STATE PERSPECTIVES ON A NATIONAL PROBLEM – MATERNAL MORTALITY IN 2018

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www.birthbythenumbers.org

MMRIA User Meeting

Centers for Disease Control and Prevention

February 7, 2018

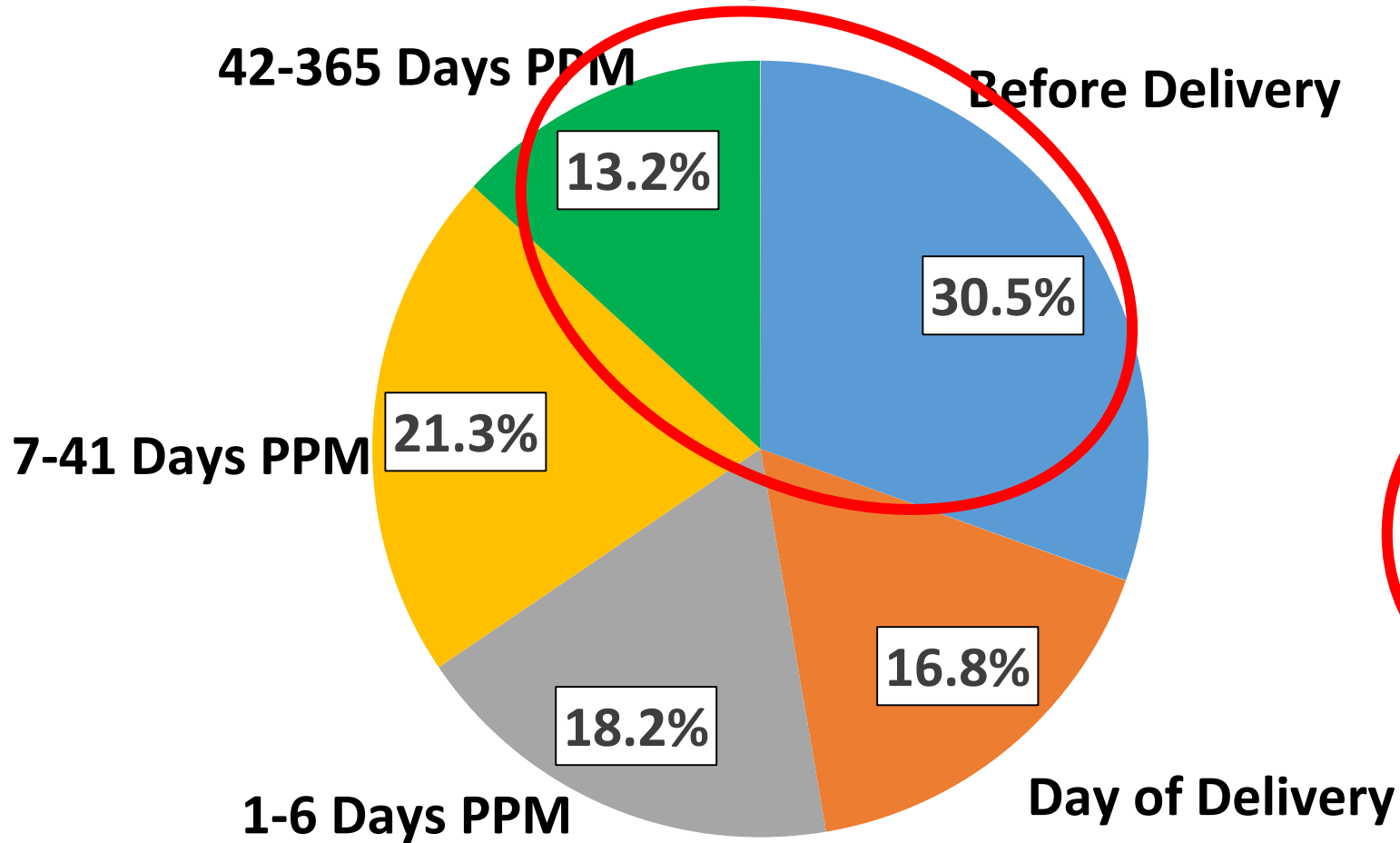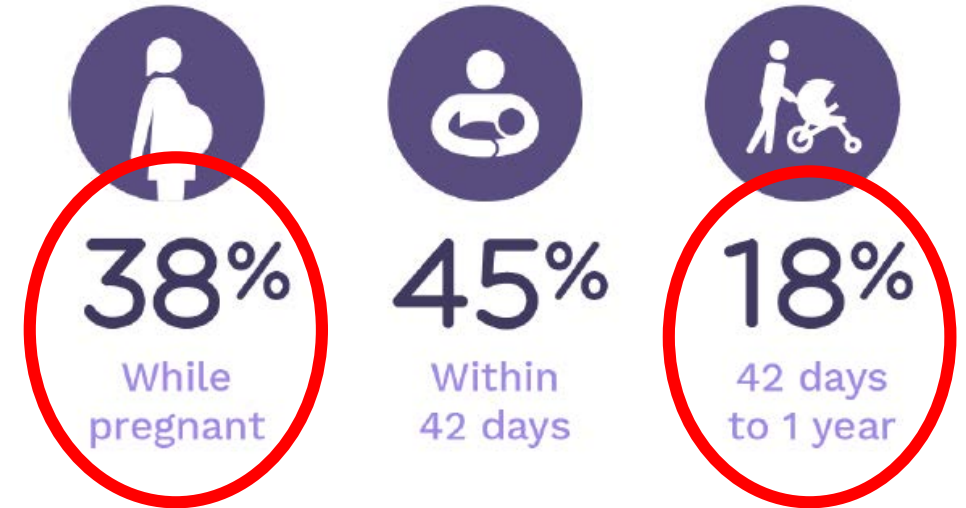# Two key background themes in this talk

Timing of Maternal Deaths

42-365 Days PPM 13.2%

Before Delivery 30.5%

7-41 Days PPM 21.3%

1-6 Days PPM 18.2%

Day of Delivery 16.8%

Figure 1. Distribution of Pregnancy-Related Deaths by Timing of Death in Relation to Pregnancy

38% While pregnant

45% Within 42 days

18% 42 days to 1 year

Source: Creanga A et al. Pregnancy Related Mortality in the U.S., 2011-2013.
Obstet & Gynec 2017 & *MMRIA* (2017).

*(1) Implication of these distributions is that any attempt to resolve the problem of maternal death that doesn't encompass **both** clinical and public health approaches is destined to miss a significant portion of women at risk*

(2) "Looking where there's light"

> *"One searches where there is light"*
>
> Goethe   1749–1832
>
> Source: Barry. *The Great Influenza*. 2004 p. 71

From Listening to Mothers 1

- Women surveyed in May & June, 2002 about their childbirth experiences. Included if they gave birth within 2 years prior to survey

Postpartum Depression

- *19% of mothers scored 13+ on the Edinburgh Postnatal Depression Scale, meaning they were probably experiencing some degree of depression in the week preceding the survey.*

- *Only 43% of this group had consulted a professional about their mental health since giving birth.*

What happened when this overall finding was stratified by time since birth?

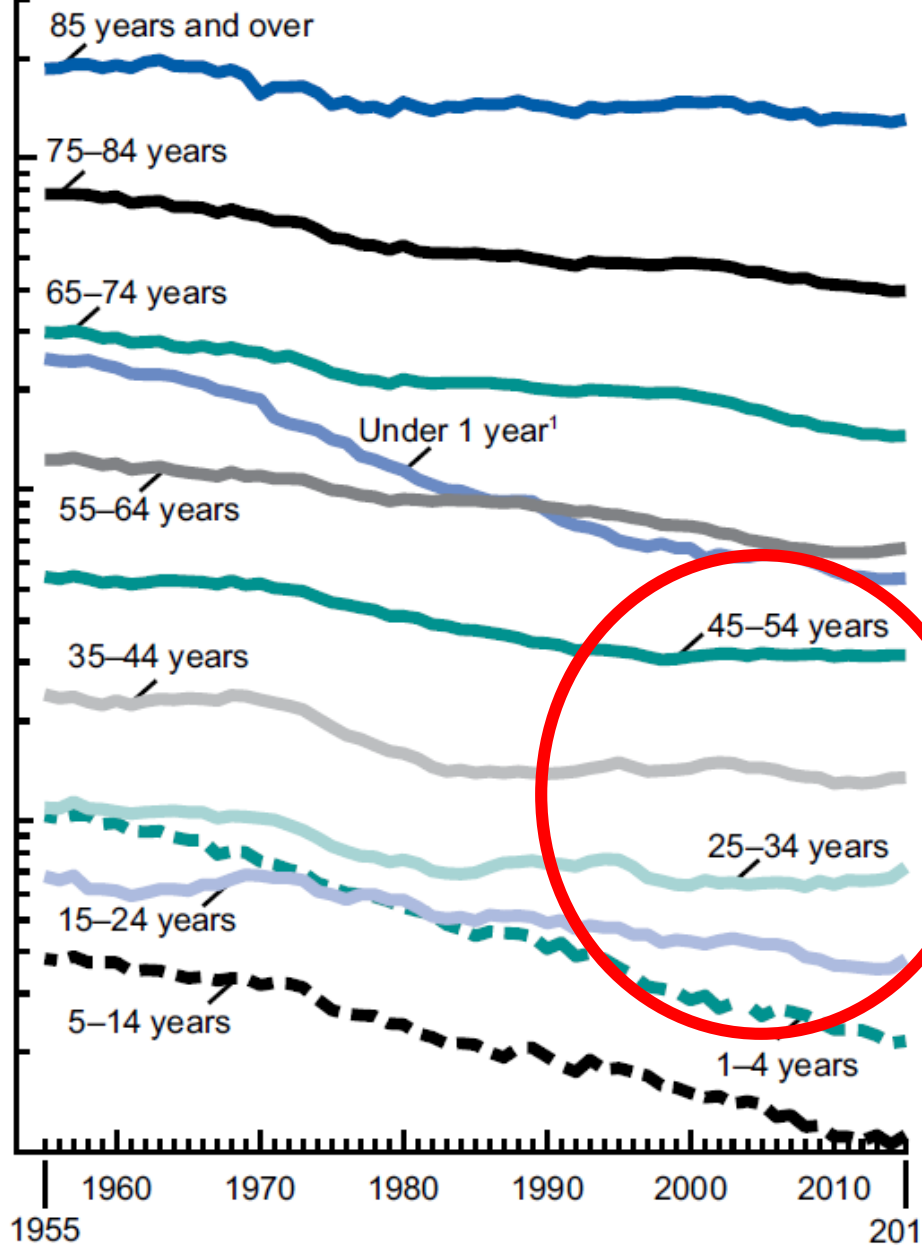# Proportion of Women Scoring 13 + on Edinburgh Postnatal Depression Scale

6 months or less	23%
7-12 months	17%
13-18 months	17%
19-24 months	20%
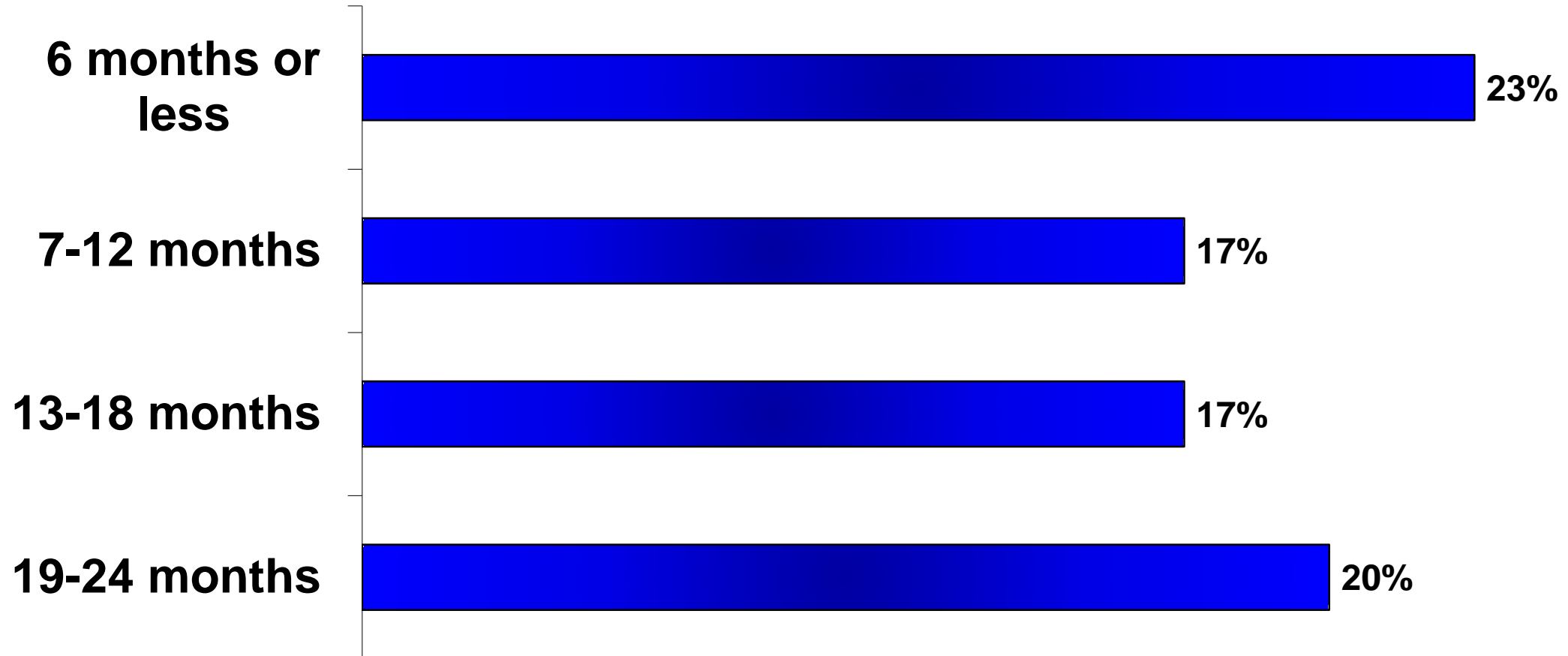
How much of what we term *postpartum depression* is chronic depression we happen to be measuring at that point in time?

What does this have to do with maternal mortality?

How much of what we're measuring as "<u>the unacceptable level of maternal mortality</u>" is actually capturing a general problem in the health of women of reproductive age and we have chosen to shine a light on it for the period of conception to 1 year postpartum?
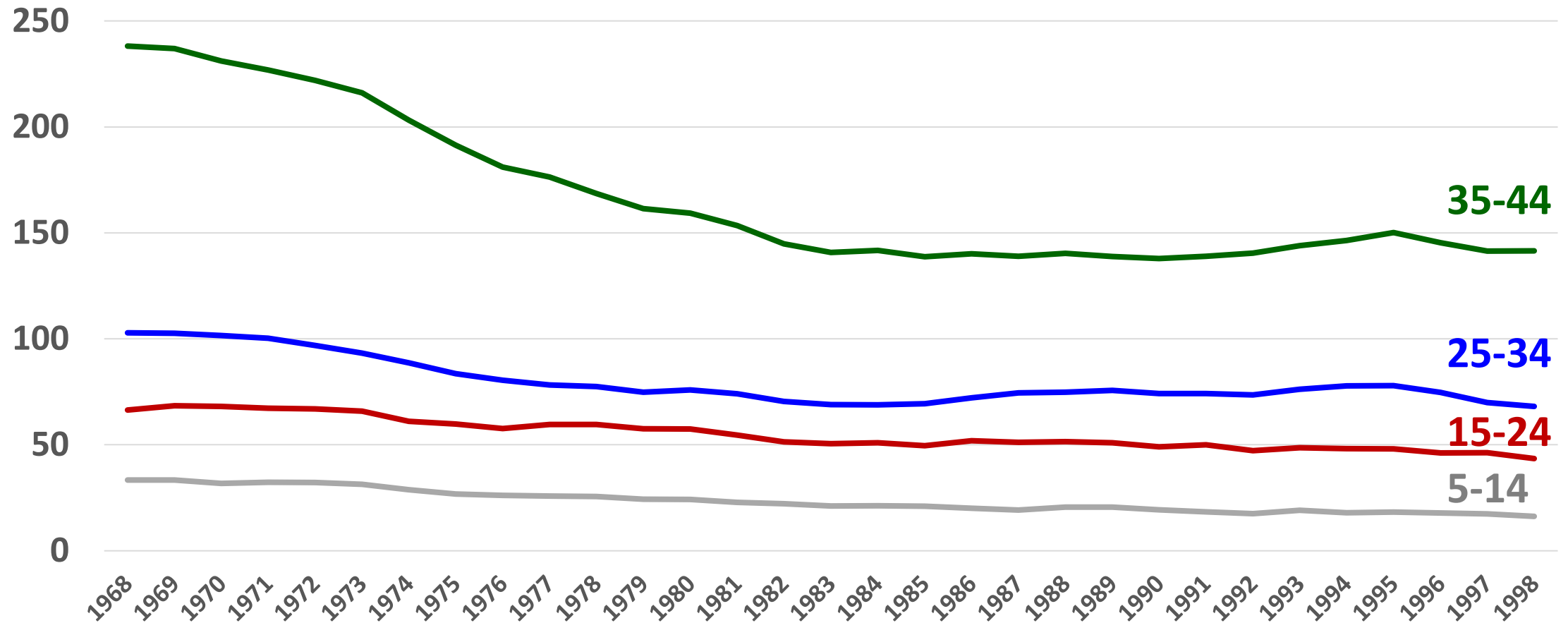
Female

85 years and over

75–84 years

65–74 years

Under 1 year[1]

55–64 years

45–54 years

35–44 years

25–34 years

15–24 years

5–14 years

1–4 years

1960 1970 1980 1990 2000 2010
1955   2015

Death rates, by age, females: United States, 1955–2015

Number of female deaths, 20-49 in 2015 73,873.

Maternal deaths = ~1% of all those.
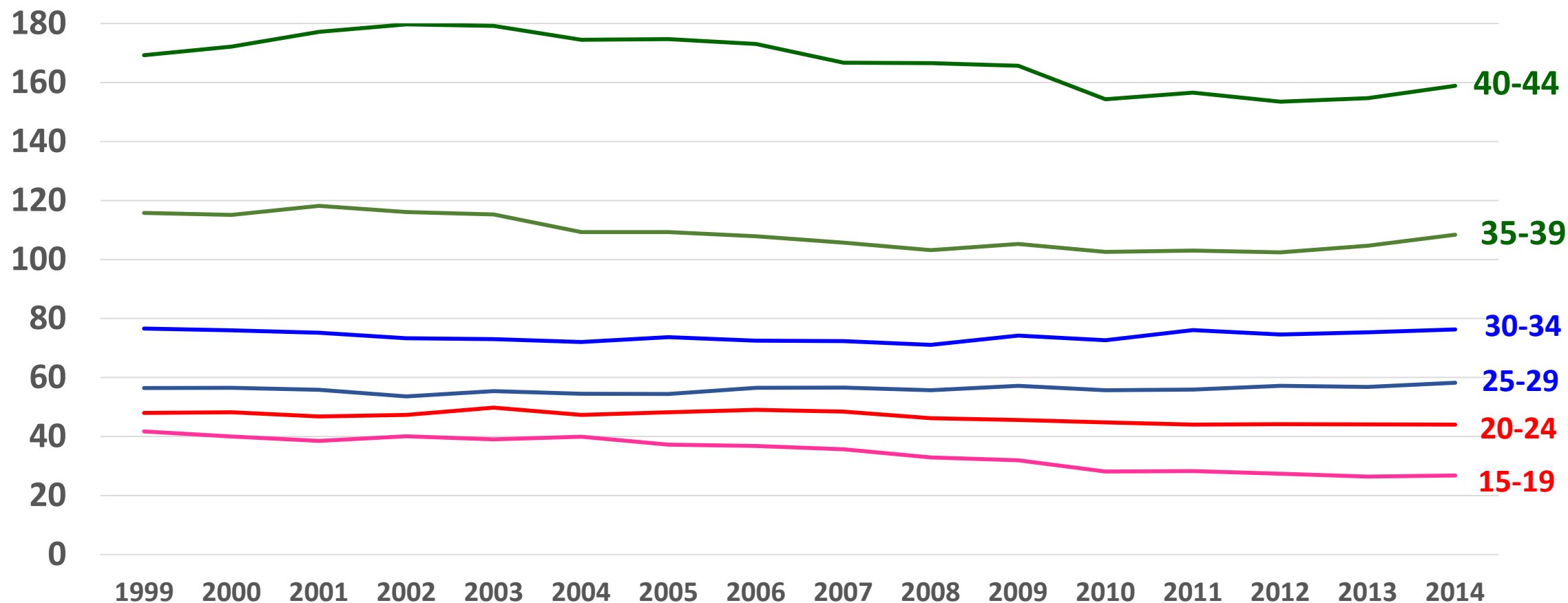
Source: NCHS. *Deaths, Final Data for 2014*

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Female Death Rates (per 100,000) for 72 Selected Causes, by Age, U.S., 1968-1998

Source: National Vital Statistics System, unpublished tables. https://www.cdc.gov/nchs/nvss/mortality/hist290.htm

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Female Death Rates (per 100,000) by Age, 1999-2014
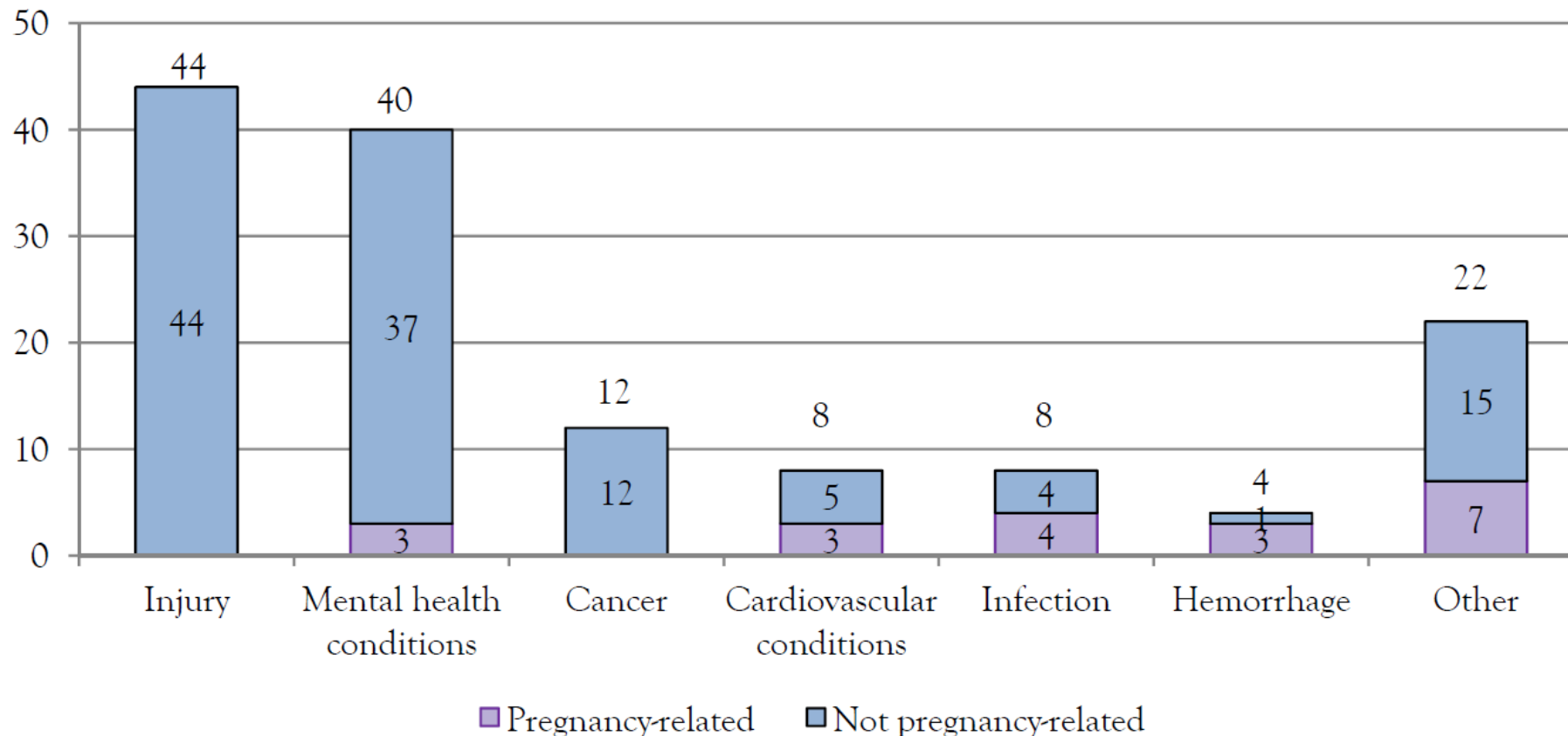

40-44
35-39
30-34
25-29
20-24
15-19

This is a less discussed reason why the work of MMRCs is so important:

MMRCs documentation of pregnancy associated deaths provides our most systematic insights into the death of women of reproductive age
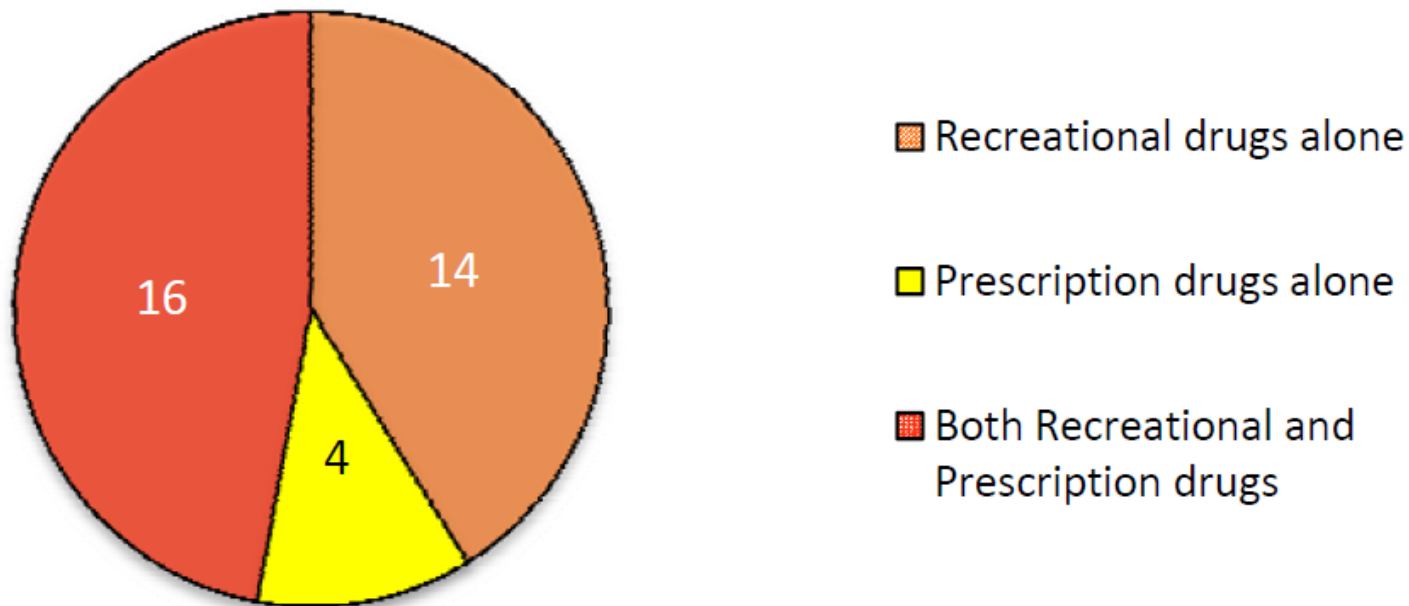
The importance of studying pregnancy associated deaths

- The deaths of women of reproductive age

Figure 4. Leading Causes of Pregnancy-Associated Death by Type of Association, Colorado, 2008-2013
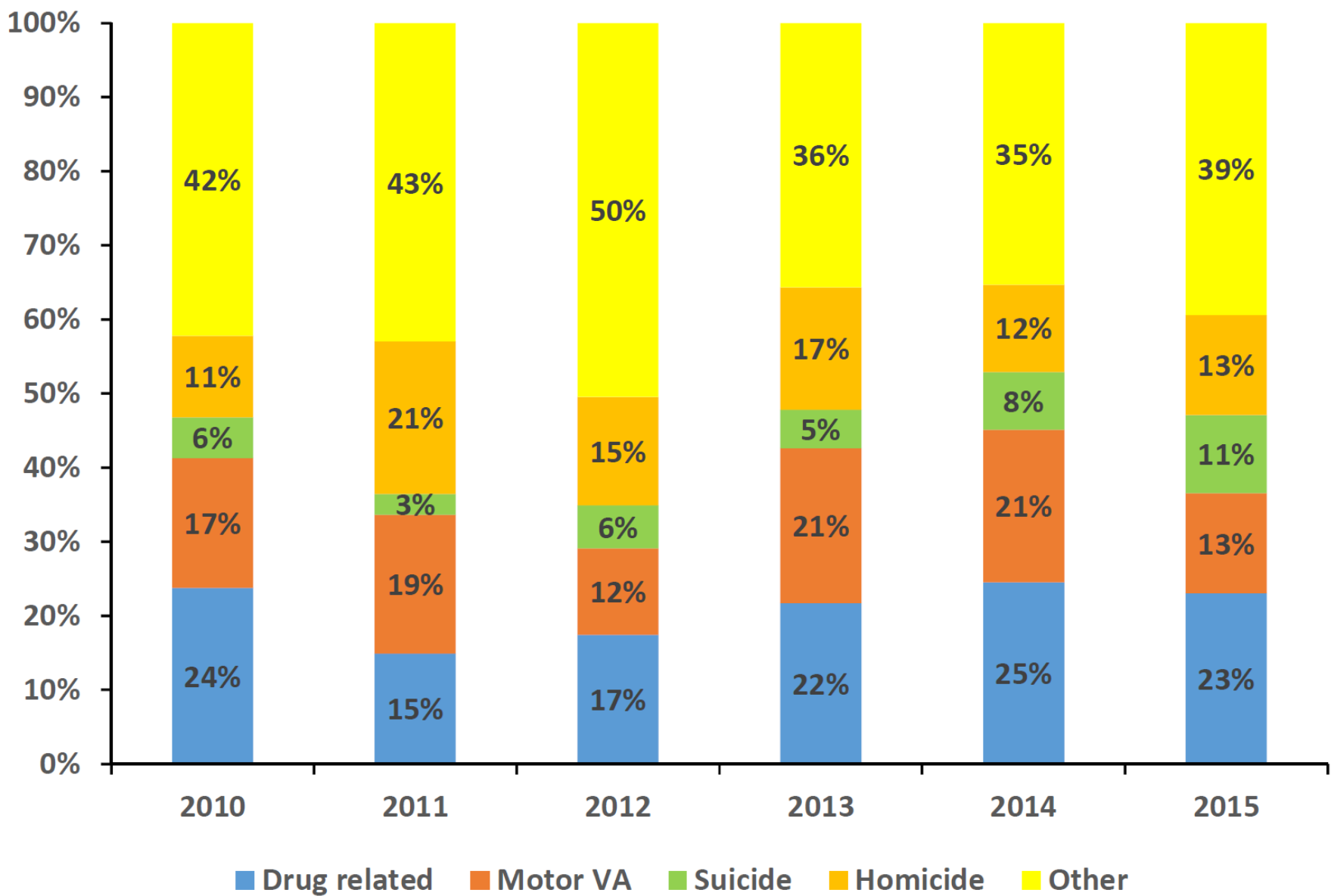
The importance of studying pregnancy associated deaths

- ▨ Recreational drugs alone
- ☐ Prescription drugs alone
- ▦ Both Recreational and Prescription drugs

| Pregnancy Status	Not pregnancy-related		Pregnancy-related	
	Number	Percent	Number	Percent
During pregnancy	15	12.5	7	33.3
1-42 days postpartum (within 6 weeks)	15	12.5	9	42.9
43-365 days postpartum (7-52 weeks)	90	75.0	5	23.8
Total	120	100.0	21	100.0

Figure 2. Not-Pregnancy-Related Death Cases by Cause of Death Florida, 2010-2015


The importance of studying pregnancy associated deaths

Year	Drug related	Motor VA	Suicide	Homicide	Other
2010	24%	17%	6%	11%	42%
2011	15%	19%	3%	21%	43%
2012	17%	12%	6%	15%	50%
2013	22%	21%	5%	17%	36%
2014	25%	21%	8%	12%	35%
2015	23%	13%	11%	13%	39%

Legend: ■ Drug related ■ Motor VA ■ Suicide ■ Homicide ■ Other

Source: Florida DoH. *Florida's Pregnancy-Associated Mortality Review 2015 Update*. **(7/17)**

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Figure 9b. Pregnancy-Related Mortality Ratios (PRMRs) by Pre-Pregnancy BMI Florida, 2006-2014 (n=378) and 2015 (n=38)

Source: Florida DoH. *Florida's Pregnancy-Associated Mortality Review 2015 Update*. **(7/17)**   www.birthbythenumbers.org
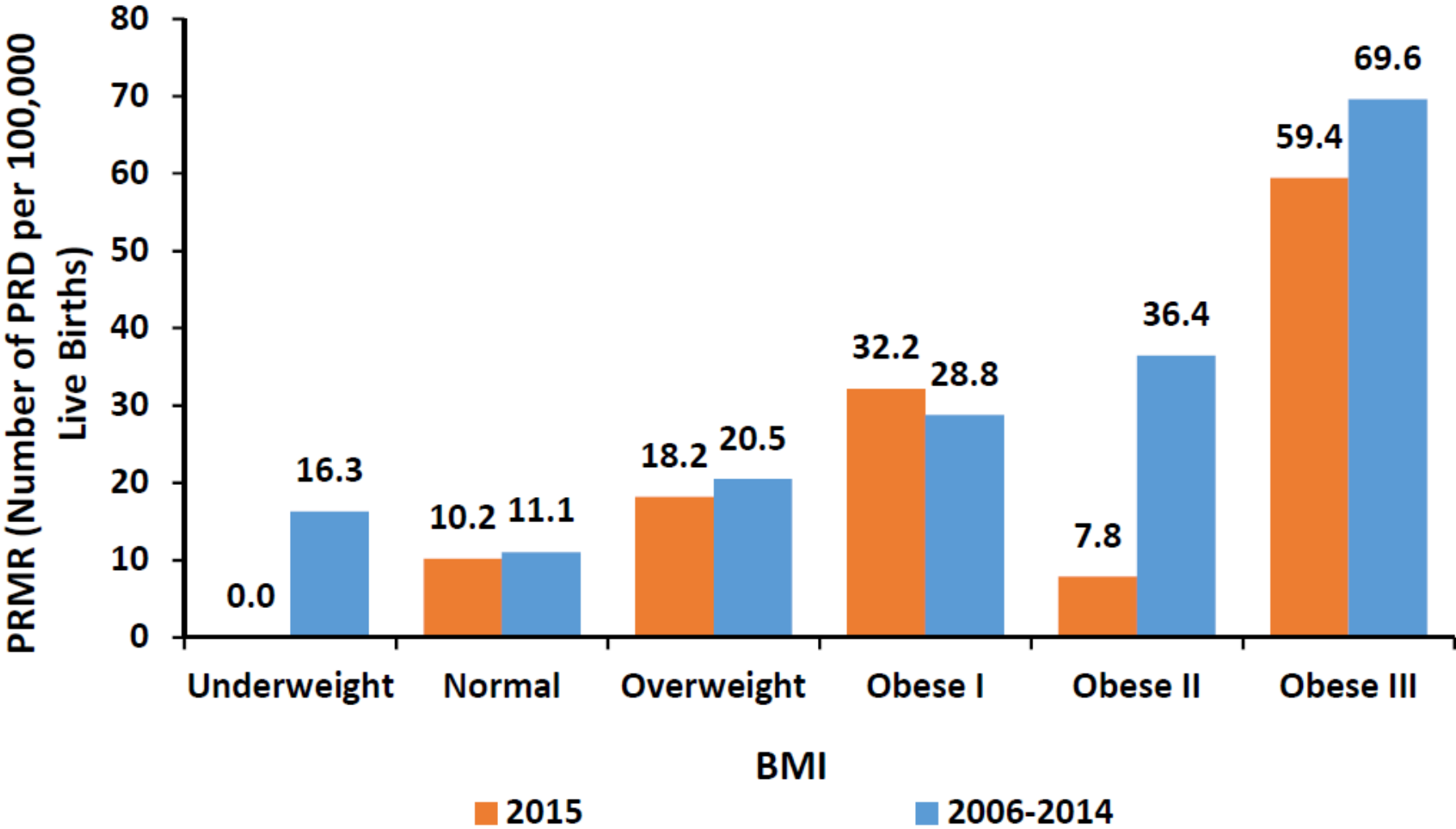
Most Common Factors Associated with Maternal Deaths in Ohio, 2008-2012
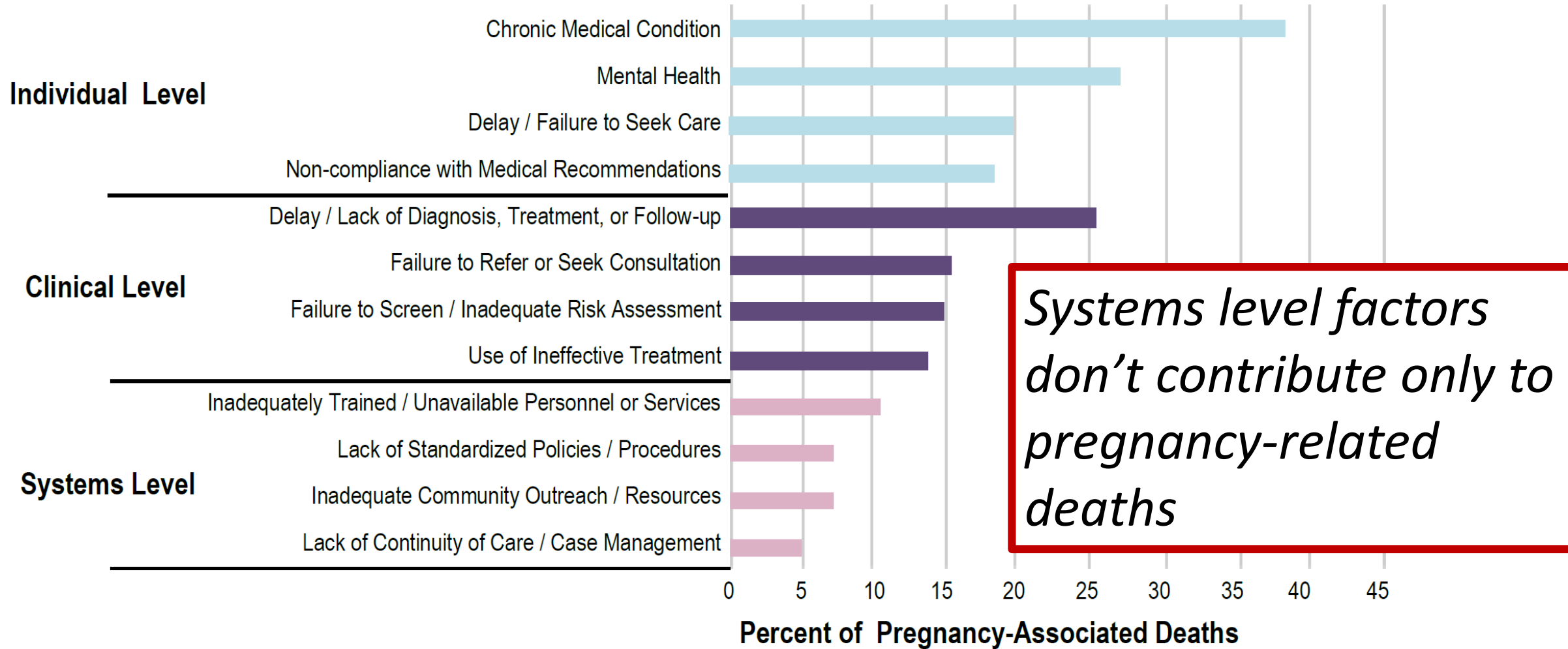
Source: Ohio Pregnancy-Associated Mortality Review

PAMR's Activities and Initiatives to Address Maternal Mortality

Source: Ohio Dept. of Health. Ohio Pregnancy-Associated Mortality Review 2015.

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So, as we turn the focus to maternal mortality, keep this larger context in mind:

if we are going to improve maternal mortality rates we need to improve **all** women's health – not just pregnant women's health.

Maternal Mortality
in the U.S.

Definitions (in the U.S.)

- **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.

- **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.

- **Pregnancy Associated Death** – The death of a women while pregnant or *within one year* of termination of pregnancy, *irrespective of cause. (WHO calls these "pregnancy related")*

Three Sources of U.S. Maternal Death Data

- **National Vital Statistics System (NVSS).** This is the source of the official maternal mortality ratio for the United States and is based on "...information from death certificates filed in the 50 states and the District of Columbia that are subsequently compiled into national data..... Physicians, medical examiners, and coroners are responsible for completing the medical portion of the death certificate." These state data are compiled by NCHS into a national data system.

- **Pregnancy Mortality Surveillance System (PMSS)**. This system was established by CDC. It is based on reports from 52 areas (50 states, Washington, D.C. and New York city) which submits to CDC "... deidentified copies of death certificates for females 12–55 years who died during or within 1 year of pregnancy from any cause; when available, linked birth or fetal death certificates are also sent. Additional sources include computerized searches of Lexis Nexis, reports by public health agencies, including state-based maternal mortality review committees, professional organizations, and individual health care providers." The records are reviewed by specially trained clinicians to determine whether or not a death was pregnancy related.

- **Maternal Mortality Review Information Application (MMRIA).**

Trends in
Maternal Mortality:
1990 to 2015

Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division

Country and territory	MMR[b]	Range of MMR uncertainty (UI 80%)		Number of maternal deaths[c]	Lifetime risk of maternal death:[d] 1 in	% of AIDS-related indirect maternal deaths[e]	PM	Range of PM uncertainty (UI 80%)	
		Lower estimate	Upper estimate					Lower estimate	Upper estimate
United Kingdom	9	8	11	74	5 800	–	0.8	0.6	0.9
United Republic of Tanzania	398	281	570	8 200	45	2.4	18.4	13.0	26.3
United States of America	14	12	16	550	3 800	–	0.8	0.7	0.9
Uruguay	15	11	19	7	3 300	–	0.9	0.7	1.2
Uzbekistan	36	20	65	240	1 000	–	2.2	1.2	4.0

Trends in Maternal Mortality: 1990 to 2013

Estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division

Decrease is less a reflection of improvement and more a function of the difficulty in estimating the maternal mortality rate in the U.S.

Country	MMR[a]	Range of MMR uncertainty		Number of maternal deaths[a]	Lifetime risk of maternal death:[a] 1 in:	% of AIDS-related indirect maternal deaths[b]	PM[c] (%)	Group[d]
		Lower estimate	Upper estimate					
United Kingdom	8	5	12	60	6900		0.6	A
United Republic of Tanzania	410	250	660	7900	44	5.9	13.3	B
United States of America	28	18	44	1200	1800		1.5	A
Uruguay	14	9	20	7	3500		0.8	A
Uzbekistan	36	31	42	220	1100		2.2	A

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

1997-2007
78% increase (7.1 to 12.7)
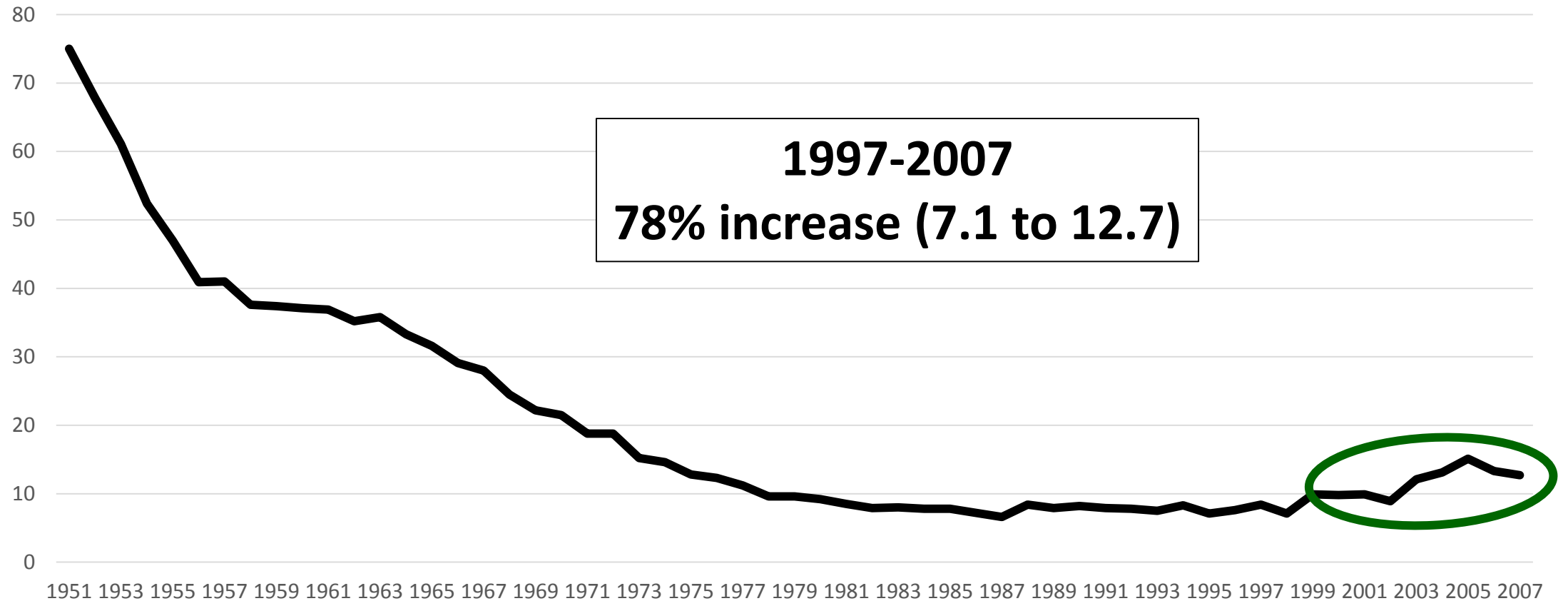
Source: NCHS. Deaths: Final Data. Annual Reports.

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

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[1]	Hispanic	Non-Hispanic[2]	Non-Hispanic white[3]	Non-Hispanic black[3]	All origins[1]	Hispanic	Non-Hispanic[2]	Non-Hispanic white[3]	Non-Hispanic black[3]
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	*	*	*	*	*

So has there been any way to monitor maternal death since 2007?

CDC and Pregnancy Related Mortality

Pregnancy Mortality Surveillance System

Data for CDCs Pregnancy Related Mortality System

*Each year, CDC requests the 52 reporting areas (50 states, New York City, and Washington DC) to **voluntarily send copies of death certificates for all women who died during pregnancy or within 1 year of pregnancy, and copies of the matching birth or fetal death certificates,** if they have the ability to perform such record links. All of the information obtained is summarized, and medically trained epidemiologists determine the cause and time of death related to the pregnancy. Causes of death are coded by using a system established in 1986 by the American College of Obstetricians and Gynecologists and the Centers for Disease Control and Prevention Maternal Mortality Study Group.*

Pregnancy Related Mortality, U.S., 1987-2013

Pregnancy-related mortality ratio*

20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0

Data points by year:
- 1987: 7.2
- 1988: 9.4
- 1989: 9.8
- 1990: 10.0
- 1991: 10.3
- 1992: 10.8
- 1993: 11.1
- 1994: 12.9
- 1995: 11.3
- 1996: 11.3
- 1997: 12.9
- 1998: 12.0
- 1999: 13.2
- 2000: 14.5
- 2001: 14.7
- 2002: 14.1
- 2003: 16.8
- 2004: 15.2
- 2005: 15.4
- 2006: 15.7
- 2007: 14.5
- 2008: 15.5
- 2009: 17.8
- 2010: 16.7
- 2011: 17.8
- 2012: 15.9
- 2013: 17.3
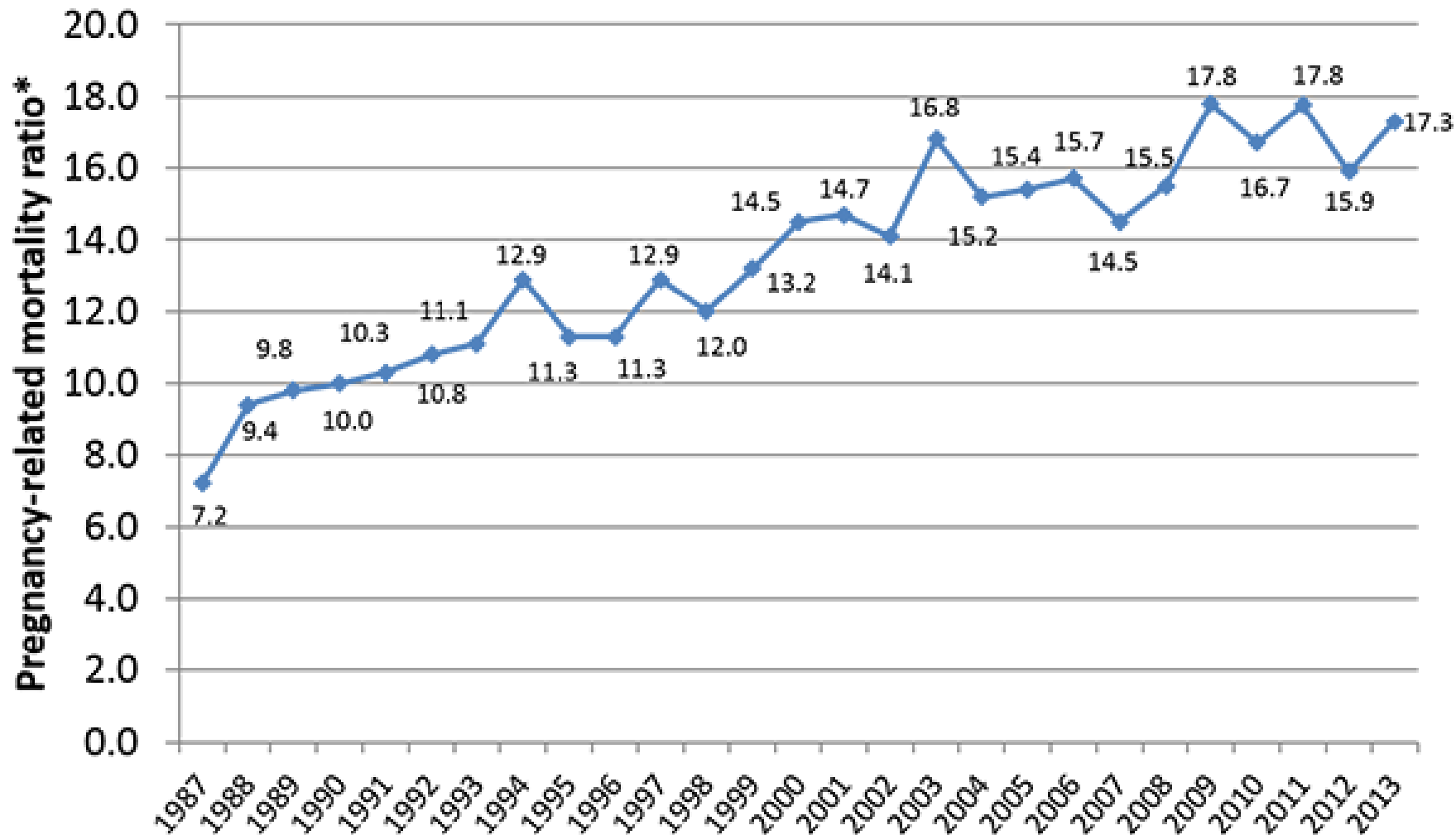
*Note: Number of pregnancy-related deaths per 100,000 live births per year.

Racial Disparities

Rates for 2011-13:

12.7	**white women**
43.5	**black women**
11.0	**Hispanic**
14.4	**other races**

Source: CDC.
Creanga. Pregnancy-Related Mortality in the United States. *Obstet Gynecol 2017*.
www.birthbythenumbers.org

Maternal Mortality Ratios (per 100K births), 2000-2013, U.S. & Comparable Countries*

Was the U.S. Increase the Result of Improved Case Ascertainment?

How did CMQCC estimate the rates after 2007?

NOTE: 2008-2013 US rates unofficial^
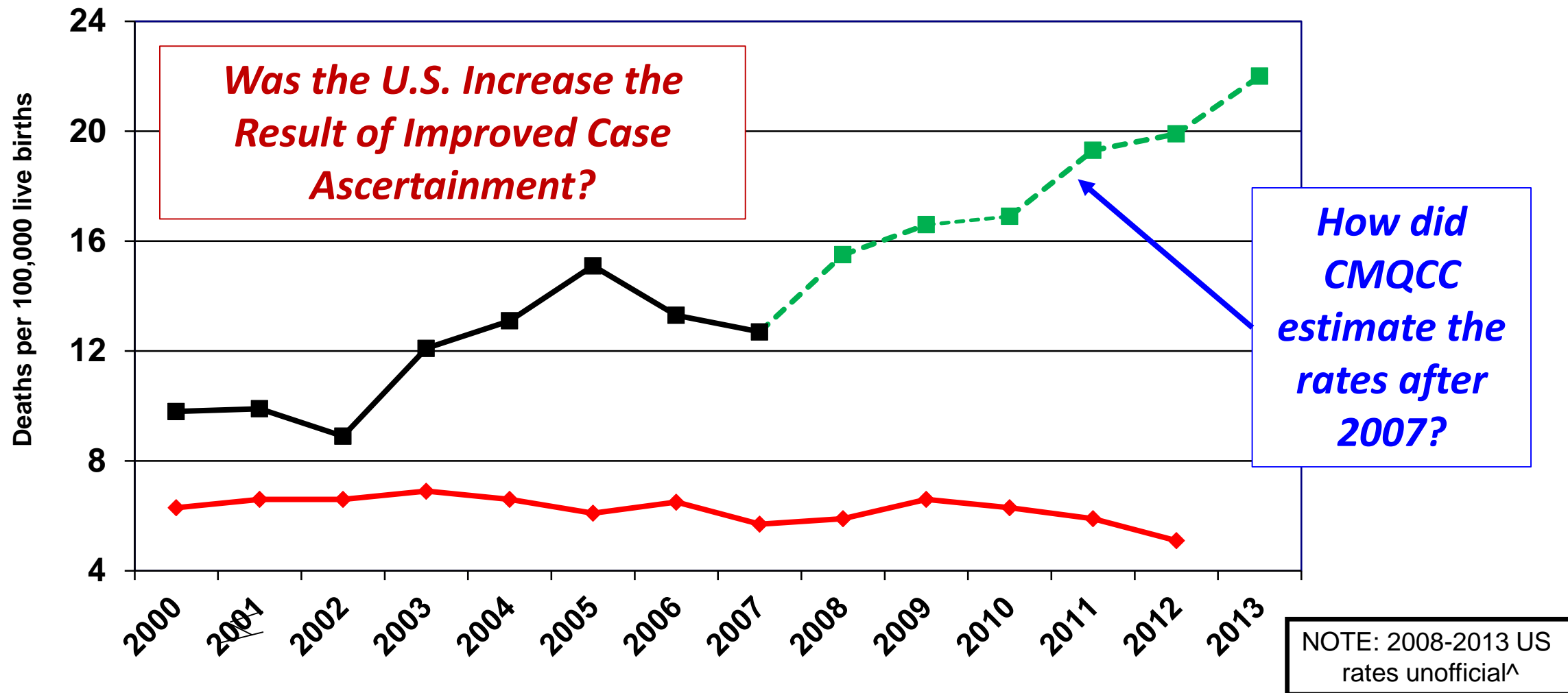
* Countries with **300,000+** births (2012): Australia, Canada, France, Germany, Italy, Japan, S. Korea, Spain, United Kingdom

Sources: OECD Health Data 2015; ^California Maternal Quality Care Collaborative (CMQCC) 2014; NCHS. 2009. *Deaths, Final Data, 2007*.

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Where CMQCC got their data – CDC Wonder

Underlying cause of death

Total maternal deaths (during pregnancy or within 42 days after the end of pregnancy) (A34, O00-O95, O98-O99)

Total direct obstetric causes (A34, O00-O92)

Pregnancy with abortive outcome (O00-O07)

   Ectopic pregnancy (O00)

Hypertensive disorders (O10-O16)

   Pre-existing hypertension (O10)

   Eclampsia and pre-eclampsia (O11,O13-O16)

Obstetric Hemorrhage (O20,O43.2,O44-O46,O67,O71.0-O71.1, O71.3-O71.4,O71.7,O72)

Pregnancy-related infection (O23,O41.1,O75.3,O85,O86,O91)

   Puerperal sepsis (O85)

Other obstetric complications (O21-O22,O24-O28,O30-O41.0, O41.8-O43.1, O43.8-O43.9,O47--O66,O68-O70,O71.2, O71.5, O71.6, O71.8, O71.9,O73,O75.0-O75.2,O75.4-O75.9,O87-O90,O92)

   Diabetes mellitus in pregnancy (O24)

Liver disorders in pregnancy (O26.6)

Other specified pregnancy-related conditions (O26.8)

Obstetric embolism (O88)

Cardiomyopathy in the puerperium (O90.3)

Anesthesia-related complications (O29,O74,O89)

Total indirect causes (O98-O99)

Mental disorders and diseases of the nervous system (O99.3)

Diseases of the circulatory system (O99.4)

Diseases of the respiratory system (O99.5)

Other specified diseases and conditions (O99.8)

Obstetric death of unspecified cause (O95)

Late maternal causes (43 days-1 year after the end of pregnancy) (O96-O97)

Maternal Death ICD-10 Codes

Revised (2003) U.S. Standard Certificate of Death

PART II (Other significant conditions)
- Enter all diseases or conditions contributing to death that were not reported in the chain of events in Part I and that did not result in the **underlying cause of death**. See attached examples.
- If two or more possible sequences resulted in death, or if two conditions seem to have added together, report in Part I the one that, in your opinion, most directly caused death. Report in Part II the other conditions or diseases.

CHANGES TO CAUSE OF DEATH
Should additional medical information or autopsy findings become available that would change the cause of death originally reported, the original death certificate should be amended by the certifying physician by **immediately** reporting the revised cause of death to the State Vital Records Office.

ITEMS 33-34 - AUTOPSY
- 33 - Enter "Yes" if either a partial or full autopsy was performed. Otherwise enter "No."
- 34 - Enter "Yes" if autopsy findings were available to complete the cause of death; otherwise enter "No". Leave item blank if no autopsy was performed.

ITEM 35 - DID TOBACCO USE CONTRIBUTE TO DEATH?
Check "yes" if, in your opinion, the use of tobacco contributed to death. Tobacco use may contribute to deaths due to a wide variety of diseases; for example, tobacco use contributes to many deaths due to emphysema or lung cancer and some heart disease and cancers of the head and neck. Check "no" if, in your clinical judgment, tobacco use did not contribute to this particular death.

ITEM 36 - IF FEMALE, WAS DECEDENT PREGNANT AT TIME OF DEATH OR WITHIN PAST YEAR?
This information is important in determining pregnancy-related mortality.

ITEM 37 - MANNER OF DEATH
- Always check Manner of Death, which is important: 1) in determining accurate causes of death; 2) in processing insurance claims; and 3) in statistical studies of injuries and death.
- Indicate "Pending investigation" if the manner of death cannot be determined whether due to an accident, suicide, or homicide within the statutory time limit for filing the death certificate. This should be changed later to one of the other terms.
- Indicate "Could not be Determined" **ONLY** when it is impossible to determine the manner of death.

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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

The Check Box
Determining Pregnancy Status to Improve Maternal Mortality Surveillance

Andrea P. MacKay, MSPH, Roger Rochat, MD, Jack C. Smith, MS, Cynthia J. Berg, MD, MPH

Objective: More than half of pregnancy-related deaths are not identified through routine surveillance methods. The purpose of this study was to evaluate the effectiveness of the pregnancy check box on death certificates in ascertaining pregnancy-related deaths.

Methods: Data derived from the Centers for Disease Control and Prevention's ongoing Pregnancy Mortality Surveillance System were used to identify states that included a check box on the death certificate in 1991 and 1992. Death certificates from those states were evaluated to determine the number and proportion of pregnancy-related deaths identified by a marked check box. Characteristics of death were also examined.

Results: Sixteen states and New York City included a check box or question specifically asking about pregnancy of the decedent. Of the 425 pregnancy-related deaths identified in the 17 reporting areas, 124 (29%) were determined to be pregnancy-related deaths only because of the pregnancy status information provided in the check box. The proportion of deaths identified only by a marked check box ranged from less than 5% for four states to 40% or more for seven states.

Conclusions: The availability of pregnancy status information on death certificates is a simple and effective aid in ascertaining a pregnancy-related death, when no other indicators of pregnancy appear on the death certificate. Routine use of the pregnancy check box for all states would lead to substantially increased classification of maternal deaths and more accurate classification of the causes of and risk factors for maternal deaths.

16 States already had a checkbox as far back as 1991-1992, but with different wording

Table III. Separate questions related to pregnancy on state certificates in 2003

Alabama . . . . Was there a pregnancy in last 42 days? (Specify Yes, No, or Unknown)

California . . . . If female, pregnant in last year? ☐ Yes ☐ No ☐ Unknown

Florida . . . . If female, was there a pregnancy in the past 3 months? ___ Yes ___ No

Idaho . . . . If female aged 10–54:
☐ 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

Illinois . . . . If female, was there a pregnancy in past three months? ☐ Yes ☐ No

Indiana . . . . Was decedent pregnant or 90 days postpartum? (Yes or no)

Iowa . . . . If female, was there a pregnancy in the past 12 months? (Specify yes or no)

Kentucky . . . . If female, was there a pregnancy in the past 12 months? ☐ Yes ☐ No

Louisiana . . . . If deceased was female 10–49, was she pregnant in the last 90 days? ☐ Yes ☐ No ☐ Unknown

Maryland . . . . If female:
Was decedent pregnant in the past 12 months? ☐ Yes ☐ No ☐ Unknown
Separate fields on dates of death and delivery support capability to compute the other categories in the standard.

Minnesota . . . . Was female pregnant:
At death? ___ yes ___ no ___ unknown
In last 12 months? ___ yes ___ no ___ unknown

Mississippi . . . . Had decedent been pregnant within 90 days prior to death? ☐ Yes ☐ No

Missouri . . . . If deceased was female 10–49, was she pregnant in the last 90 days? ☐ Yes ☐ No ☐ Unknown

Montana . . . . If female:
☐ not pregnant within past year ☐ not pregnant but pregnant with 42 days of death
☐ not pregnant but pregnant 43 days to 1 year before death ☐ pregnant at time of death
☐ unknown if pregnant within past year

Nebraska . . . . If female, was there a pregnancy in the past 3 months? ☐ Yes ☐ No

New Jersey . . . . If female, was she pregnant at death, or any time 90 days prior to death? ☐ Yes ☐ No

New Mexico . . . . Was decedent pregnant within last 6 weeks? ☐ Yes ☐ No

New York City . . . . If female:
☐ not pregnant within 1 year of death ☐ pregnant at time of death ☐ not pregnant at death, but pregnant within 42 days of death
☐ not pregnant at death, but pregnant 43 days to 1 year before death ☐ unknown if pregnant within 1 year of death
Also have date of outcome, so could compute intervals if needed.

New York State . . . . If female:
☐ not pregnant within last 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 past year
Also have date of delivery, so could compute intervals if needed.

North Dakota . . . . Was deceased pregnant within 18 months of death? ☐ Yes ☐ No

Texas . . . . Was decedent pregnant at time of death ☐ Yes ☐ No ☐ Unknown
within last 12 months ☐ Yes ☐ No ☐ Unknown

Virginia . . . . If female, was there a pregnancy in past 3 months? ☐ Yes ☐ No ☐ Unknown

Time periods used:
42 days;
6 weeks;
3 months;
90 days;
12 mos;
"last year"

Source: Hoyert . *Maternal Mortality and Related Concepts*. NCHS. Vital Health Stat 3(33). 2007. p.12.

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	New Adopters*	Total
2003	4	4
2004	7	11
2005	7	18
2006	4	22
2007	2	(24)
2008	7	31
2009	0	31
2010	4	35
2011	2	37
2012	4	41
2013	1	42
2014	5	47
2015	2	49
2016	1	50
2017	1	51

Delays in Adoption of the U.S. Standard Pregnancy Question among States

New England	
New Hampshire	4/2004
Connecticut	2005
Rhode Island	2006
Vermont	7/2008
Maine	2010
Massachusetts	**9/2014**

* Note: Some states adopted change in the middle of the calendar year.

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Our Analysis

We did an analysis that examined data by state, modeled for whether or not they were using the new item, and came up with national estimates.

Not enough cases to do single state analyses, but could look at some of the larger states.

Recent Increases in the U.S. Maternal Mortality Rate

Disentangling Trends From Measurement Issues

Marian F. MacDorman, PhD, Eugene Declercq, PhD, Howard Cabral, PhD, and Christine Morton, PhD

RESULTS: The estimated maternal mortality rate (per 100,000 live births) for 48 states and Washington, DC (excluding California and Texas, analyzed separately) increased by 26.6%, from 18.8 in 2000 to 23.8 in 2014. California showed a declining trend, whereas Texas had a sudden increase in 2011–2012. Analysis of the measurement change suggests that U.S. rates in the early 2000s were higher than previously reported.

Grouping the States

- **Group 1** – **24 states** & D.C. that *did not have an unrevised pregnancy question* and adopted the U. S. standard question by January 2013

- **Group 2** – **14 states** that *had an unrevised pregnancy question with a timeframe longer* than the U.S. standard

- **Group 3** – **7 states** that *had not revised by late 2013* with either no pregnancy question or a nonstandard pregnancy question on their unrevised death certificate.

- **Group 4** – **3 states** that *had an unrevised pregnancy question consistent with the U.S. standard.*

Correcting for Impact of Adding Pregnancy Box

$$\text{Correction factor} = \frac{\text{Sum of the number of maternal deaths in each state for 2 years following the revision date}}{\text{Sum of the number of maternal deaths in each state for the 2 years preceding the revision date}}$$

Also did tests involving 1 year and 3 year periods with little change

Estimating a Combined, Adjusted MMR, for 48 states and DC, from 2000-2014

- California excluded because only reports deaths at <1 year. Texas excluded because of divergent trend.

- First, computed the weighted average of the slopes of the regression lines from Analysis Groups 1-4, weighted by the total number of live births in each group from 2000-2014. Weighted slope=0.357.

- Then computed a combined 2014 MMR for the 44 states and DC with standard pregnancy question.

- Used the combined slope to back-estimate MMRs back to 2000.

Estimated MMRs, 48 states* and DC, 2000-2014

27% increase 2000-2014

23.8

18.8

Rate per 100,000 live births

How might the U.S. compare internationally?

30

25

20

15

10

5

0

2000   2005   2010   2014
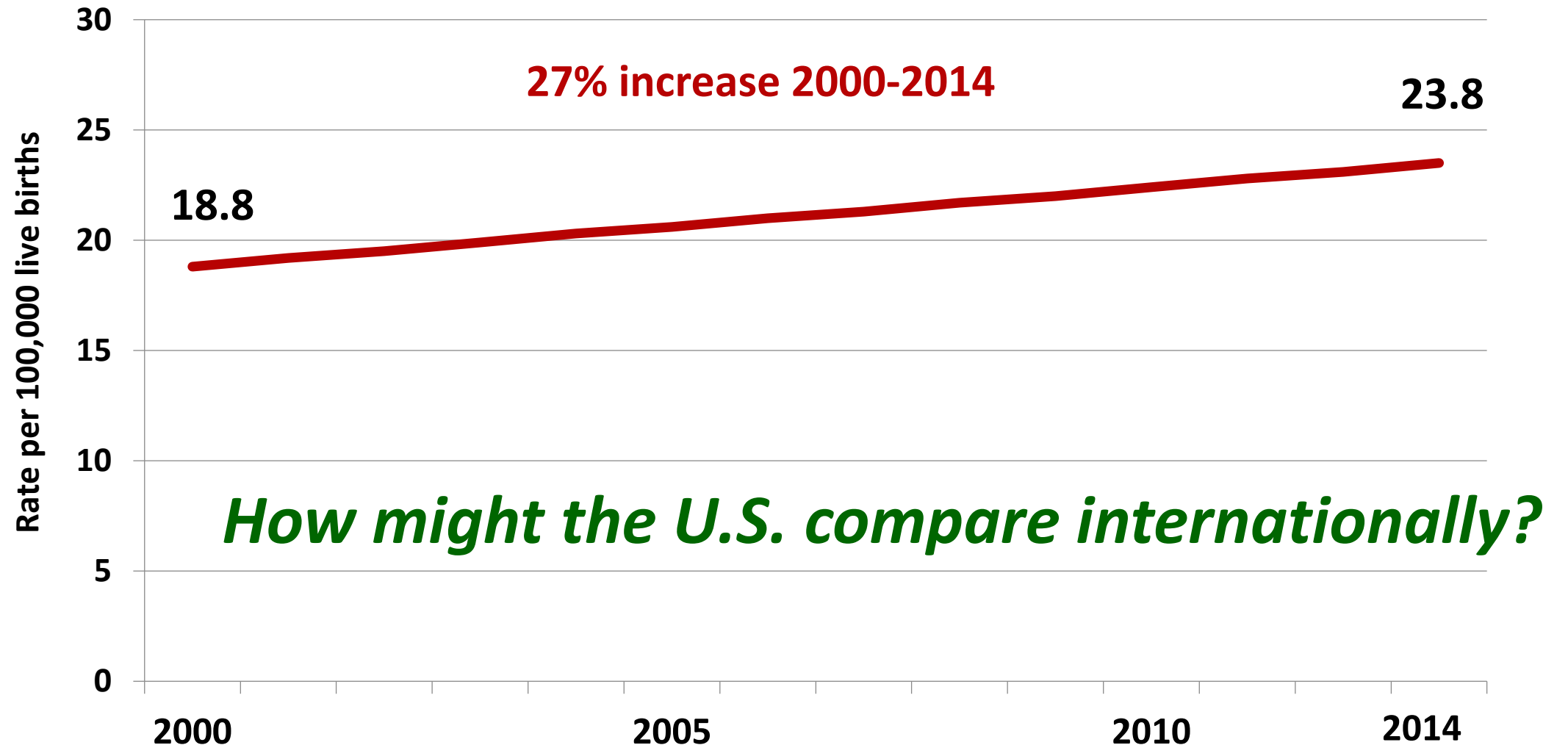
*Excludes California and Texas.

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Maternal Mortality Ratios, OECD* Countries, 2014

Source: OECD Health Data 2016
* 2013
# 2012
^U.S. from MacDorman et al.

Luxembourg
Iceland
Greece#
Poland*
Australia*
Spain
Italy#
Switzerland*
Netherlands
Ireland
Norway
Japan
Finland#
Sweden
Slovak Republic
Germany
Israel*
Belgium#
France*
Canada#
Portugal*
Czech Republic
Hungary
United Kingdom
Estonia*
Denmark*
Austria
Korea
New Zealand#
Turkey
Chile*
United States^

0   5   10   15   20   25

* Organization for Economic and Cooperation and Development

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Using a more conservative estimate

*Adjusting the CDC Pregnancy Related Mortality data
to reflect a maternal mortality rate*

Estimated for 2011-2013 (per 100,000 live births):

- **All women**   **14.8**
- Non-Hispanic white women   **11.3**
- Non-Hispanic black women   **36.2**
- Hispanic women   **10.0**

- **Black-white disparity**   **3.2**

U.S. MMR* Compared to Countries with 300,000+ births, 2014, using WHO Estimates

Country	MMR
Italy	4
Spain	5
Japan	5
Australia	6
Germany	6
Canada	7
France	8
U.K.	9
Korea	11
U.S.	14.8
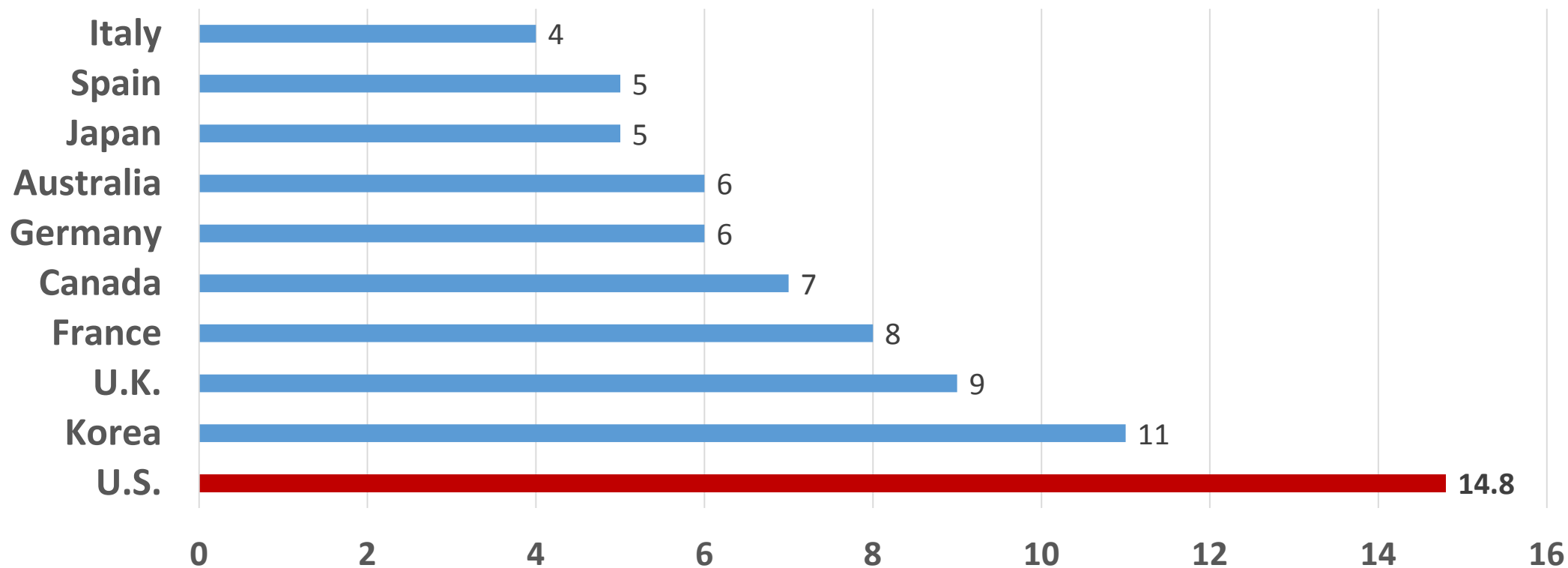
* Maternal Mortality per 100,000 births

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U.S. MMR* Compared to Countries with 300,000+ births, 2014, using WHO Estimates

Country	MMR
Italy	4
Spain	5
Japan	5
Australia	6
Germany	6
Canada	7
France	8
U.K.	9
Korea	11
U.S. White NH	11.3
U.S. All	14.8

* Maternal Mortality Ratio per 100,000 births

Source: *Maternal Mortality: 1990 to 2015* Estimates by WHO, UNICEF, UNFPA, World Bank Group & UN Population Division. Geneva: 2015.

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But what about causes of death?

Cause-specific proportionate pregnancy-related mortality: United States, 1987–2013.

Legend:
- 1987–1990
- 1991–1997
- 1998–2005
- 2006–2010
- 2011–2013

Y-axis: Pregnancy-related deaths (%)

Hemorrhage: 28.7, 18.2, 12.5, 11.4, 11.4 — **-60%**

Hypertensive disorder of pregnancy: 17.6, 15.9, 12.3, 9.4, 7.4 — **-58%**

Infection: 13.1, 13.2, 10.7, 13.6, 12.7 — **-60%**

Thrombotic pulmonary embolism: 11.9, 11.3, 10.2, 9.6, 9.2 — **-23%**

Amniotic fluid embolism: 7.6, 8.6, 7.5, 5.3, 5.5 — **-21%**

Anesthesia complication: 2.5, 1.6, 1.2, 0.7, 0.2 — **-92%**

Cardiovascular condition: 3.0, 6.2, 12.4, 14.6, 15.5 — **+417%**

Cardiomyopathy: 5.6, 7.7, 11.6, 11.8, 11.0 — **+96%**

Cerebrovascular accident: 3.6, 4.7, 6.2, 6.2, 6.6 — **+83%**

Other condition: 8.7, 12.0, 13.2, 12.7, 14.5 — **+67%**

Source: Creanga. Pregnancy-Related Mortality in the United States. Obstet Gynecol 2017.

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2nd Article in Series – Causes of Maternal Death in the NVSS

Trends in Maternal Mortality by Sociodemographic Characteristics and Cause of Death in 27 States and the District of Columbia

Marian F. MacDorman, PhD, Eugene Declercq, PhD, and Marie E. Thoma, PhD

Over Ascertainment??

- Research into the cause of death category finds much of the increase is coming from *less specific codes*.

- Other specified pregnancy-related conditions (O26.8)

- Other obstetric complications (O21–O22, O24– O41.0, O41.8–O43.1, O43.8–O43.9,O47–O66, O68–O70, O71.2, O71.5,O71.6, O71.8, O71.9, O73–O75.2,O75.4–O75.9, O87–O90, O92)

- Other specified diseases and conditions (O99.8)

- Obstetric death of unspecified cause (O95)

Underlying cause of death

Total maternal deaths (during pregnancy or within 42 days after the end of pregnancy) (A34, O00-O95, O98-O99)

Total direct obstetric causes (A34, O00-O92)

  Pregnancy with abortive outcome (O00-O07)

  Ectopic pregnancy (O00)

  Hypertensive disorders (O10-O16)

  Pre-existing hypertension (O10)

  Eclampsia and pre-eclampsia (O11,O13-O16)

  Obstetric Hemorrhage (O20,O43.2,O44-O46,O67,O71.0-O71.1, O71.3-O71.4,O71.7,O72)

  Pregnancy-related infection (O23,O41.1,O75.3,O85,O86,O91)

  Puerperal sepsis (O85)

Other obstetric complications (O21-O22,O24-O28,O30-O41.0, O41.8-O43.1, O43.8-O43.9,O47--O66,O68-O70,O71.2, O71.5, O71.6, O71.8, O71.9,O73,O75.0-O75.2,O75.4-O75.9,O87-O90,O92)

  Diabetes mellitus in pregnancy (O24)

  Liver disorders in pregnancy (O26.6)

  Other specified pregnancy-related conditions (O26.8)

  Obstetric embolism (O88)

  Cardiomyopathy in the puerperium (O90.3)

  Anesthesia-related complications (O29,O74,O89)

Total indirect causes (O98-O99)

  Mental disorders and diseases of the nervous system (O99.3)

  Diseases of the circulatory system (O99.4)

  Diseases of the respiratory system (O99.5)

Other specified diseases and conditions (O99.8)

Obstetric death of unspecified cause (O95)

Late maternal causes (43 days-1 year after the end of pregnancy) (O96-O97)

Maternal Death ICD-10 Codes

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Assessing the impact of ill-defined causes on maternal deaths and mortality rates by cause of death, 27 states and DC, 2008-2009 to 2013-2014

Underlying cause of death (ICD-10 category)	2008-9		2013-14		Percent change 2008-9 to 2013-14
	Number of deaths	Rate~	Number of deaths	Rate~	
Total maternal (A34, O00-O05, O98-O99)	780	20.6	907	25.4	23.3
Ill-defined causes (O26.8, O95, O99.8)	266	7.0	371	10.4	47.9
Total maternal minus ill-defined causes (Remainder)	514	13.5	536	15.0	10.6
Total direct obstetric (A34, O00-O92)	527	13.9	595	16.6	19.7
Other specified pregnancy-related conditions (O26.8)	130	3.4	212	5.9	73.0
Total direct obstetric minus O26.8 (Remainder)	397	10.5	383	10.7	2.3
Total indirect causes (O98-O99)	202	5.3	294	8.2	54.4
Other specified diseases and conditions (O99.8)	85	2.2	141	3.9	75.9
Total indirect causes minus O99.8 (Remainder)	117	3.1	153	4.3	38.7

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Maternal mortality rates by age for specific & nonspecific causes of death, 27 states & DC, 2008–2009 and 2013–2014.

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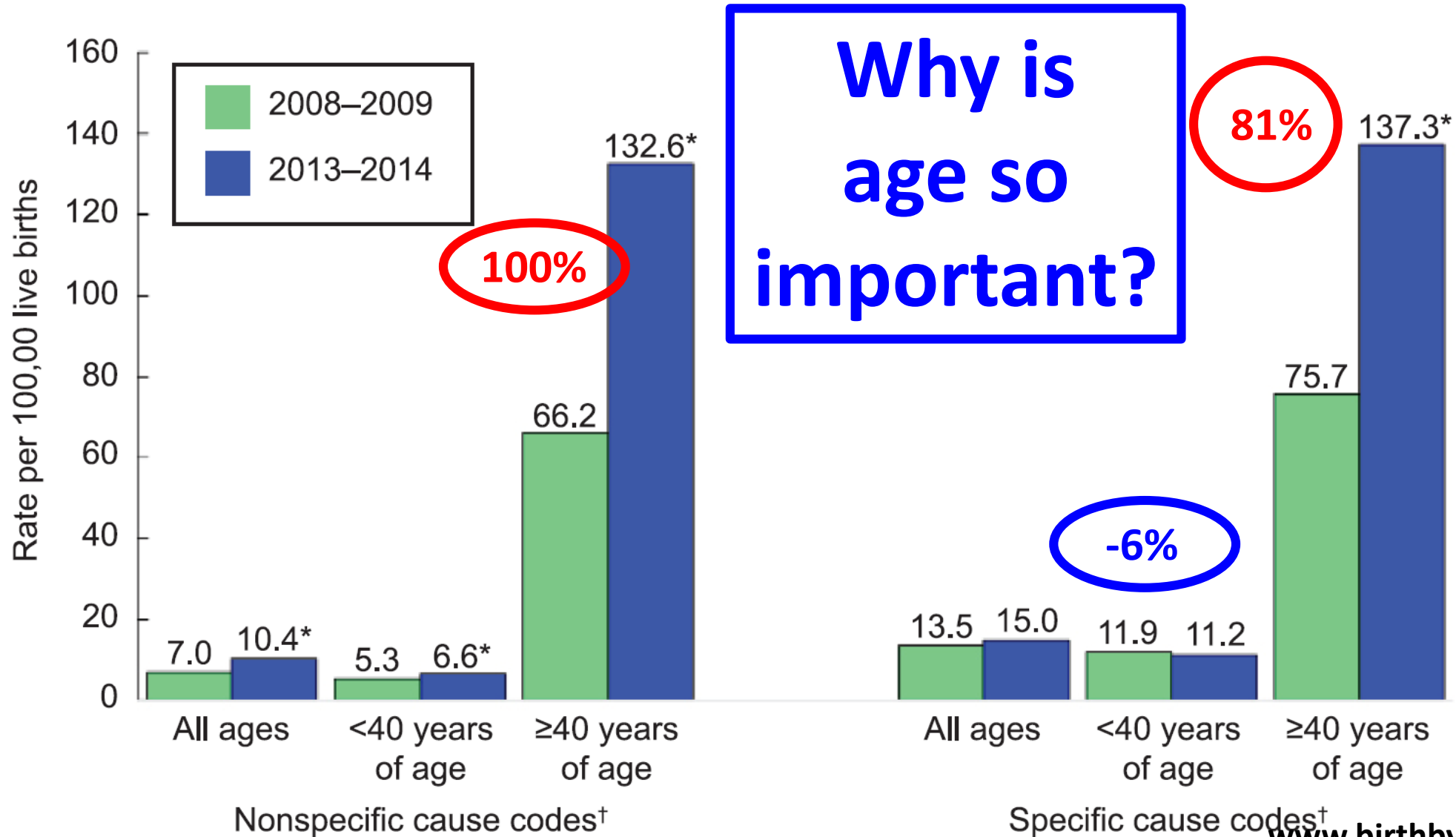
Overall death rates of women 35-44 are 2-3 times higher than those of younger women.

Data lines labeled: 35-44 (green), 25-34 (blue), 15-24 (red), 5-14 (gray). Y-axis: 0 to 250. X-axis: years 1968 to 1998.

Source: National Vital Statistics System, unpublished tables. https://www.cdc.gov/nchs/nvss/mortality/hist290.htm

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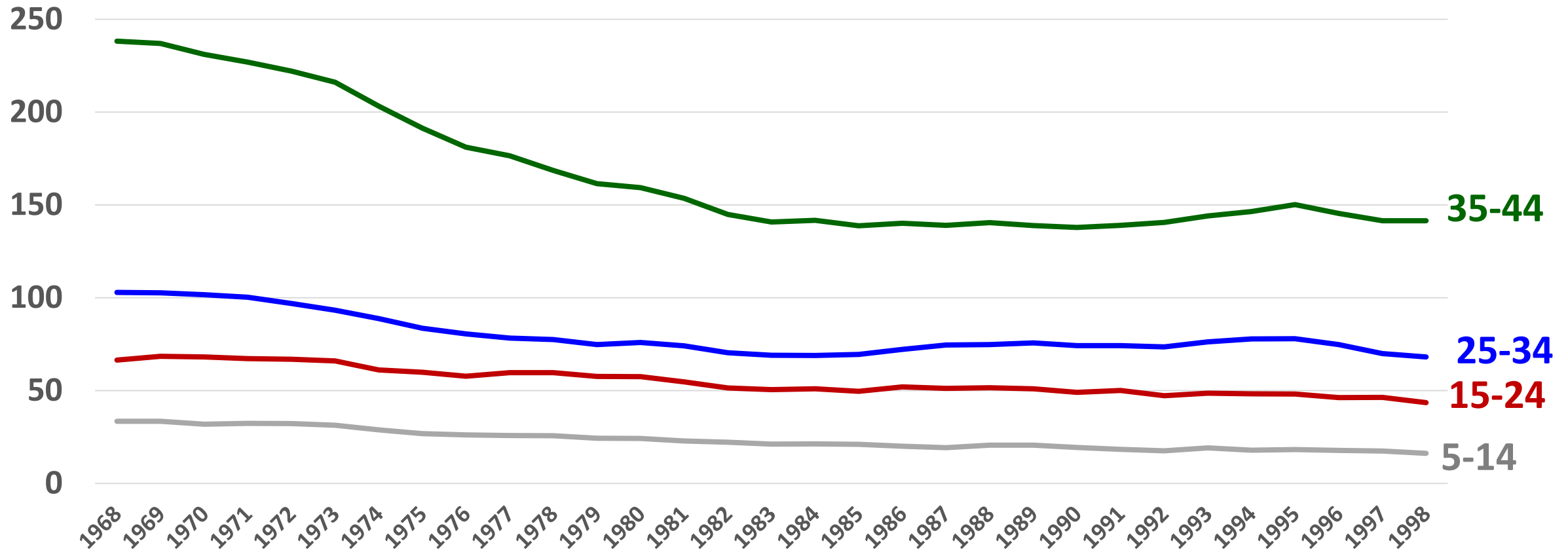
Sensitivity Analysis of Impact of 1% Random Miscoding

Age (y)	No. of Maternal Deaths	No. of Female Deaths From Natural Causes (Excludes Maternal Deaths)	No. of Maternal Deaths With 1% False-Positives Added to Total	% Increase in MMR With 1% False-Positive Rate
Total	907	82,572	1,733	91.0
Younger than 40	618	15,553	774	25.2
15–19	26	929	35	35.7
20–24	119	1,619	135	13.6
25–29	152	2,568	178	16.9
30–34	177	4,092	218	23.1
35–39	144	6,345	207	44.1
40–54	289	67,019	959	231.9

REPORT FROM MATERNAL MORTALITY REVIEW COMMITTEES: A VIEW INTO THEIR CRITICAL ROLE

MMRIA
MATERNAL MORTALITY REVIEW
INFORMATION APP

BUILDING U.S. CAPACITY TO REVIEW AND PREVENT MATERNAL DEATHS

REVIEW to ACTION
WORKING TOGETHER TO PREVENT
MATERNAL MORTALITY

www.birthbythenumbers.org

Impact of the Checkbox – Better _and_ Worse Ascertainment

- The Four Committee data includes a total **_of 650 potentially pregnancy-related deaths. Among these, 97_ (14.9%) _were determined to have no evidence of pregnancy within the year prior to the woman's death_** (neither pregnancy-related nor – associated; false positive pregnancy-associated deaths), and so were excluded from further analysis. The **_predominant reason for these 97 false positives were errors on the death certificate from the pregnancy checkbox_**.

- **_(MMRIA Report 2) 119 of 855 (13.9%) potential pregnancy-related deaths were determined to have not been pregnant_**

Impact of the Checkbox – Better _and_ Worse Ascertainment

- While the checkbox contributed to errors, the Four Committee data show that the **checkbox also improved identification of pregnancy-related deaths**. **_Without the pregnancy checkbox, approximately 50% of pregnancy-related deaths that occurred during pregnancy and 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 would have been missed._**

Real potential for over-ascertainment, though unlikely it accounts for the increases which are seen across all settings and even the most conservative measures show the U.S. faring poorly in international comparisons.

How do these findings vary by race/ethnicity?

Disparities in Maternal Mortality

	2007 Official MMR		2011-13 Pregnancy Related Mortality Adjusted for MMR	
Category	Ratio	Category	Ratio
All	12.7	All	14.8
Non-Hispanic white	10.5	White	11.3
Non-Hispanic black	28.4	Black	36.2
Hispanic	8.9	Hispanic	10.0
Black-White ratio	**2.7**		**3.2**

Note consistently better performance for Hispanic mothers

Interracial Differences

Where would estimated rates leave the U.S. in international comparisons?

Hispanic   10.0 (Lithuania 10/Portugal 10)

NH White   11.3 (Bulgaria 11/S. Korea 11)

NH Black   36.2 (Uzbekistan 36/ Mexico 38)

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

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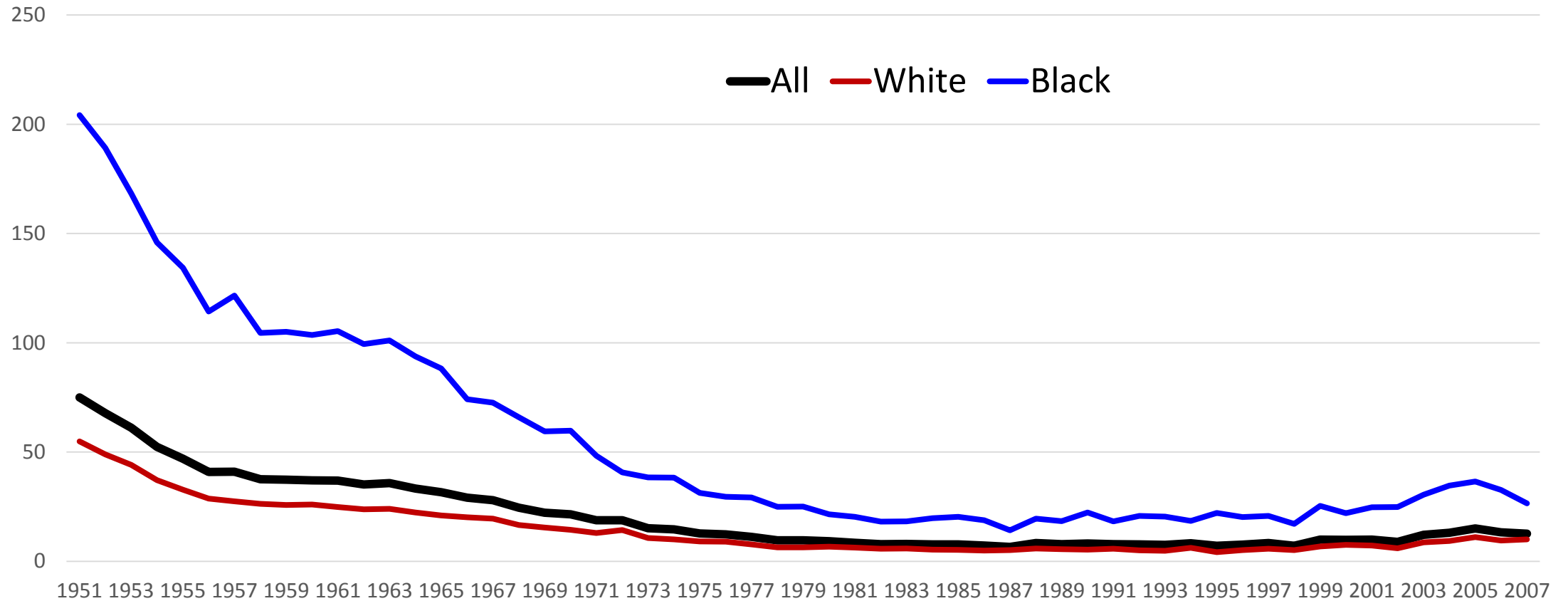
U.S. Infant & Maternal Mortality Black to White Ratios of 1980-2014
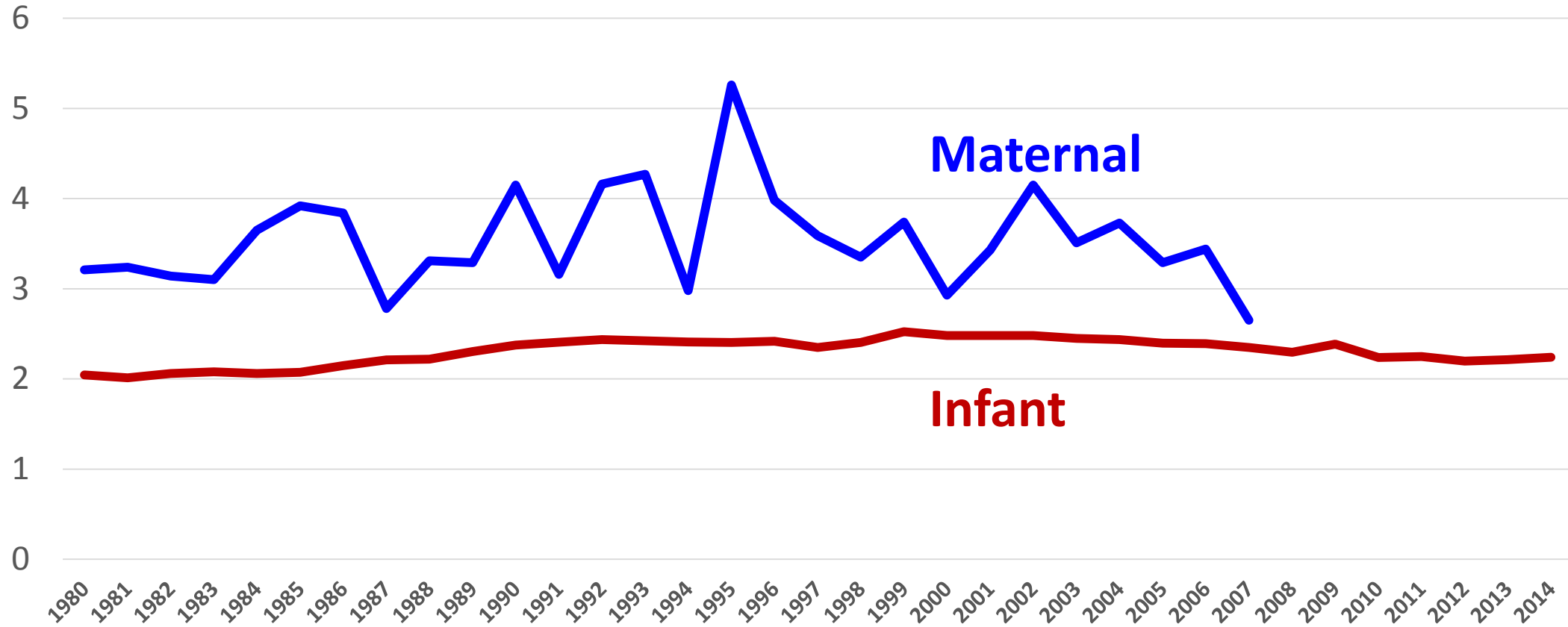
Maternal

Infant

Why is disparity greater for maternal mortality than infant mortality?

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Variation in Medicaid Eligibility by Pregnancy Status
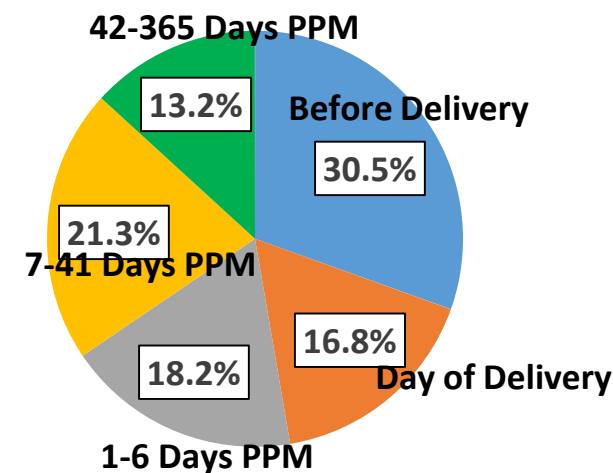
As of 1/1/17	Medicaid Eligibility	
	Pregnancy	Adult in Family
Alabama	146%	18%
California	213%	138%
Florida	196%	33%
Georgia	225%	37%
Iowa	380%	138%
Louisiana	214%	138%
Maine	214%	105%
Massachusetts	205%	138%
New Hampshire	205%	138%
New York	223%	138%
Ohio	205%	205%
Pennsylvania	220%	138%
Texas	203%	18%
Wisconsin	306%	100%

Pie chart:
- 42-365 Days PPM: 13.2%
- Before Delivery: 30.5%
- Day of Delivery: 16.8%
- 1-6 Days PPM: 18.2%
- 7-41 Days PPM: 21.3%

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

Private or other

Medicaid or CHIP

No insurance

Months before delivery

Months after delivery

FOR ALL CHILDBEARING WOMEN AND INFANTS

FOR CHILDBEARING WOMEN AND INFANTS WITH COMPLICATIONS

Practice categories

| Education Information Health promotion | Assessment Screening Care planning | Promoting normal processes, preventing complications | First line management of complications | Medical obstetric neonatal services |

Organization of care

Available, accessible, acceptable, good quality services - adequate resources, competent workforce
Continuity, services integrated across community and facilities

Values

Respect, communication, community knowledge
Care tailored to women's circumstances and needs

Philosophy

Optimising biological, psychological, social and cultural processes, expectant management,
using interventions only when indicated, strengthening woman's capabilities

Care providers

Practitioners who combine clinical knowledge and skills with interpersonal and cultural competence -
division of roles and responsibilities based on need, competencies, resources

Source: Lancet, 2014. 384: 1129–45

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Conclusions

- Maternal mortality may be rising at a slower rate than thought, but largely because the earlier rates may have underestimated the actual number of maternal deaths.

- We don't actually know what the exact national rate is & won't until we standardize measurement across all states (2018?).

- Maternal deaths in the U.S. by any measure appear to be rising in contrast to most of the rest of the world, resulting in the U.S. ranking declining in international comparisons.

Conclusions

- There are wide disparities by race/ethnicity, HOWEVER, even if we limit comparisons of whites to other countries, the U.S. still fares poorly in international comparisons.

- Deaths for unspecified causes needs more examination, particularly among older mothers

- The solution to the problem involves a commitment to improved clinical care, but also better public health system improvements for all women, not just those who are pregnant.

Conclusions

- *There is currently a major media focus on maternal mortality. This is a unique opportunity for MMRCs to influence the national discussion about the need to improve women's health in general.*

- *The current focus on maternal death won't last. There is an urgency to the work we do in moving the public debate to better systems to support the health needs of women of reproductive age.*

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