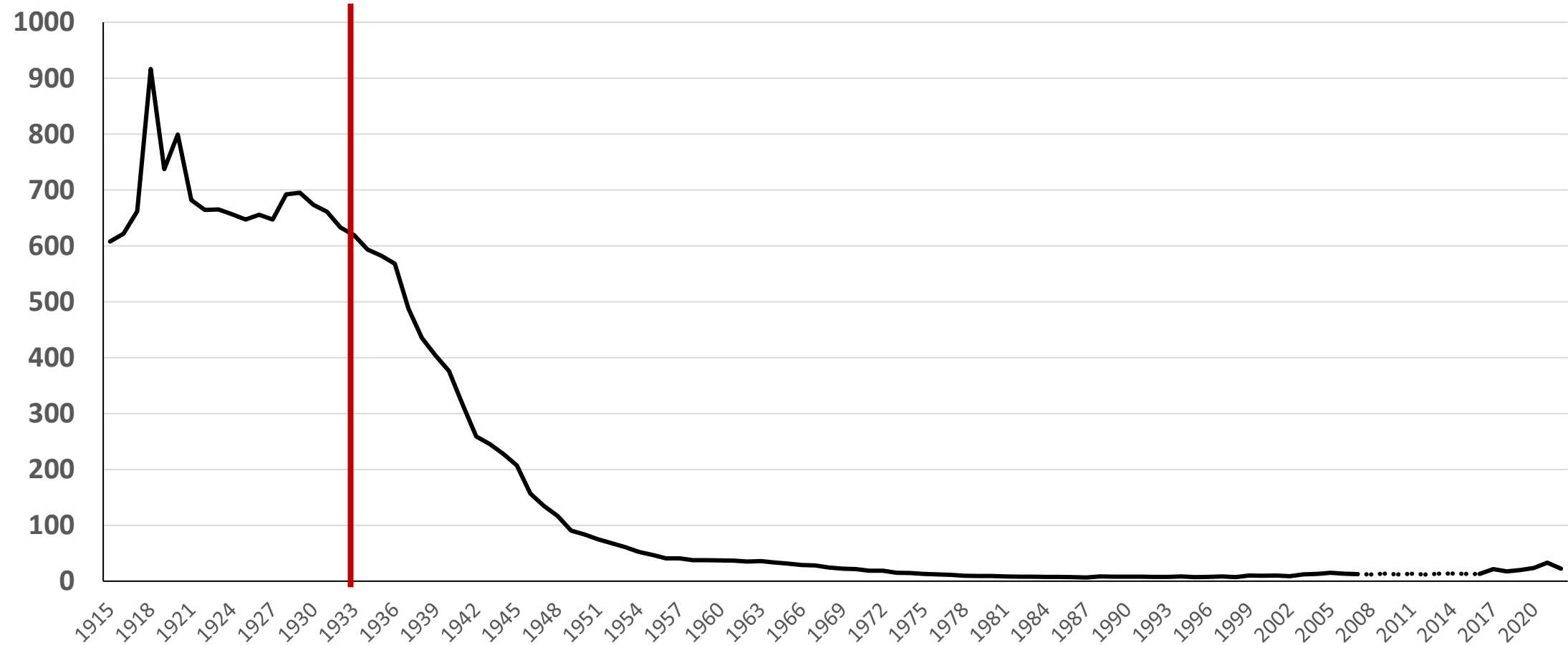
# Declaring Premature Victory

*“An examination of the rates for the different states indicates areas in which further improvement can be expected, but it is clear that maternal mortality is no longer a nationwide problem.....Childbearing has been made quite safe.”*

- Maternal Deaths One in a Thousand. *JAMA, 1950; 144: 1096-7.*
- *At the time the maternal mortality rate was 100 per 100,000*



# U.S. Maternal Mortality (per 100,000 births), 1915-2022



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; CDC Wonder Mortality File.

# The Growth of a National Reporting System

## *Year State was Added to the Maternal Death Registry*

Year	State	Year	State	Year	State
1880.....	Massachusetts. New Jersey. District of Columbia. <sup>1</sup>	1908.....	Washington. Wisconsin.	1919.....	Florida. Mississippi.
1890.....	Connecticut. Delaware. <sup>2</sup> New Hampshire. New York. Rhode Island. Vermont.	1909.....	Ohio.	1920.....	Nebraska.
1900.....	Maine. Michigan. Indiana.	1910.....	Minnesota. Montana. Utah.	1922.....	Georgia. <sup>5</sup> Idaho. Wyoming.
1906.....	California. Colorado. Maryland. Pennsylvania. South Dakota. <sup>3</sup>	1911.....	Kentucky. Missouri.	1923.....	Iowa.
		1913.....	Virginia.	1924.....	North Dakota.
		1914.....	Kansas.	1925.....	Alabama. West Virginia.
		1916.....	South Carolina. North Carolina. <sup>4</sup>	1926.....	Arizona.
		1917.....	Tennessee.	1927.....	Arkansas.
		1918.....	Illinois. Louisiana. Oregon.	1928.....	Oklahoma.
				1929.....	Nevada. New Mexico.
				1933.....	Texas.
				1959.....	Alaska.
				1960.....	Hawaii.

<sup>1</sup> Included as a State.

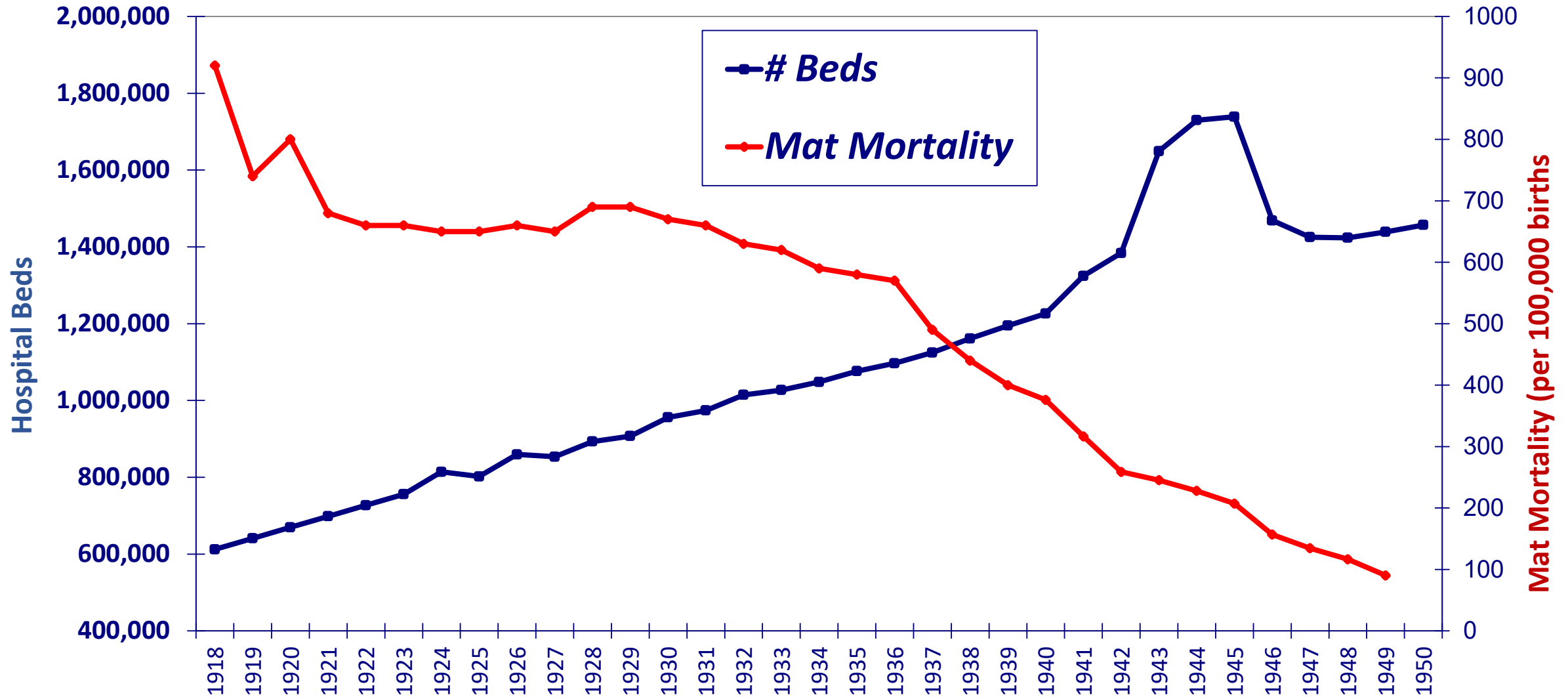
<sup>2</sup> Dropped from the registration system in 1900; readmitted in 1919.

<sup>3</sup> Dropped from the registration system in 1910; readmitted in 1930.

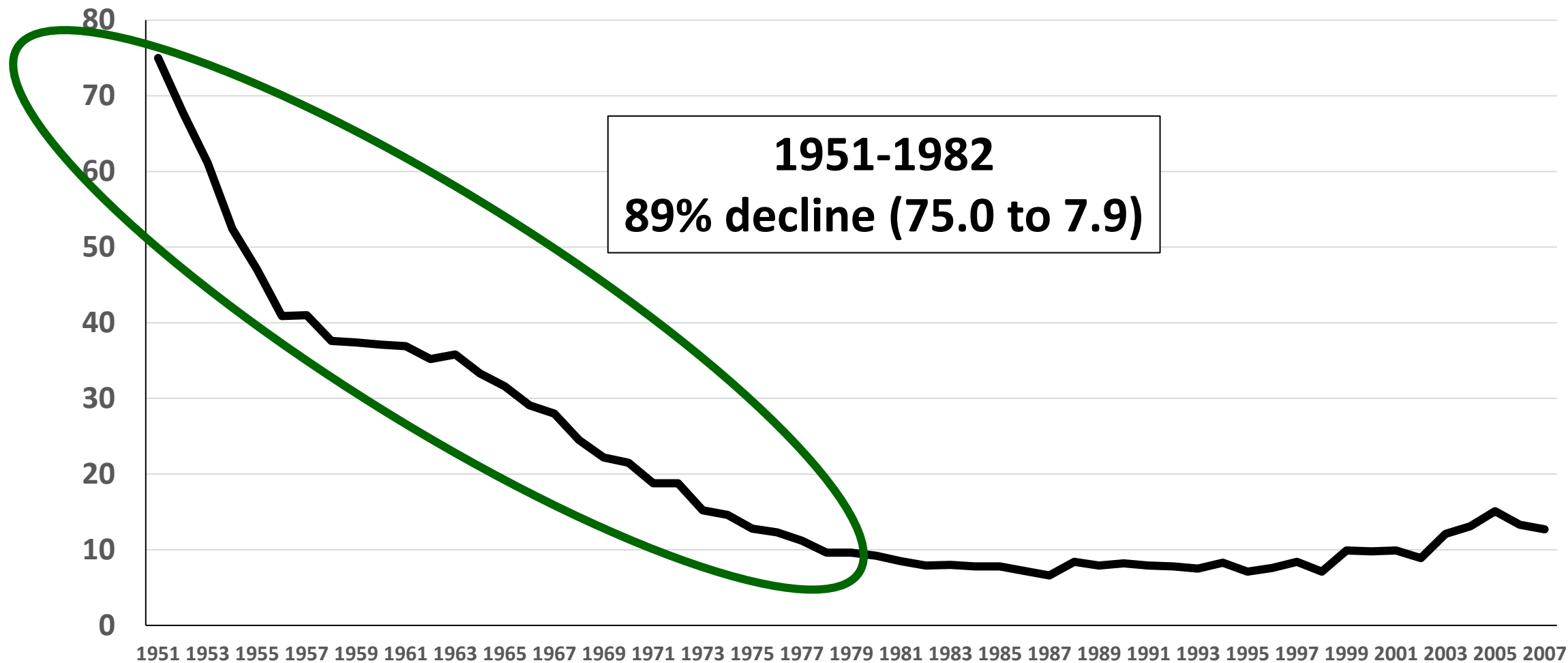
<sup>4</sup> Included only municipalities with populations of 1,000 or more in 1900 (about 16 percent of the total population); the remainder of the State was added to the system in 1916.

<sup>5</sup> Dropped from the registration system in 1925; readmitted in 1928.

# Number of U.S. Hospital Beds and Maternal Mortality, 1918-1950

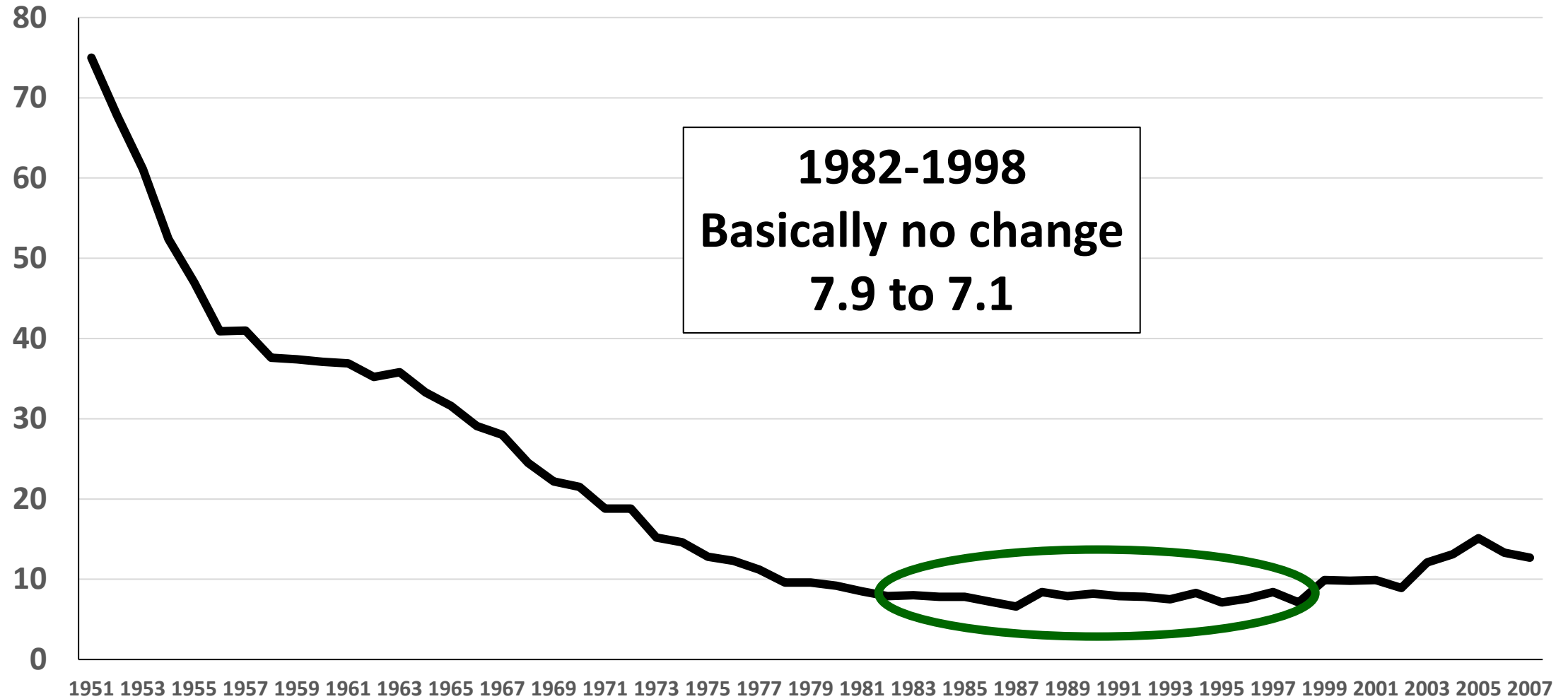


# U.S. Maternal Mortality (per 100,000 live births), 1951-2007



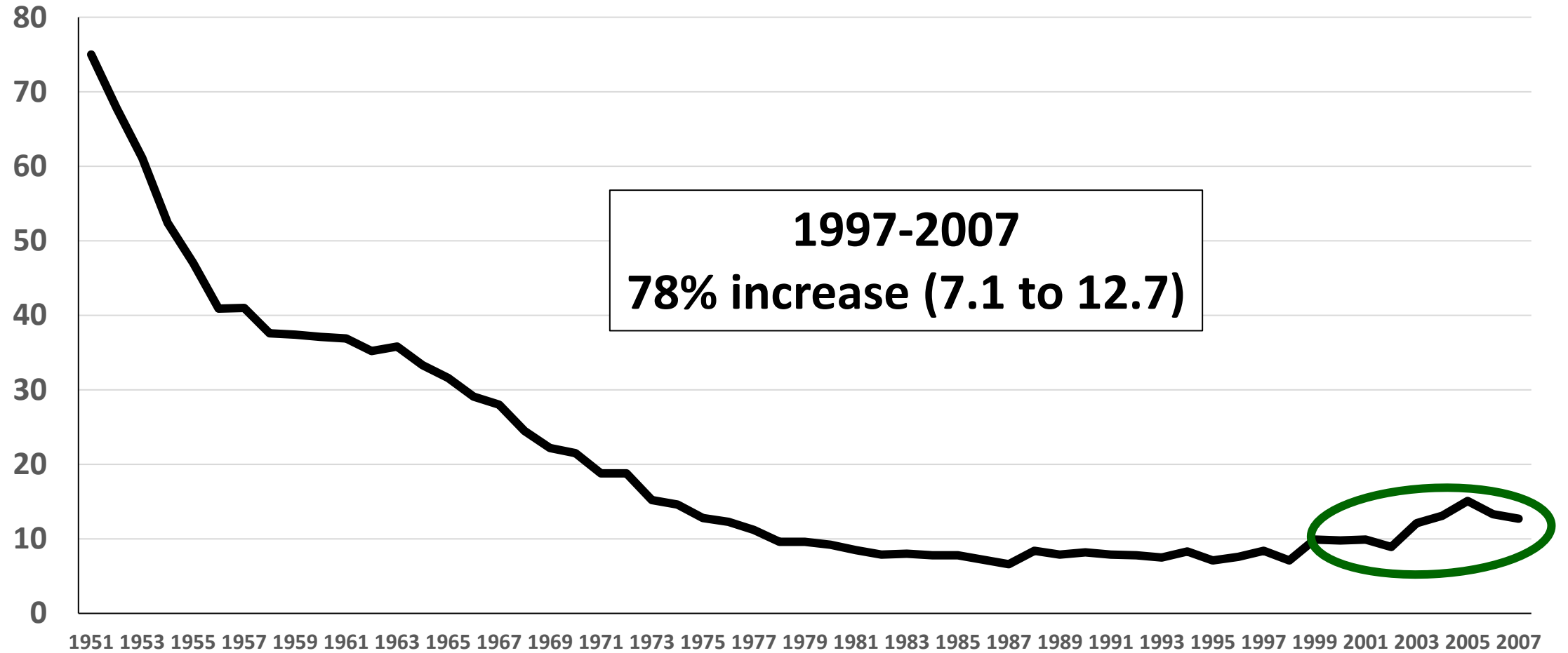
Source: NCHS. Deaths: Final Data. Annual Reports.

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



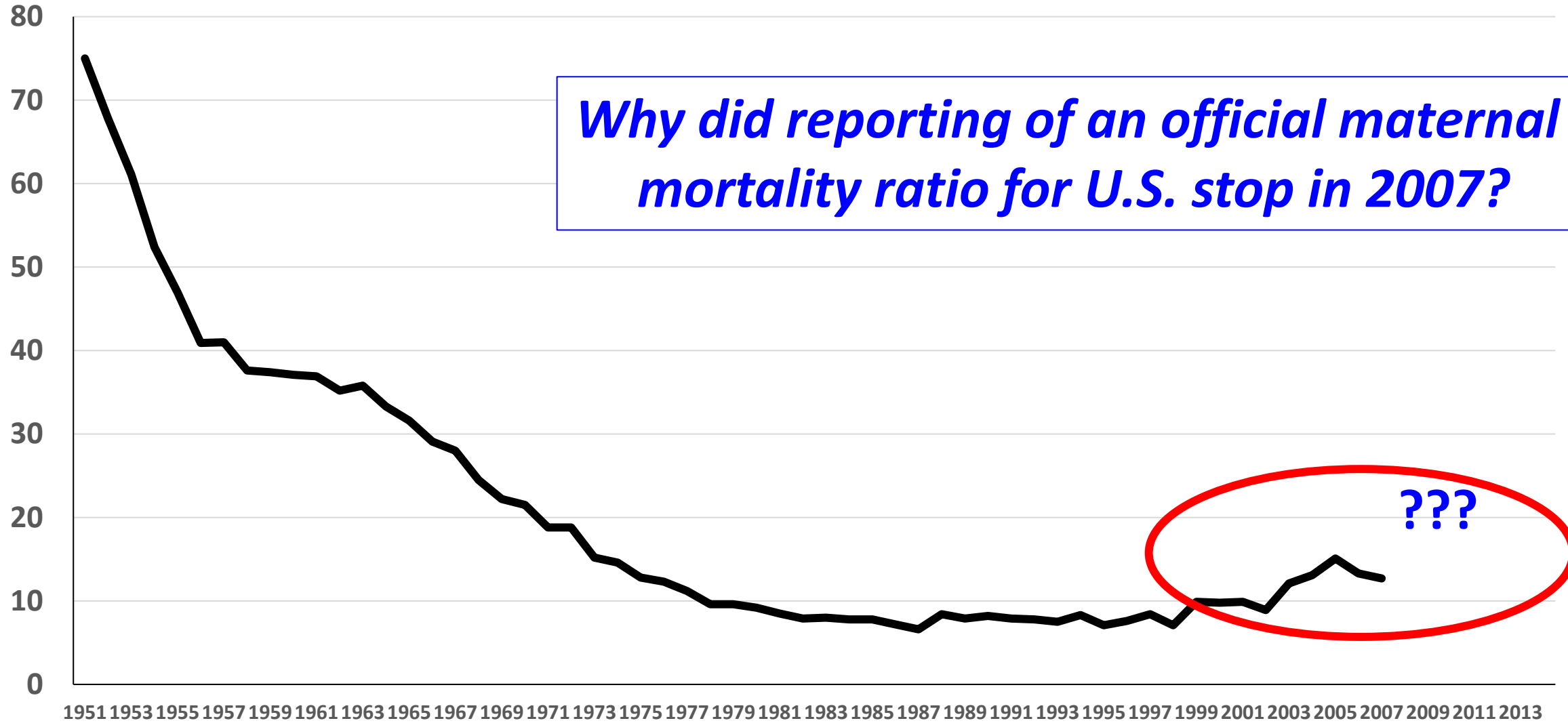
Source: NCHS. Deaths: Final Data. Annual Reports.

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



Source: NCHS. Deaths: Final Data. Annual Reports.

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



# Last reporting (2007) of a maternal mortality rate by NCHS before 2018

**Table 34. Number of maternal deaths and maternal mortality rates for selected causes, by Hispanic origin and race for non-Hispanic population: United States, 2007**

[Maternal causes are those assigned to categories A34, O00–O95, and O98–O99 of the *International Classification of Diseases, Tenth Revision (ICD–10)*, Second Edition. An increasing number of states use a separate item regarding pregnancy status on the death certificate to help identify these deaths; see “Technical Notes.” Rates are per 100,000 live births in specified group; see “Technical Notes.” Race and Hispanic origin are reported separately on the death certificate. Persons of Hispanic origin may be of any race. Data for Hispanic persons are not tabulated separately by race; data for non-Hispanic persons are tabulated by race. Data for Hispanic origin should be interpreted with caution because of inconsistencies between reporting Hispanic origin on death certificates and on censuses and surveys; see “Technical Notes”]

Cause of death (based on ICD–10, 2004)	Number					Rate				
	All origins <sup>1</sup>	Hispanic	Non-Hispanic <sup>2</sup>	Non-Hispanic white <sup>3</sup>	Non-Hispanic black <sup>3</sup>	All origins <sup>1</sup>	Hispanic	Non-Hispanic <sup>2</sup>	Non-Hispanic white <sup>3</sup>	Non-Hispanic black <sup>3</sup>
Maternal causes . . . . .(A34,O00–O95,O98–O99)	548	95	453	242	178	12.7	8.9	14.1	10.5	28.4
Pregnancy with abortive outcome . . . . .(O00–O07)	31	5	26	8	17	0.7	*	0.8	*	*
Ectopic pregnancy . . . . .(O00)	14	1	13	2	11	*	*	*	*	*
Spontaneous abortion . . . . .(O03)	9	2	7	3	3	*	*	*	*	*
Medical abortion . . . . .(O04)	–	–	–	–	–	*	*	*	*	*
Other abortion . . . . .(O05)	1	–	1	–	1	*	*	*	*	*
Other and unspecified pregnancy with abortive outcome . . . . .(O01–O02,O06–O07)	7	2	5	3	2	*	*	*	*	*
Other direct obstetric causes . . . . .(A34,O10–O92)	362	67	295	153	117	8.4	6.3	9.2	6.6	18.7
Eclampsia and pre-eclampsia . . . . .(O11,O13–O16)	64	13	51	29	19	1.5	*	1.6	1.3	*
Hemorrhage of pregnancy and childbirth and placenta previa . . . . .(O20,O44–O46,O67,O72)	41	12	29	18	9	0.9	*	0.9	*	*
Complications predominately related to the puerperium . . . . .(A34,O85–O92)	93	15	78	35	31	2.2	*	2.4	1.5	4.9
Obstetrical tetanus . . . . .(A34)	–	–	–	–	–	*	*	*	*	*
Obstetric embolism . . . . .(O88)	33	6	27	12	8	0.8	*	0.8	*	*
Other complications predominately related to the puerperium (O85–O87,O89–O92)	60	9	51	23	23	1.4	*	1.6	1.0	3.7
All other direct obstetric causes . . . . .(O10,O12,O21–O43,O47–O66,O68–O71,O73–O75)	164	27	137	71	58	3.8	2.5	4.3	3.1	9.2
Obstetric death of unspecified cause . . . . .(O95)	20	4	16	7	7	0.5	*	*	*	*
Indirect obstetric causes . . . . .(O98–O99)	135	19	116	74	37	3.1	*	3.6	3.2	5.9
Maternal causes more than 42 days after delivery or termination of pregnancy . . . . .(O96–O97)	221	39	181	92	70	5.1	3.7	5.6	4.0	11.2
Death from any obstetric cause occurring more than 42 days but less than 1 year after delivery . . . . .(O96)	215	38	176	92	66	5.0	3.6	5.5	4.0	10.5
Death from sequelae of direct obstetric causes . . . . .(O97)	6	1	5	–	4	*	*			





***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 (see part 2)***