

Infant and Maternal Mortality in the US: Data from the National Vital Statistics System

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Outline

- About the data
- Fetal mortality (stillbirth)
- Infant mortality
 - Trends, selected variables, cause of death
 - Relationship to preterm birth
 - Race and ethnic differences
 - International comparisons
- Maternal mortality

National Vital Statistics System

- Based on birth certificates, death certificates, and reports of fetal death filed in state vital statistics offices, and transmitted to NCHS.
- National data files produced:
 - Birth (natality) data set
 - Main mortality file
 - Linked birth/infant death data set
 - Links birth and death certificate data for all infant deaths.
 - Purpose: To use more detailed data from the birth certificate for infant mortality analysis.
 - Fetal death data reported by all US states
 - Most states report fetal deaths of 20 weeks of gestation or more.
 - Some variability in data completeness and quality.

National Vital Statistics System

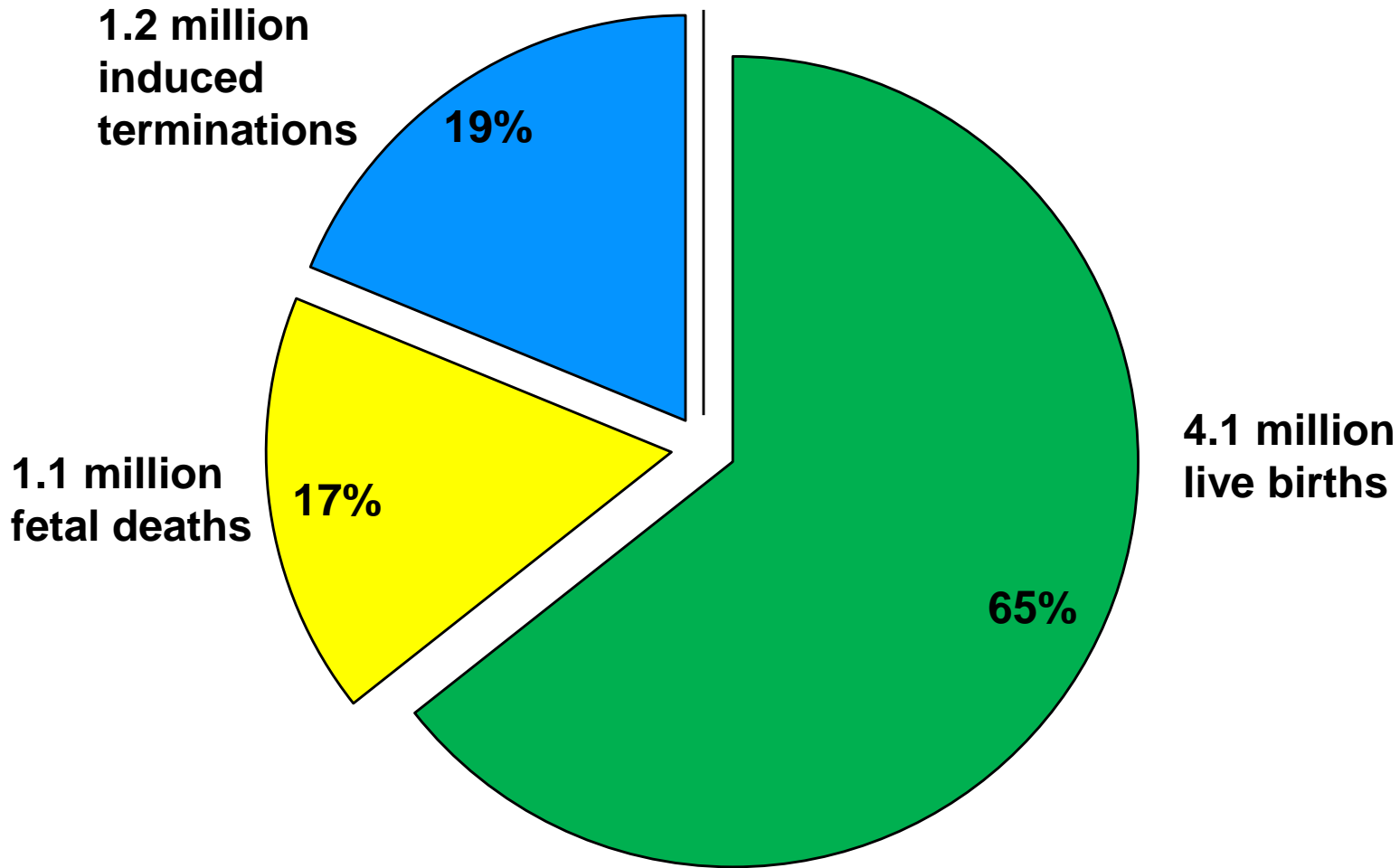
– Analytical Challenges

- Certificate revision in 2003, but not all states have adopted
- Some items not comparable between old and new versions of the certificates
- Timeliness of data file availability is highly variable
 - Preliminary birth and death certificate data now available through 2009
 - Linked birth/infant death data through 2007
 - Fetal death data through 2005
- NCHS is working to catch up on data production in a limited resource climate.

Fetal Mortality

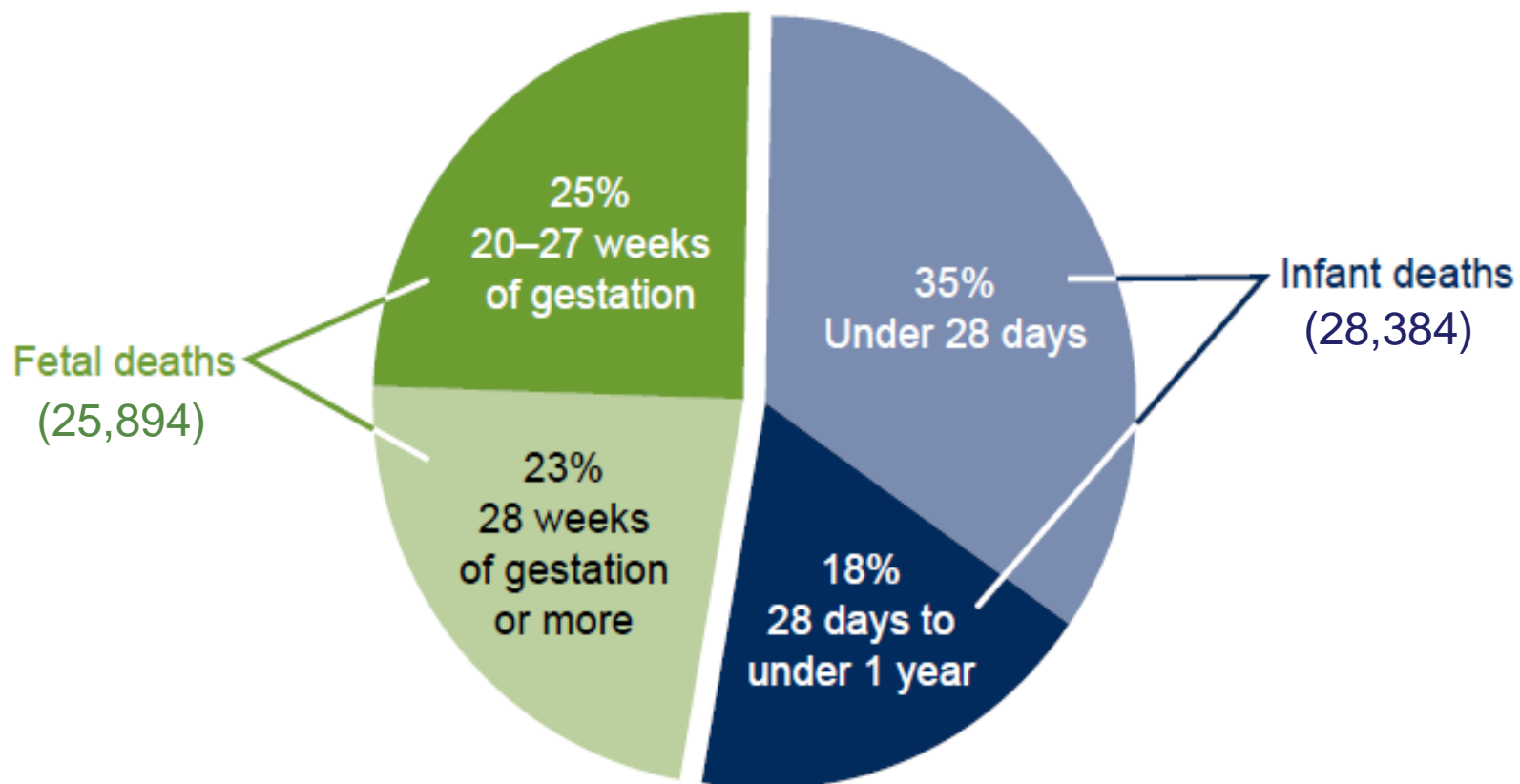
All pregnancies, US, 2005

(n=6.4 million pregnancies)



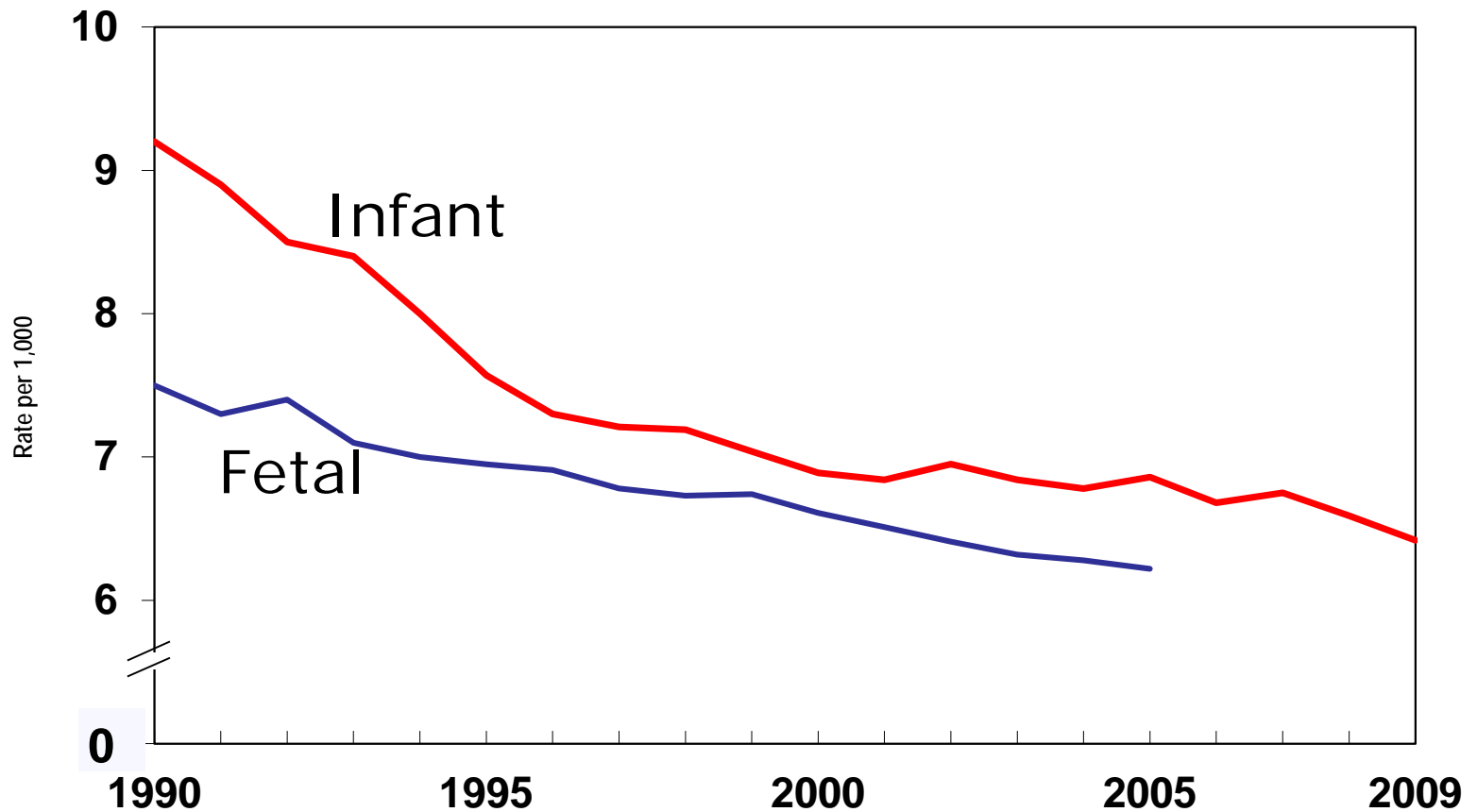
Source: Ventura SJ, Abma JC, Mosher WD. Estimated pregnancy rates for the United States, 1990-2005: An Update. National vital statistics reports vol 58 no 4. 2009.

Figure 1. Relative magnitude of fetal deaths of 20 weeks of gestation or more, and infant deaths: United States, 2005



SOURCE: CDC/NCHS, National Vital Statistics System.

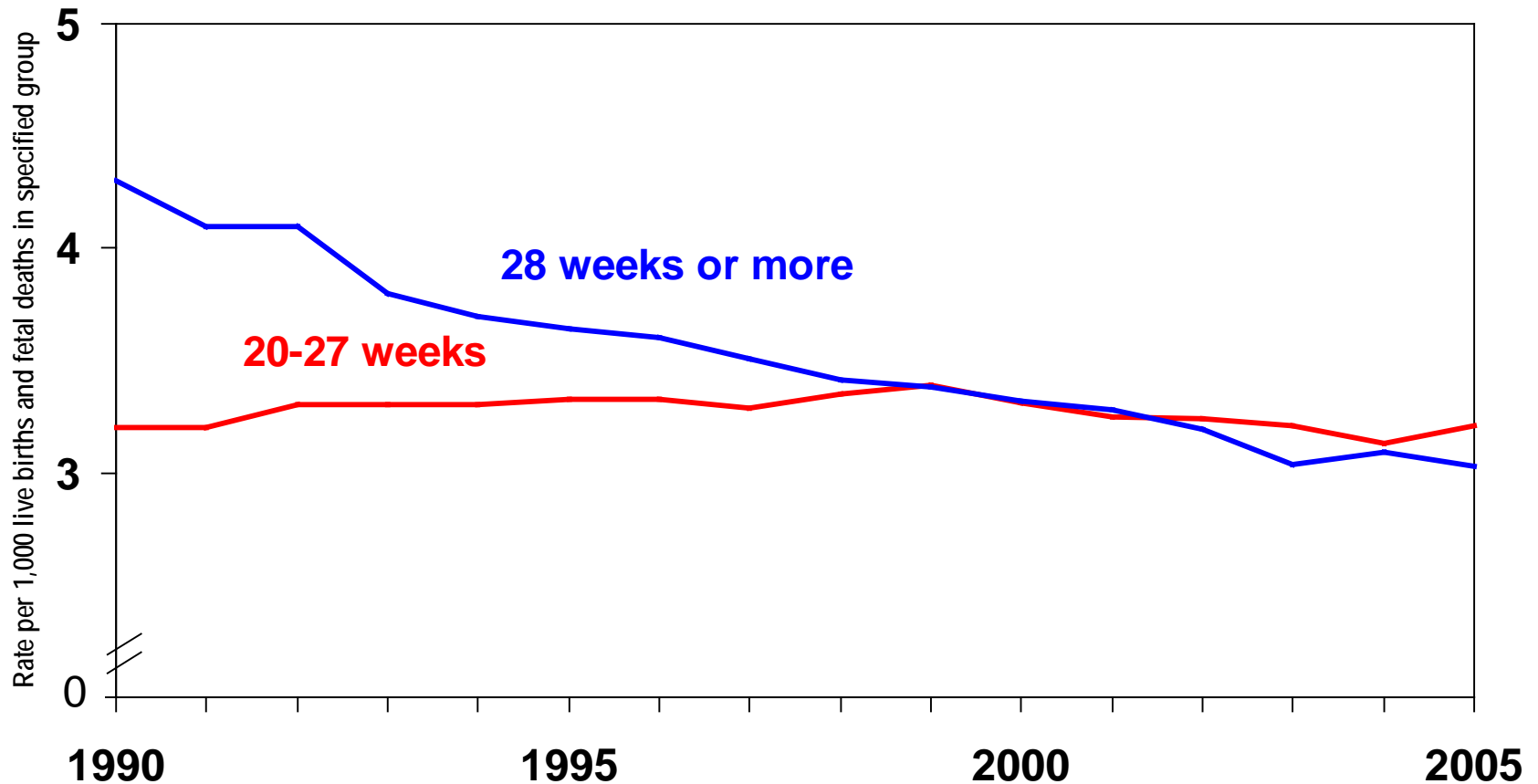
Fetal mortality rate 1990-2005, and infant mortality rate, 1990-2009



NOTE: Infant mortality rates are the number of infant deaths per 1,000 live births. 2007 data are preliminary. Fetal mortality rates are the number of fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths.

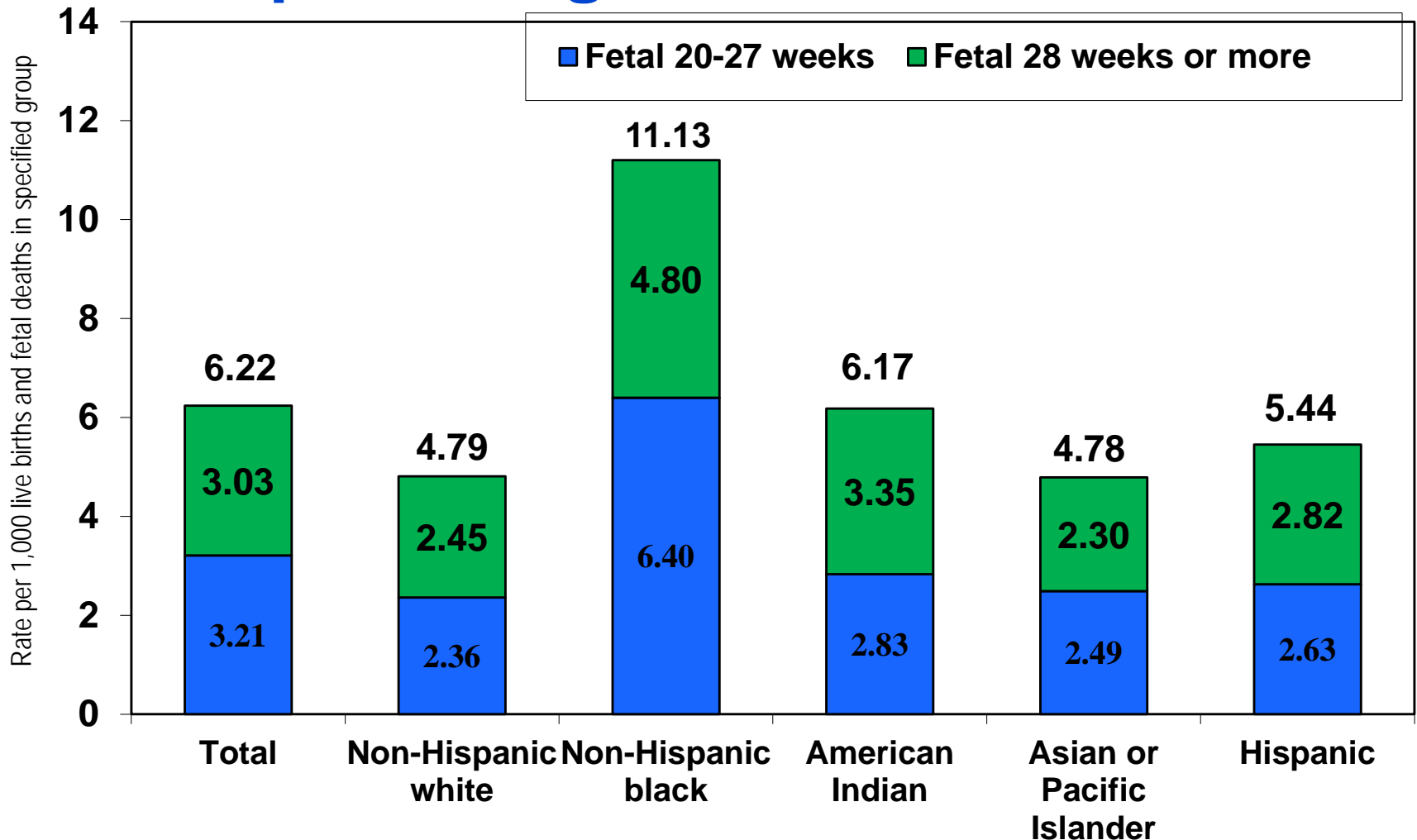
SOURCE: CDC/NCHS, National Vital Statistics System.

Fetal mortality rates by period of gestation: US, 1990-2005



SOURCE: MacDorman MF and Kirmeyer S. Fetal and perinatal mortality, US, 2005. National vital statistics reports vol 57 no 8.

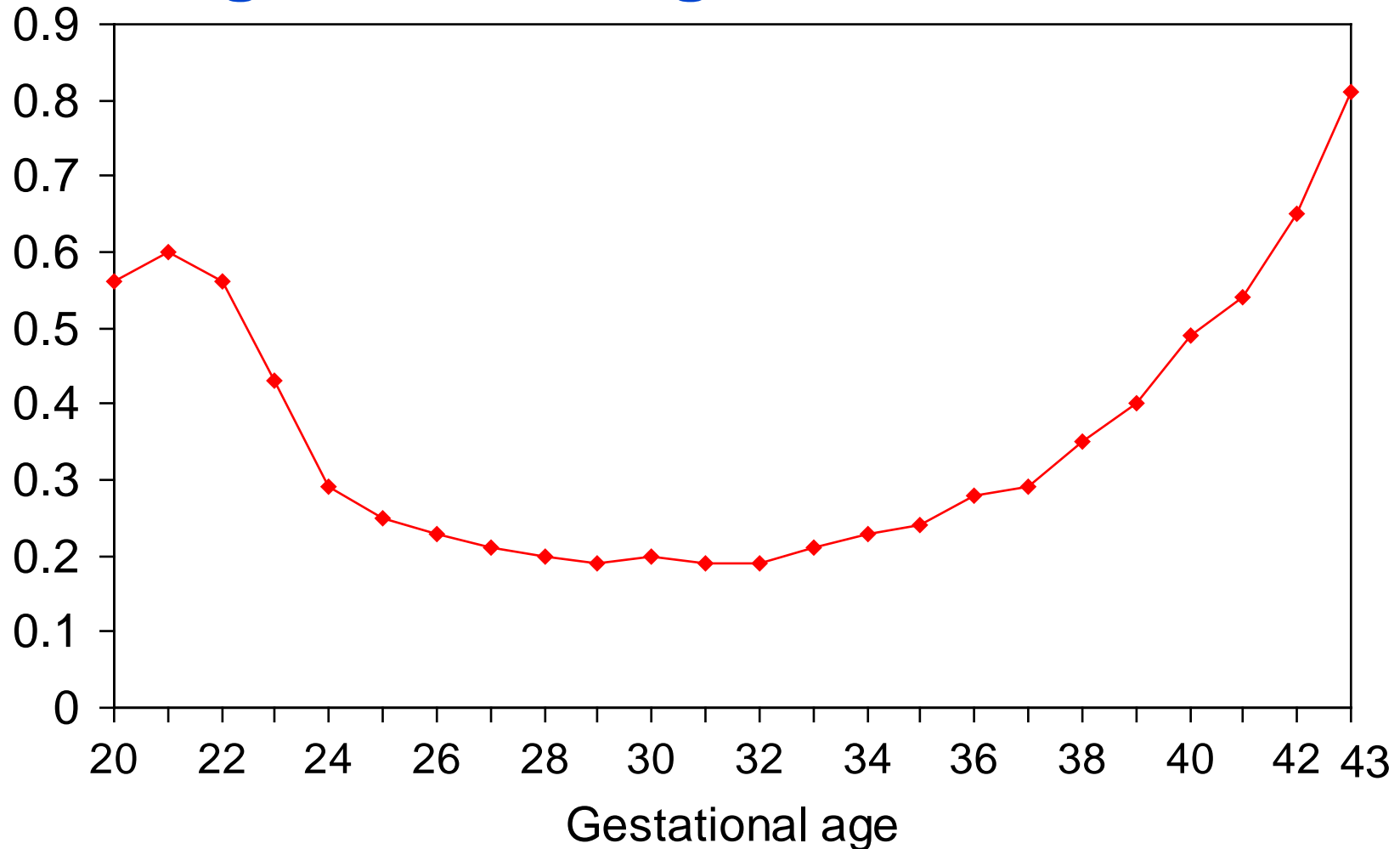
Fetal mortality rates by race and Hispanic origin of mother: US, 2005



NOTE: Rates for subtotals do not add exactly to totals due to slight differences in the denominators used for rate computations; see Technical notes.

SOURCE: Fetal and perinatal mortality, US, 2005. National vital statistics reports vol 57 no 8.

Prospective fetal mortality rate by single weeks of gestation: US, 2005



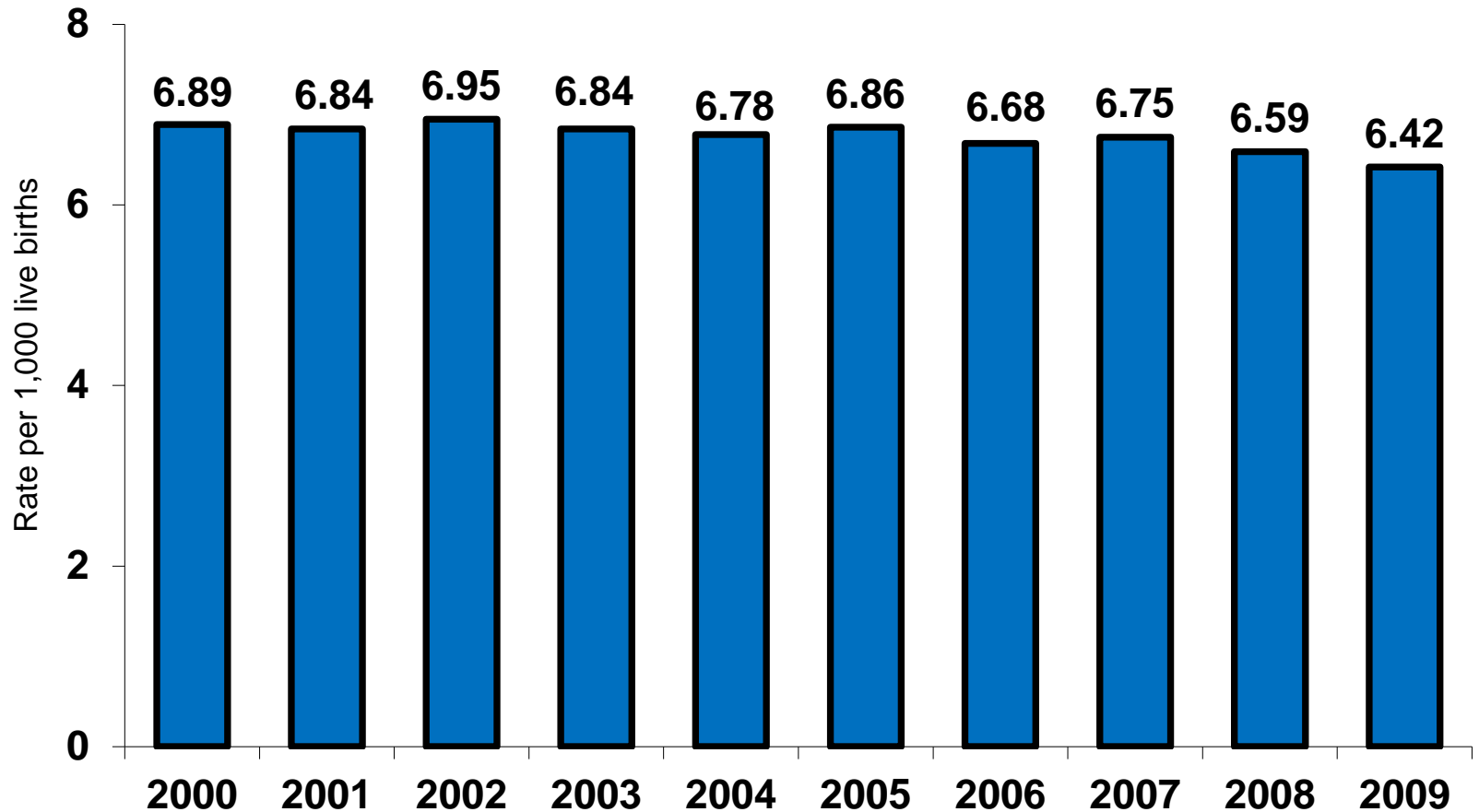
Note: The prospective fetal mortality rate is the number of fetal deaths at a given gestational age per 1,000 live births and fetal deaths at that gestational age or greater.

Source: MacDorman MF, Kirmeyer S. Fetal and perinatal mortality, US, 2005. National vital statistics reports vol 57 no 8.

Infant Mortality:

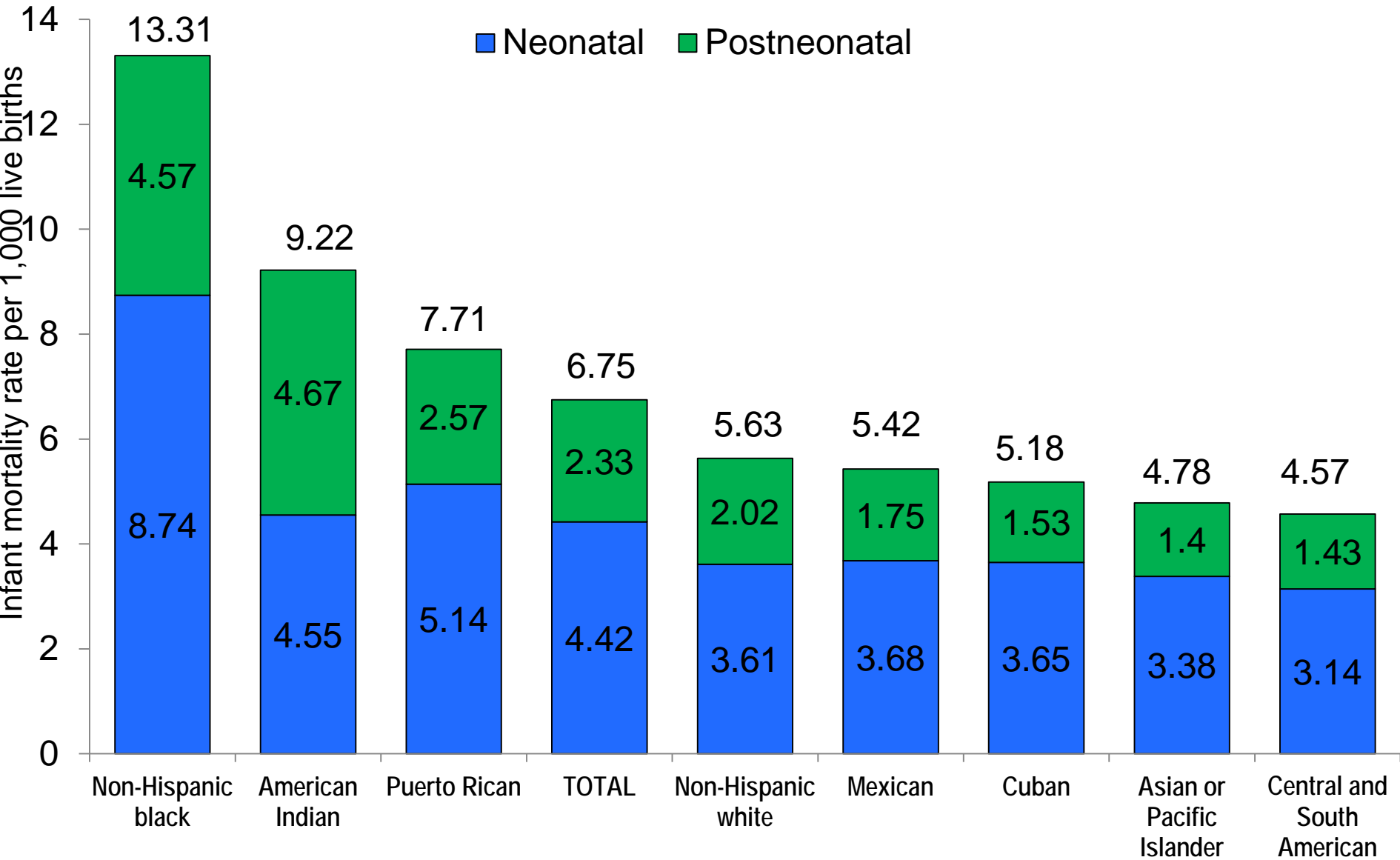
Trends and selected variables

Infant mortality rate, United States, 2000-2009



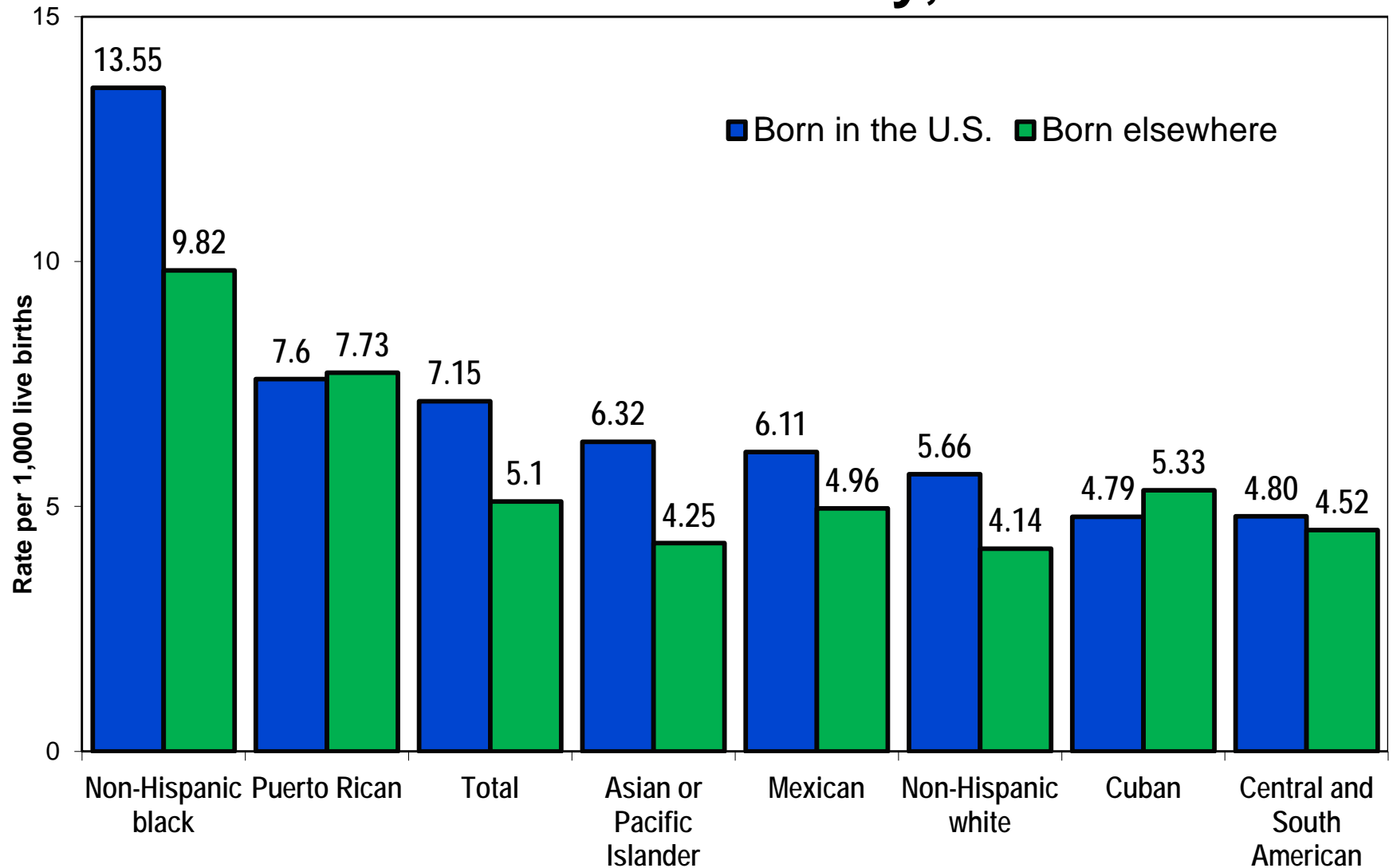
Source: 2000-2007 data are from the linked birth/infant death data sets. 2008 and 2009 data are preliminary data from the main mortality files.

Infant mortality rates by maternal race and ethnicity, 2007



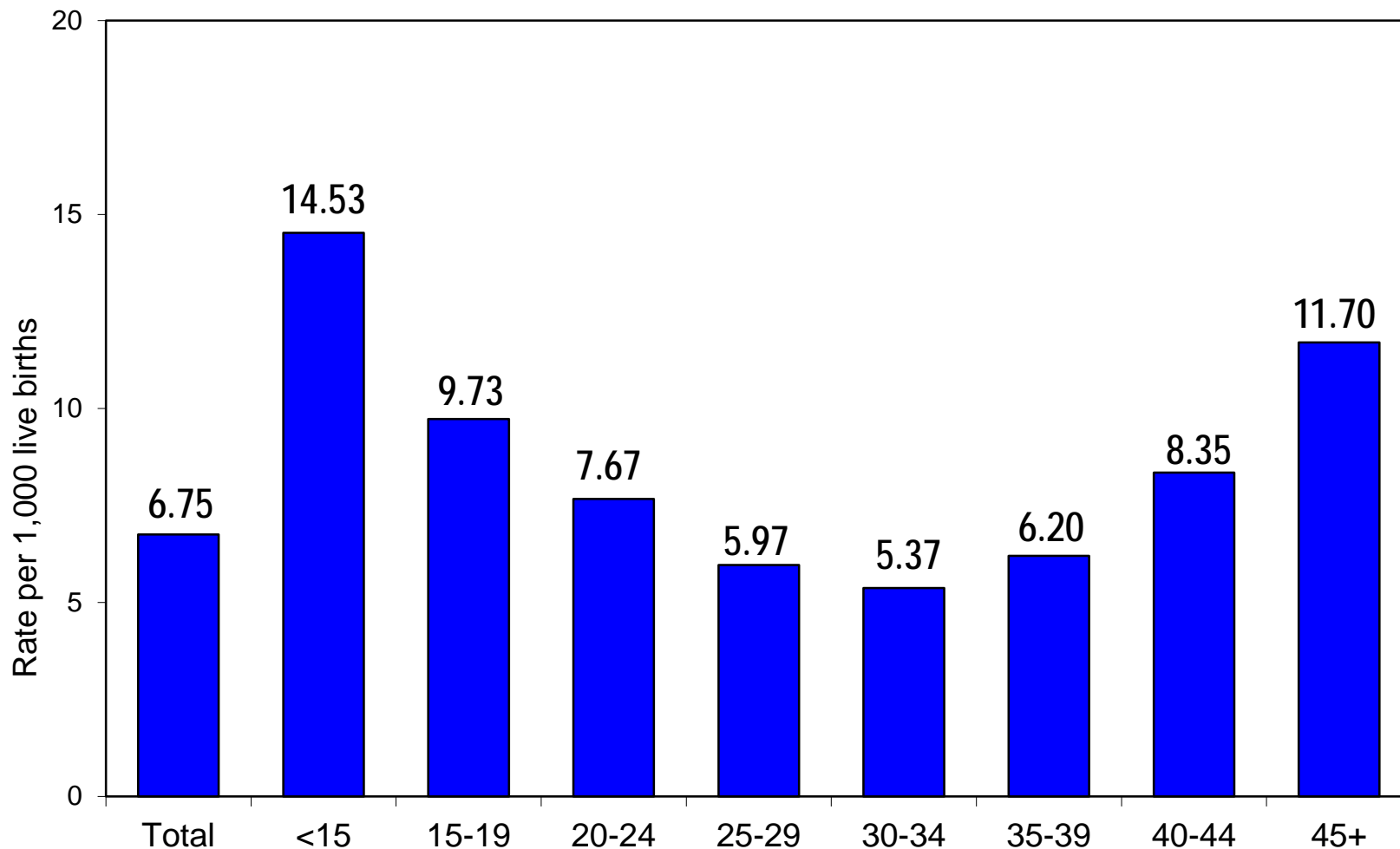
Source: NCHS linked birth/infant death data set, 2007

Infant mortality rates by mother's place of birth and race/ethnicity, 2007



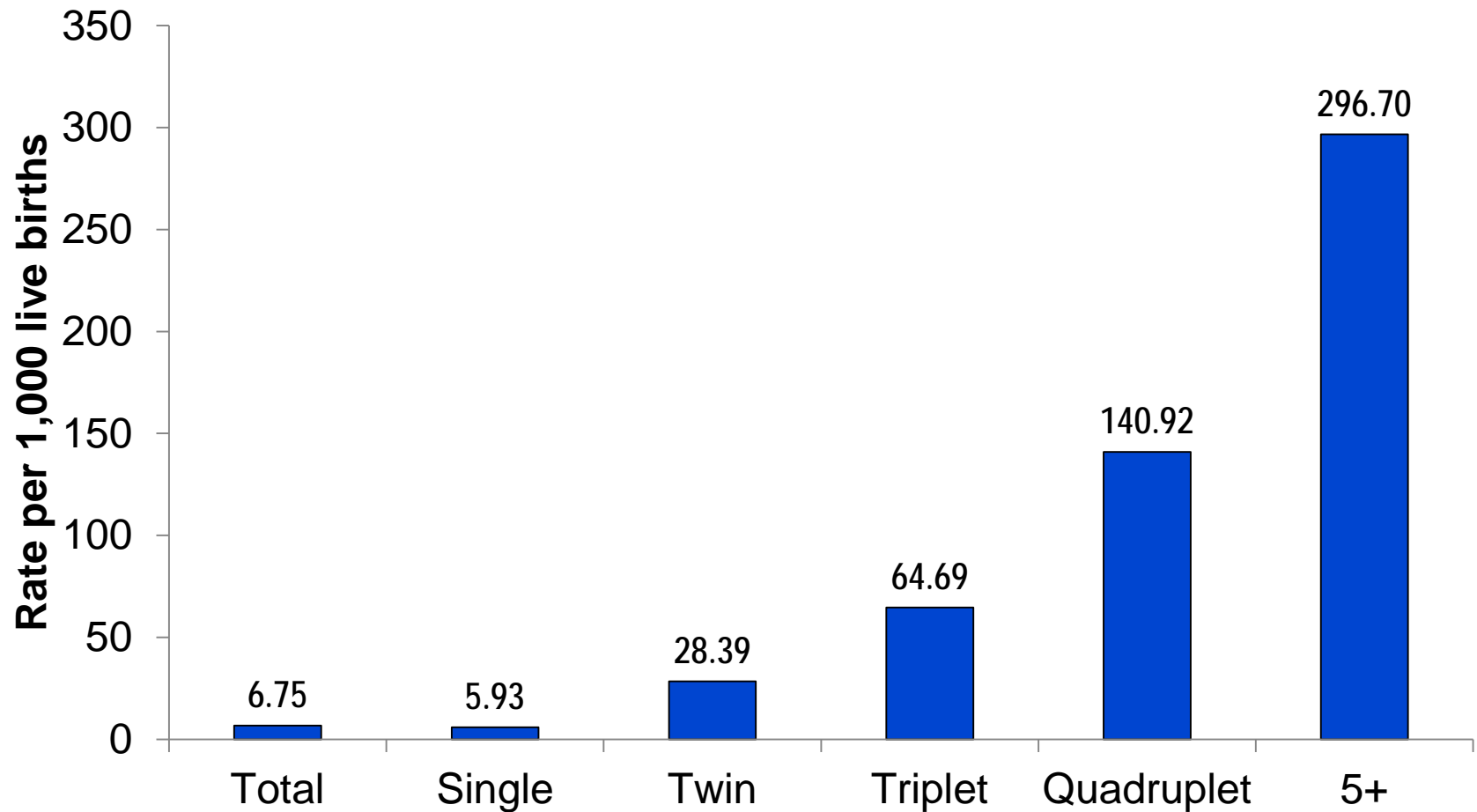
Source: NCHS, linked birth/infant death data set, 2007

Infant mortality rates by maternal age, US, 2007



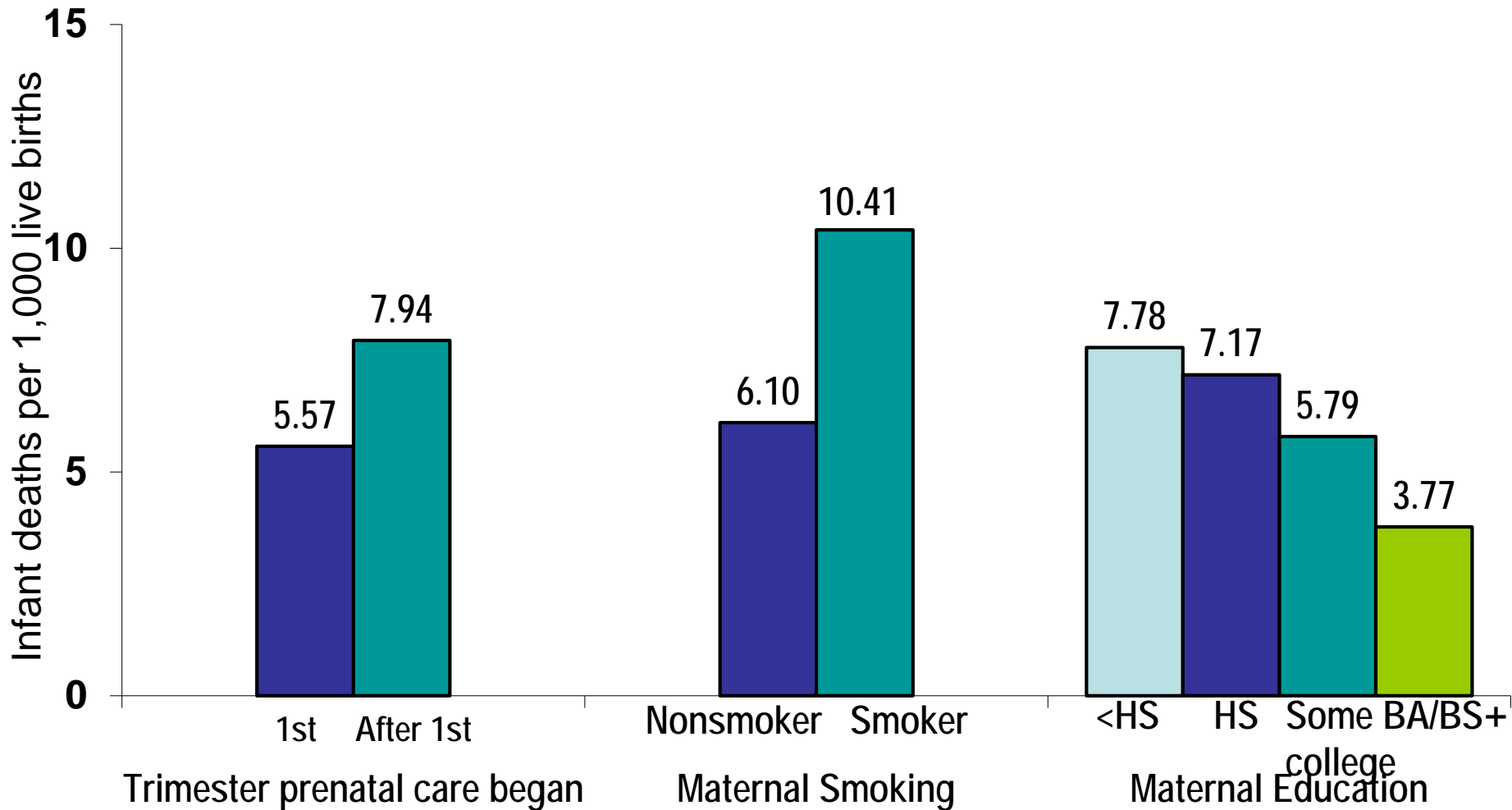
Source: NCHS, linked birth/infant death data set, 2007.

Infant mortality rates by plurality, 2007



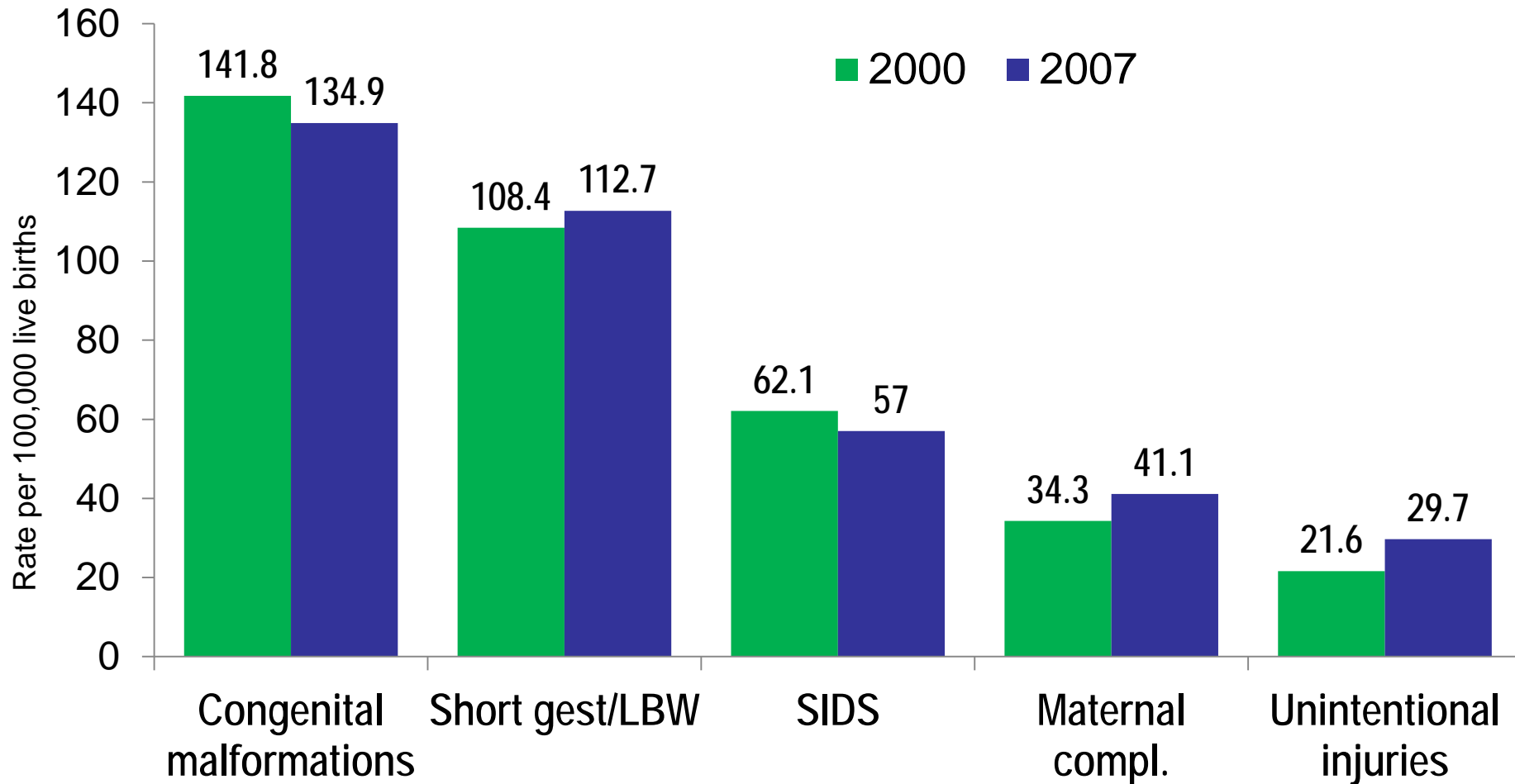
Source: CDC/NCHS linked birth/infant death data set, 2007

Infant mortality rates by selected variables: 19 states, 2007



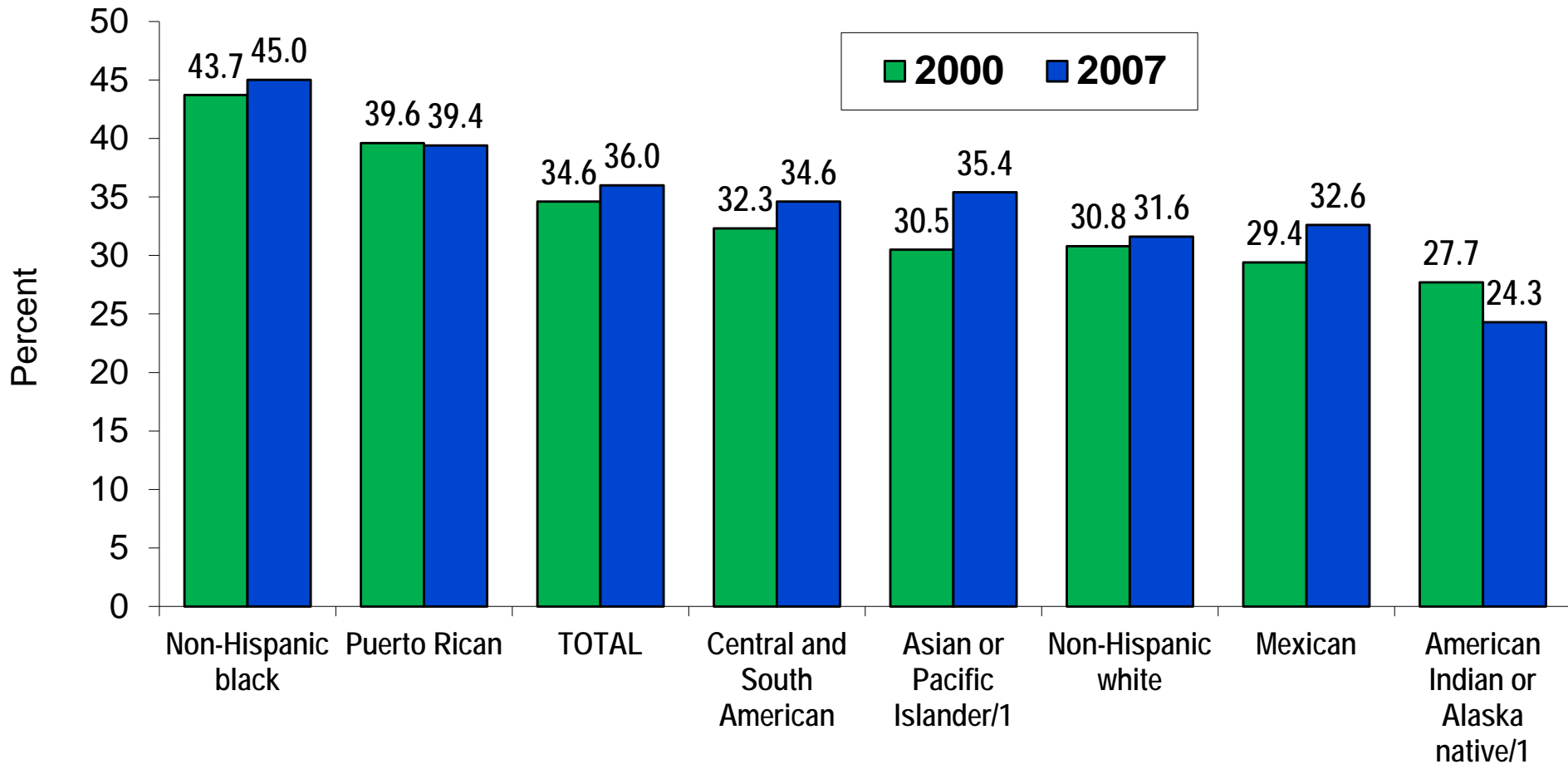
Source: NCHS, linked birth/infant death data set

Infant mortality rates by leading causes of death, US, 2000 and 2007



Source: NCHS, linked birth/infant death data set.

Percentage of Infant Deaths from Preterm-Related Causes* by Race/Ethnicity, US, 2000 and 2007

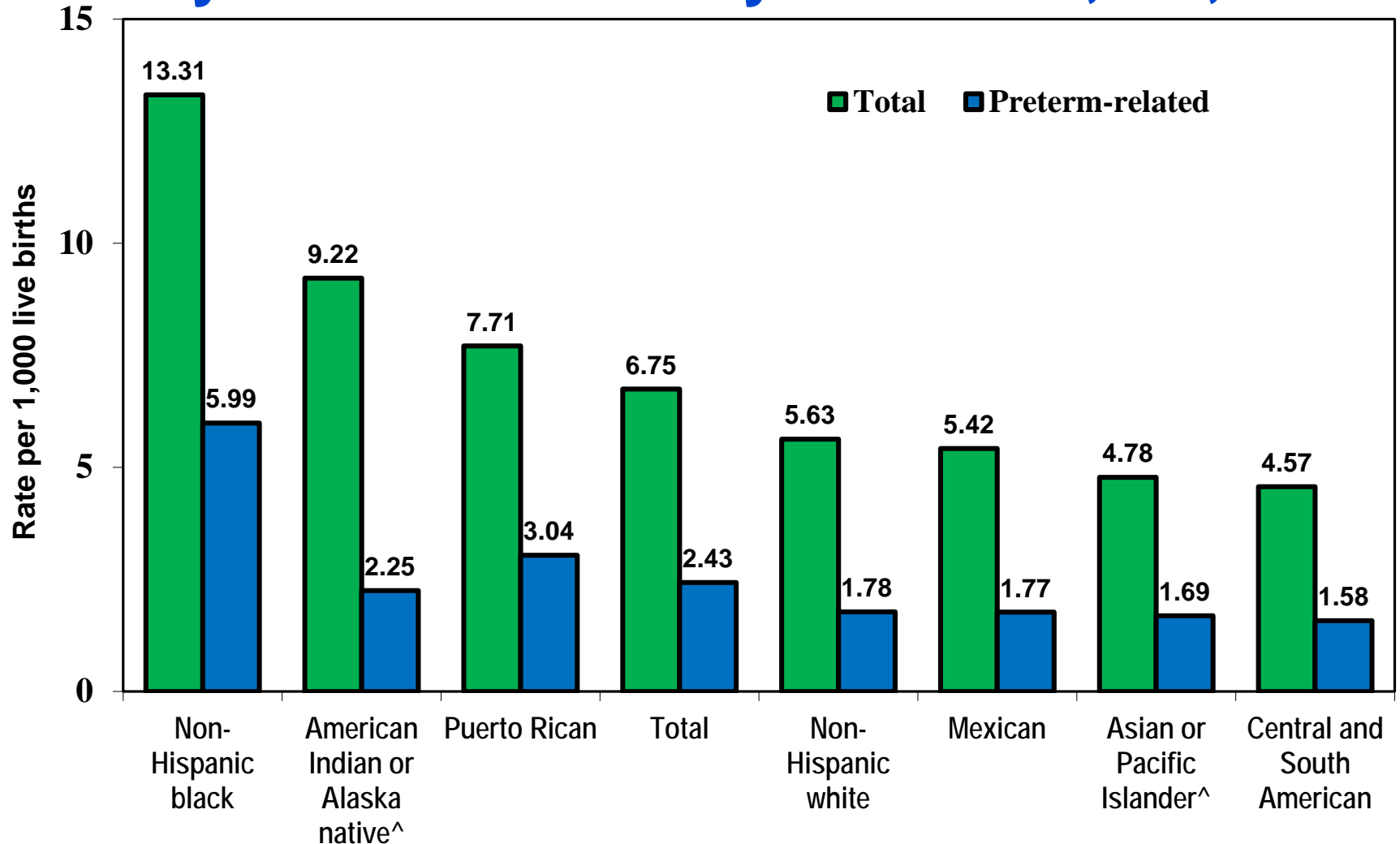


* Infants born at <37 weeks of gestation with cause of death that was a direct cause or consequence of preterm birth (ICD-10 codes K550, P000, P010, P011, P015, P020, P021, P027, P070-P073, P102, P220-P229, P250-279, P280, P281, P360-P369, P520-P523, P77).

1/ Includes persons of Hispanic and non-Hispanic origin.

SOURCE: NCHS, linked birth/infant death data set.

Total and preterm-related* infant mortality rates by race and ethnicity of mother, US, 2007

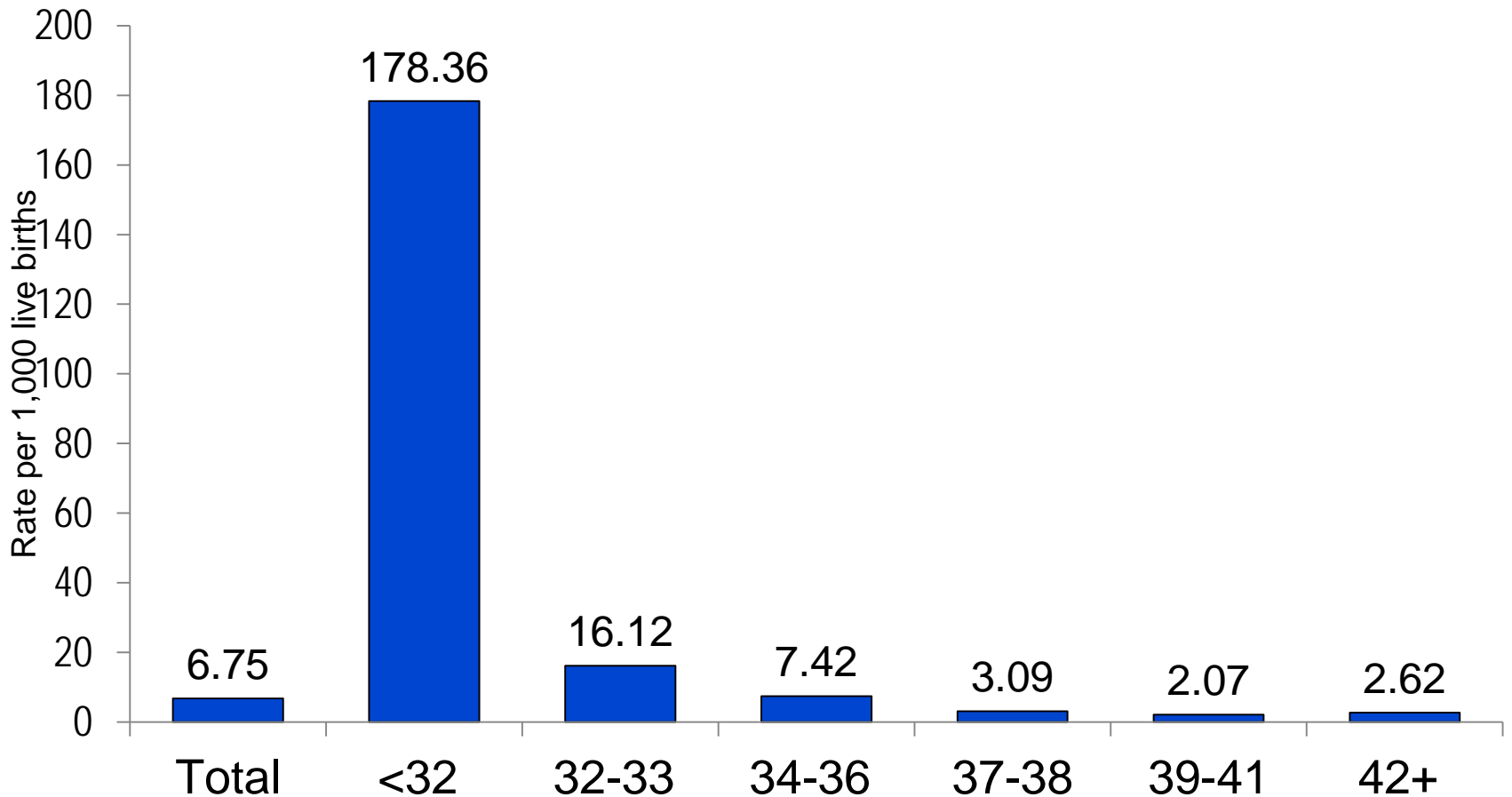


* Preterm-related deaths are those where the infant was born preterm with the underlying cause of death assigned to one of the following ICD-10 categories: K550, P000, P010, P011, P015, P020, P021, P027, P070-P073, P102, P220-P229, P250-279, P280, P281, P360-P369, P520-P523, P77.

^Includes persons of Hispanic and Non-Hispanic origin. SOURCE: NCHS linked birth/infant death data set, 2007

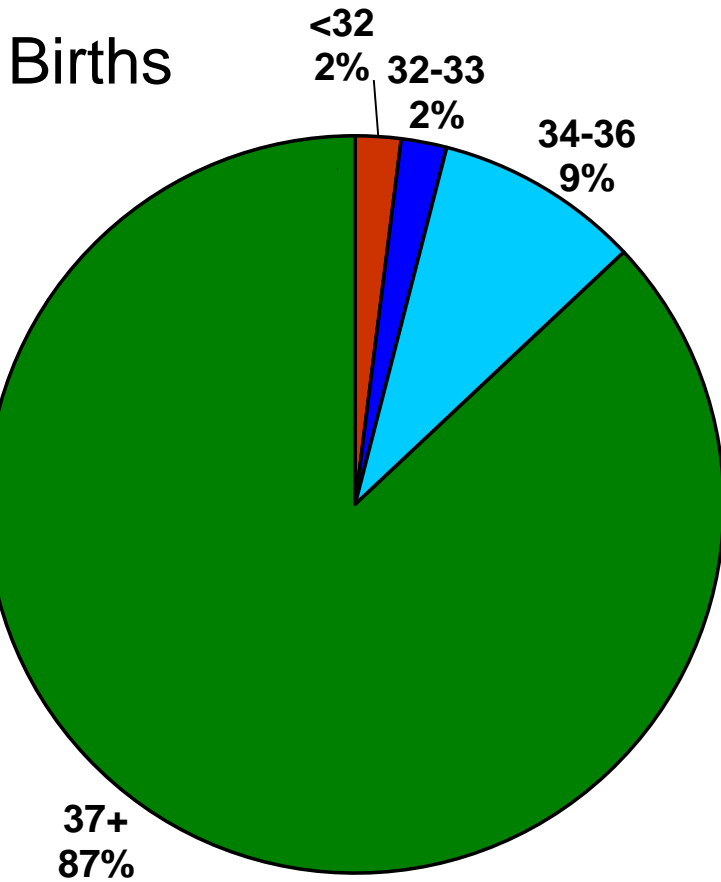
Infant Mortality and Preterm Birth

Infant mortality rates by gestational age (in weeks), US, 2007

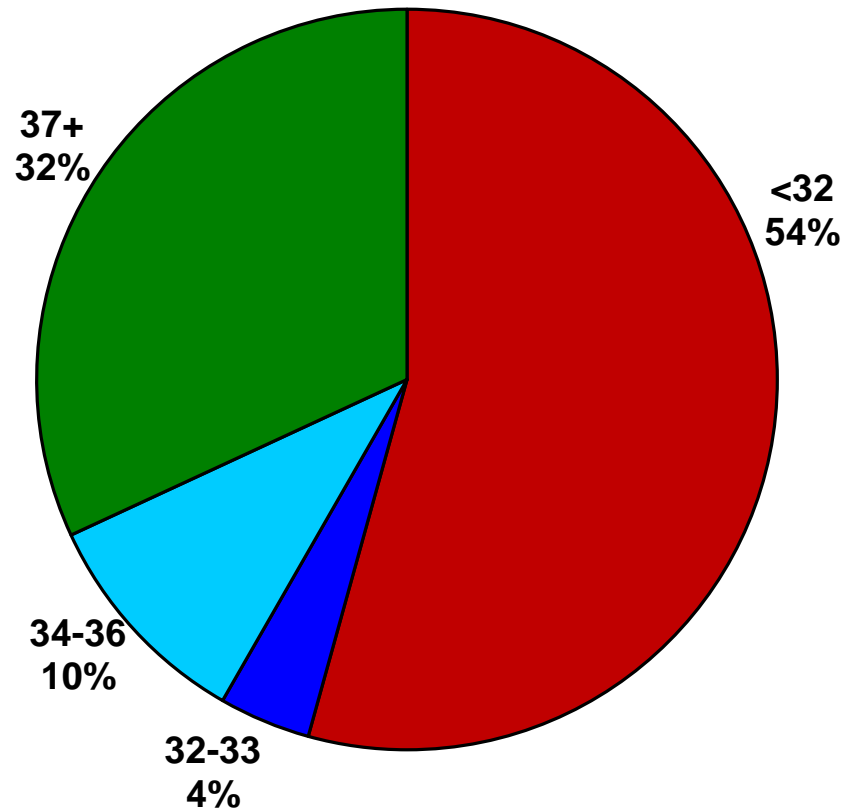


Source: NCHS, linked birth/infant death data set.

Percent of live births and infant deaths by weeks of gestation, US, 2007

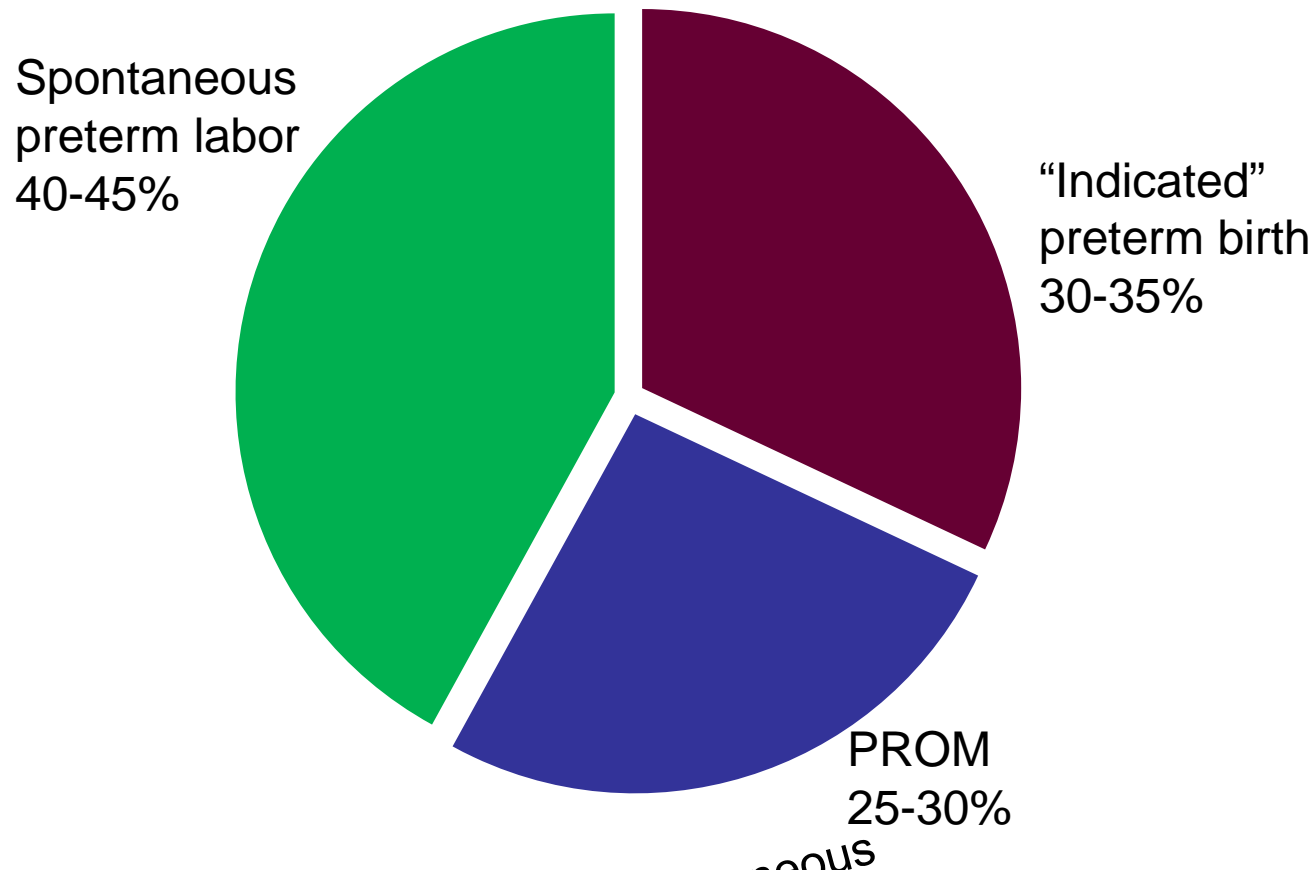


Infant Deaths



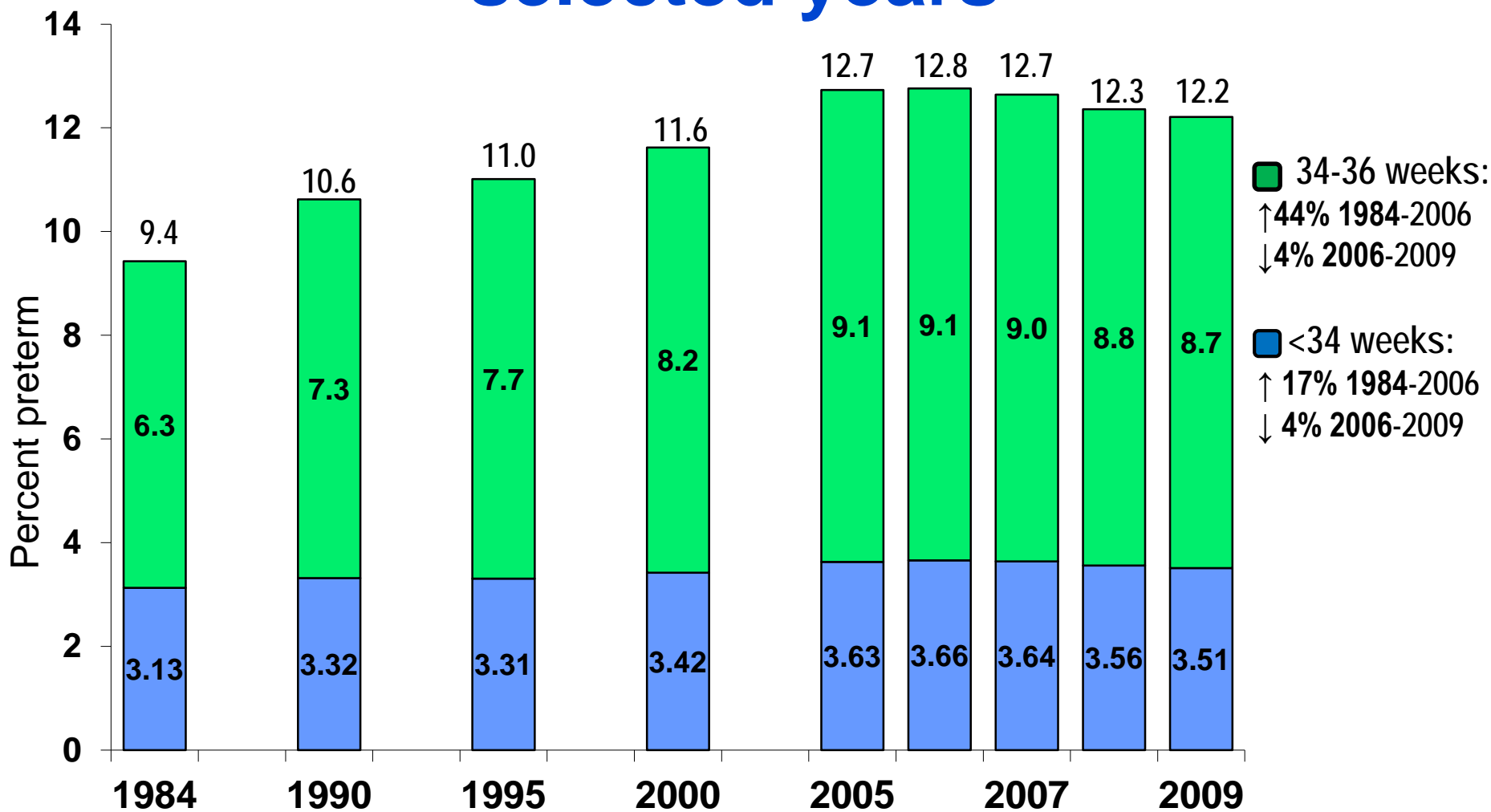
Source: NCHS, linked birth/infant death data set

Components of preterm birth



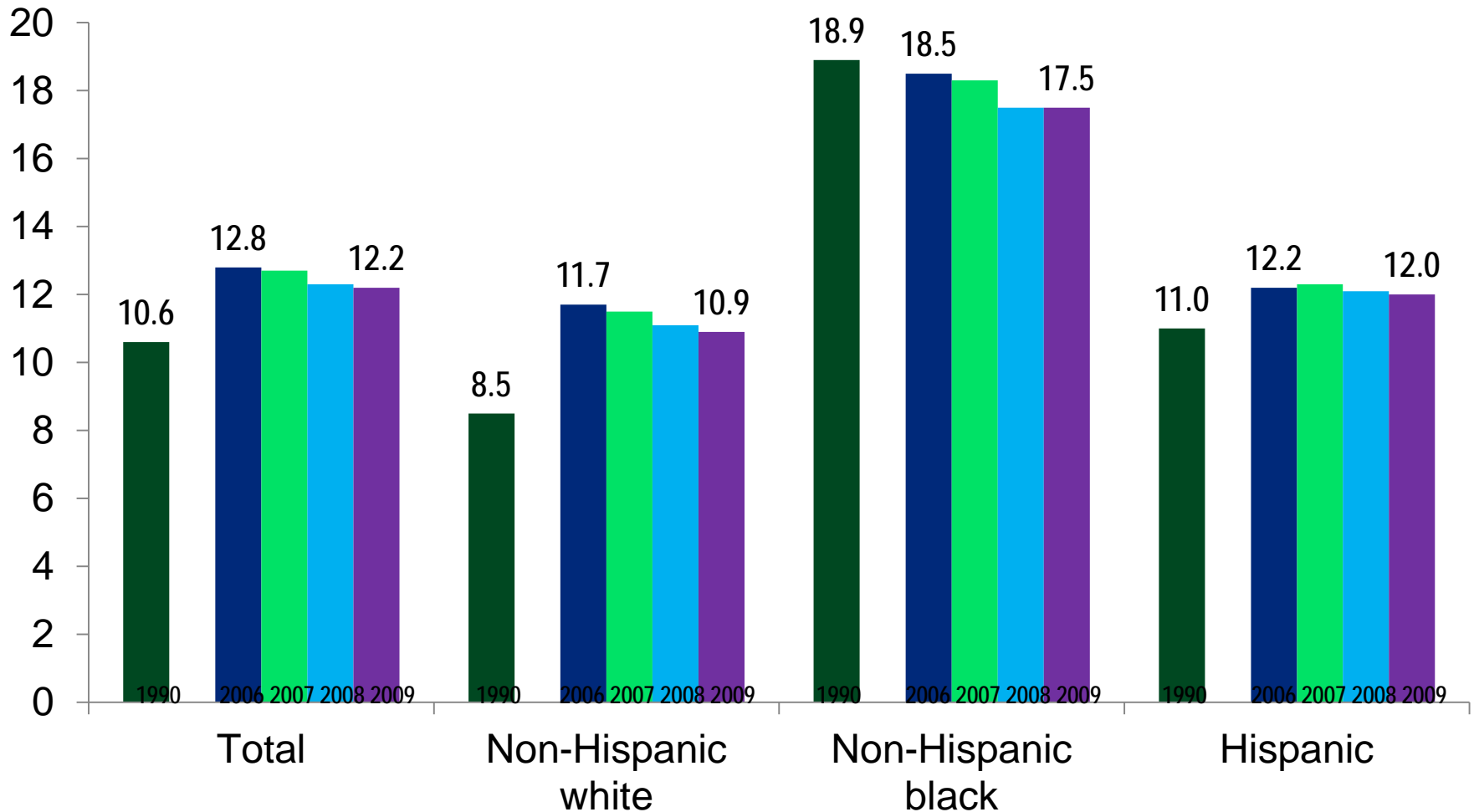
Source: Goldenberg et al. *Lancet*, 2008.

Percentage of preterm births: US, selected years



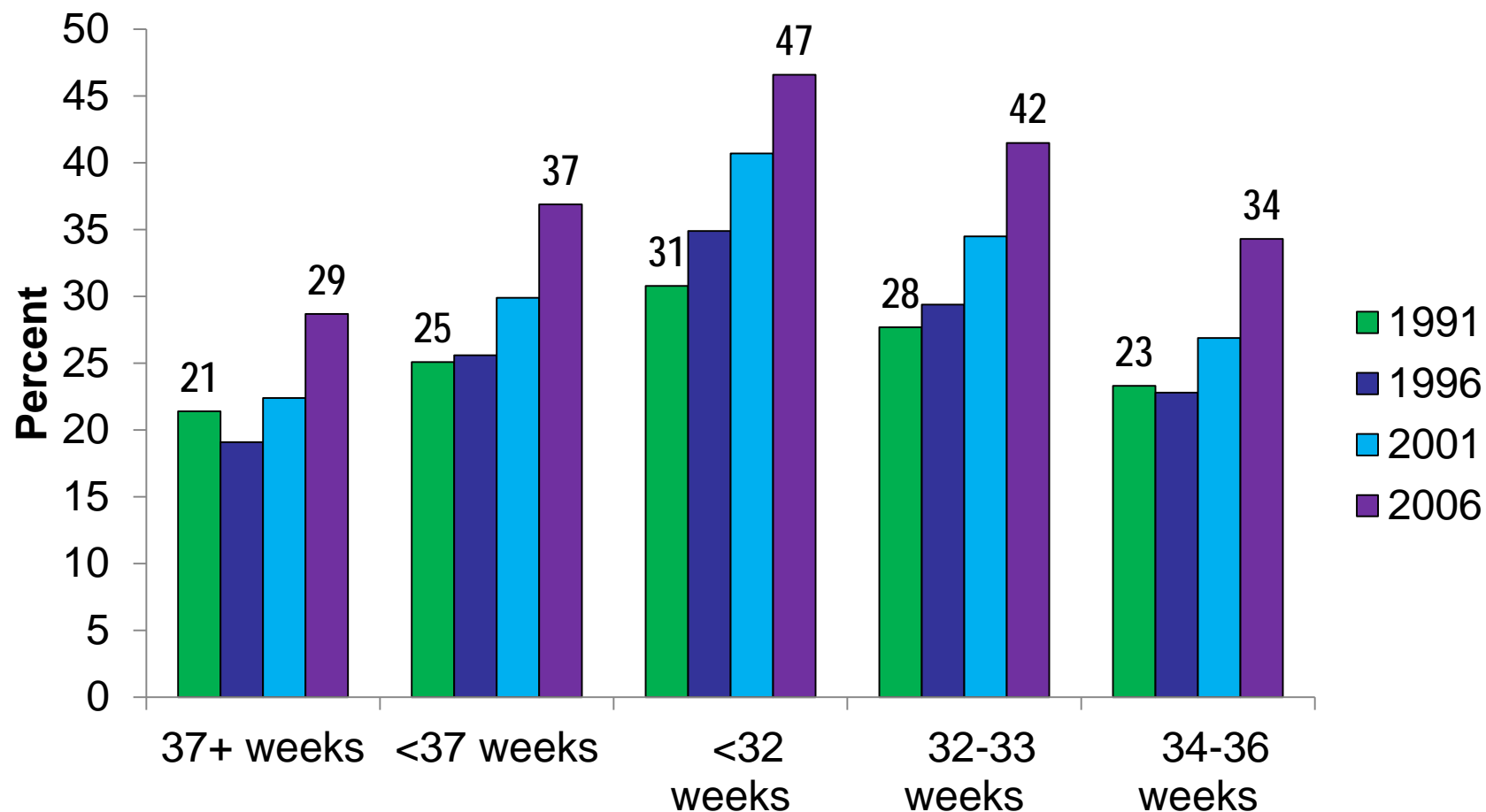
Source: CDC/NCHS national natality files. 1984-2008 are final birth data, 2009 data are preliminary.

Percent of preterm births by race and ethnicity, US, 1990 and 2006-2009



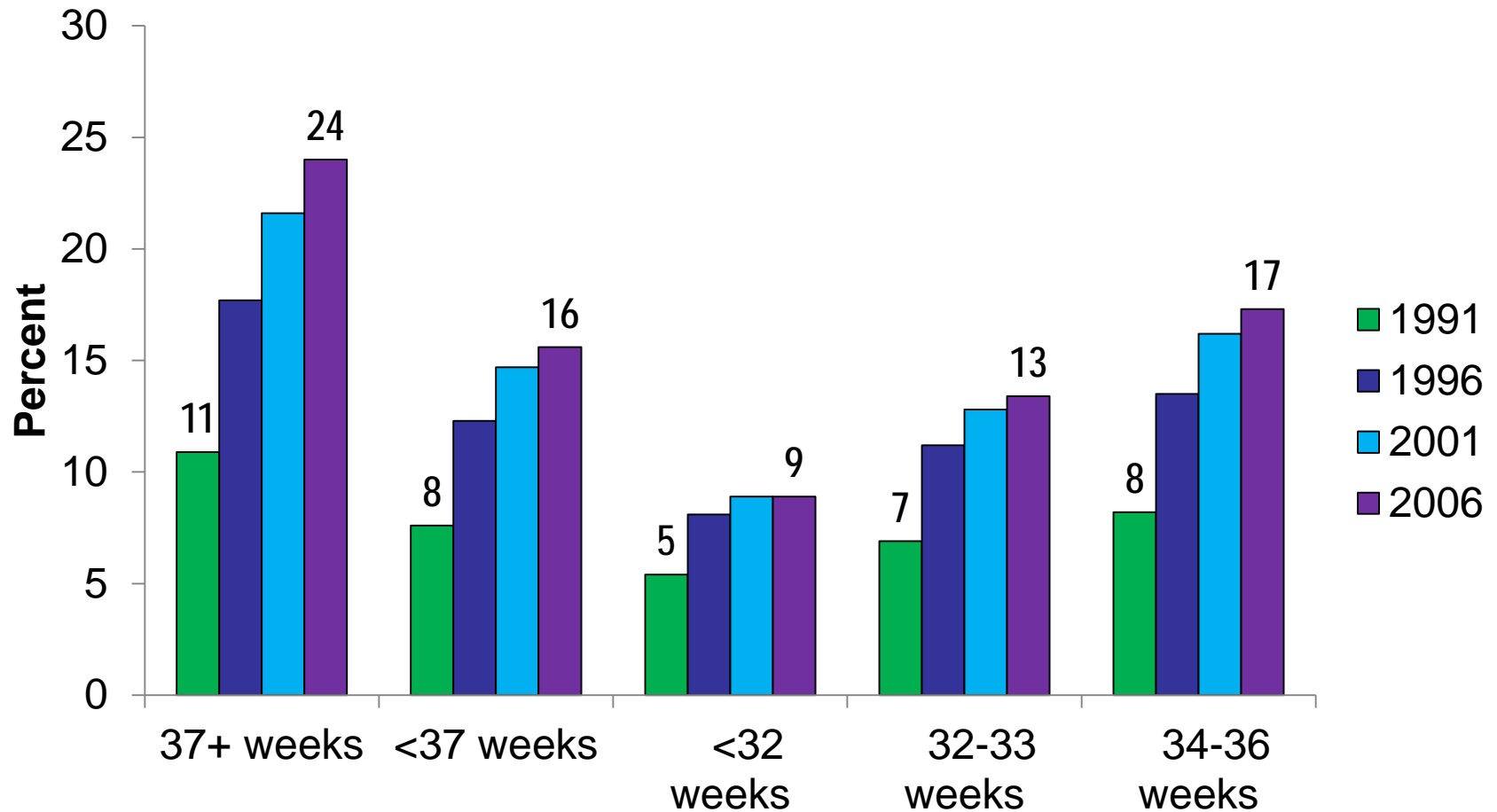
Source: CDC/NCHS national natality files. 1990-2008 data are final. 2009 data are preliminary.

Percent of singleton births delivered by cesarean by gestational age, US, selected years



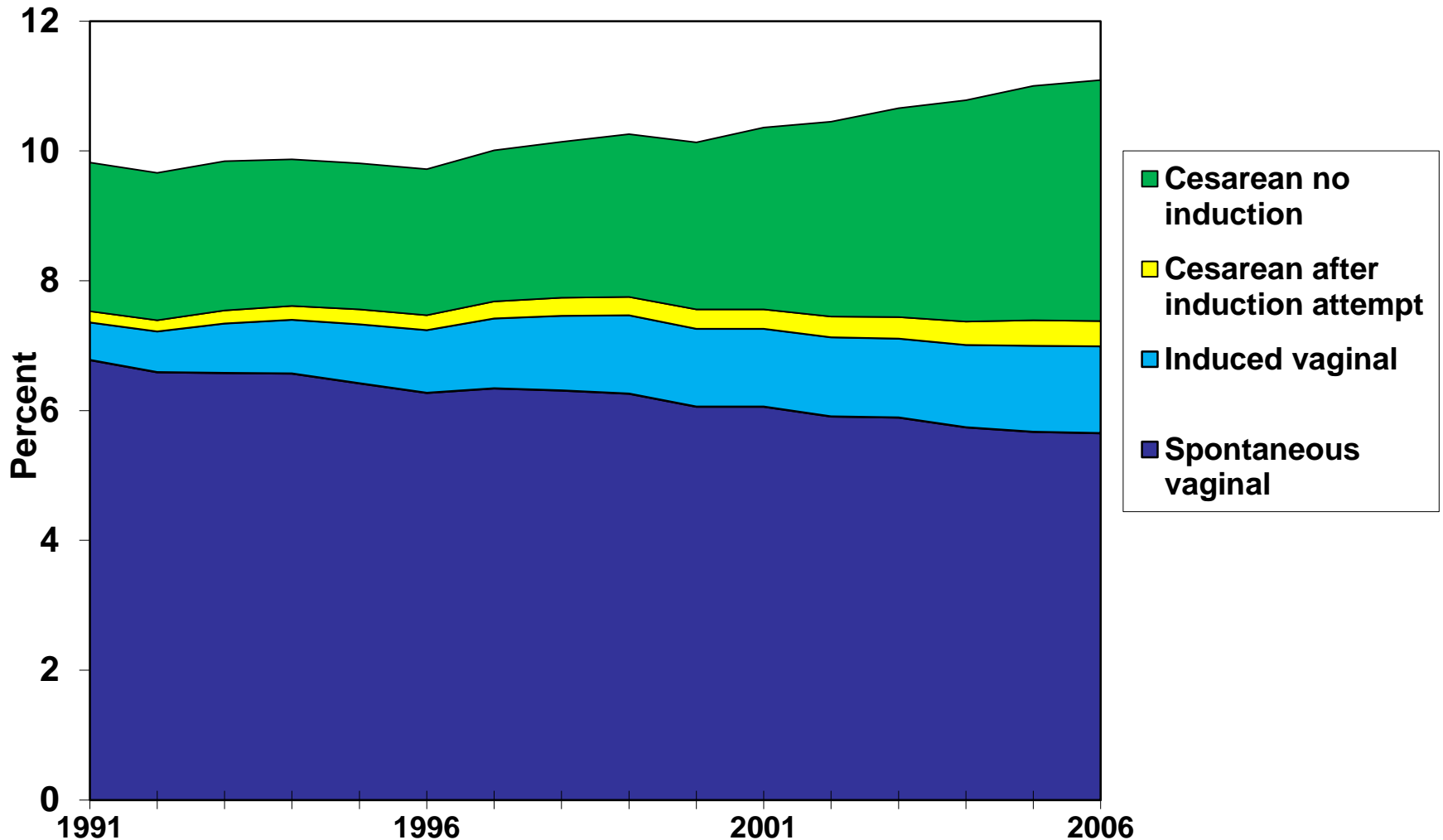
Source: MacDorman et al, AJPH, 2010.

Percent of singleton births with induction of labor, US, selected years



Source: MacDorman et al, AJPH, 2010.

Percent of singleton preterm (<37 weeks) births by method of delivery, US, 1991-2006



Note: Births with method of delivery and induction of labor not stated are excluded. Source: MacDorman et al, AJPH, 2010.

Decreasing Elective Deliveries Before 39 Weeks of Gestation in an Integrated Health Care System

Bryan T. Oshiro, MD, Erick Henry, MPH, Janie Wilson, RN, D. Ware Branch, MD, and Michael W. Varner, MD, for the Women and Newborn Clinical Integration Program

OBJECTIVE: The American College of Obstetricians and Gynecologists has recommended that elective deliveries not be performed before 39 weeks of gestation, to minimize prematurity-related neonatal complications. Because a worrisome number of elective deliveries were occurring before 39 weeks of gestation in our system, we developed and implemented a program to decrease the number of these early term elective deliveries. Secondary objectives were to monitor relevant clinical outcomes.

METHODS: The electronic medical records of an integrated health care system involving nine labor and delivery units in Utah were queried to establish the incidence of patients admitted for elective induction of labor or planned elective cesarean delivery. These facilities have open staff models with obstetricians, family practitioners, and certified nurse midwives. Guidelines were developed and imple-

less than 3%. A reduced length of stay in labor and delivery occurred with the introduction of the program, and there were no adverse effects on secondary clinical outcomes.

CONCLUSION: With institutional commitment, it is possible to substantially reduce and sustain a decline in the incidence of elective deliveries before 39 weeks of gestation.

(Obstet Gynecol 2009;113:804-11)

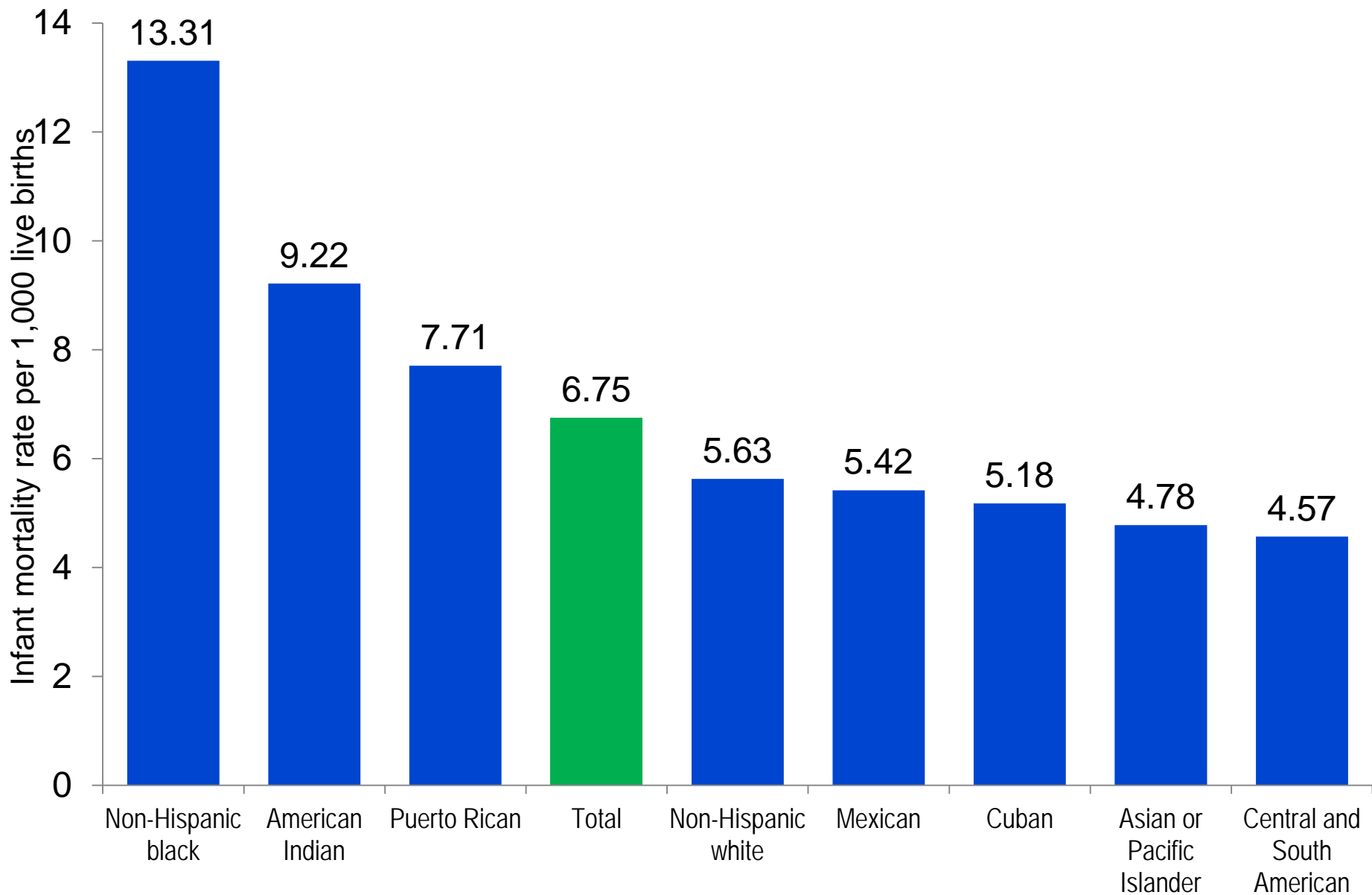
LEVEL OF EVIDENCE: III

Induction of labor in the United States has more than doubled as a proportion of all births, from 9% if 1989 to 21% in 2002, with a sharper increase in elective than in medically indicated inductions.¹ The induction rate in Utah has also increased and has

Infant Mortality:

Race and ethnic differences

Figure 1. Infant mortality rates by race and ethnicity of mother, US, 2007

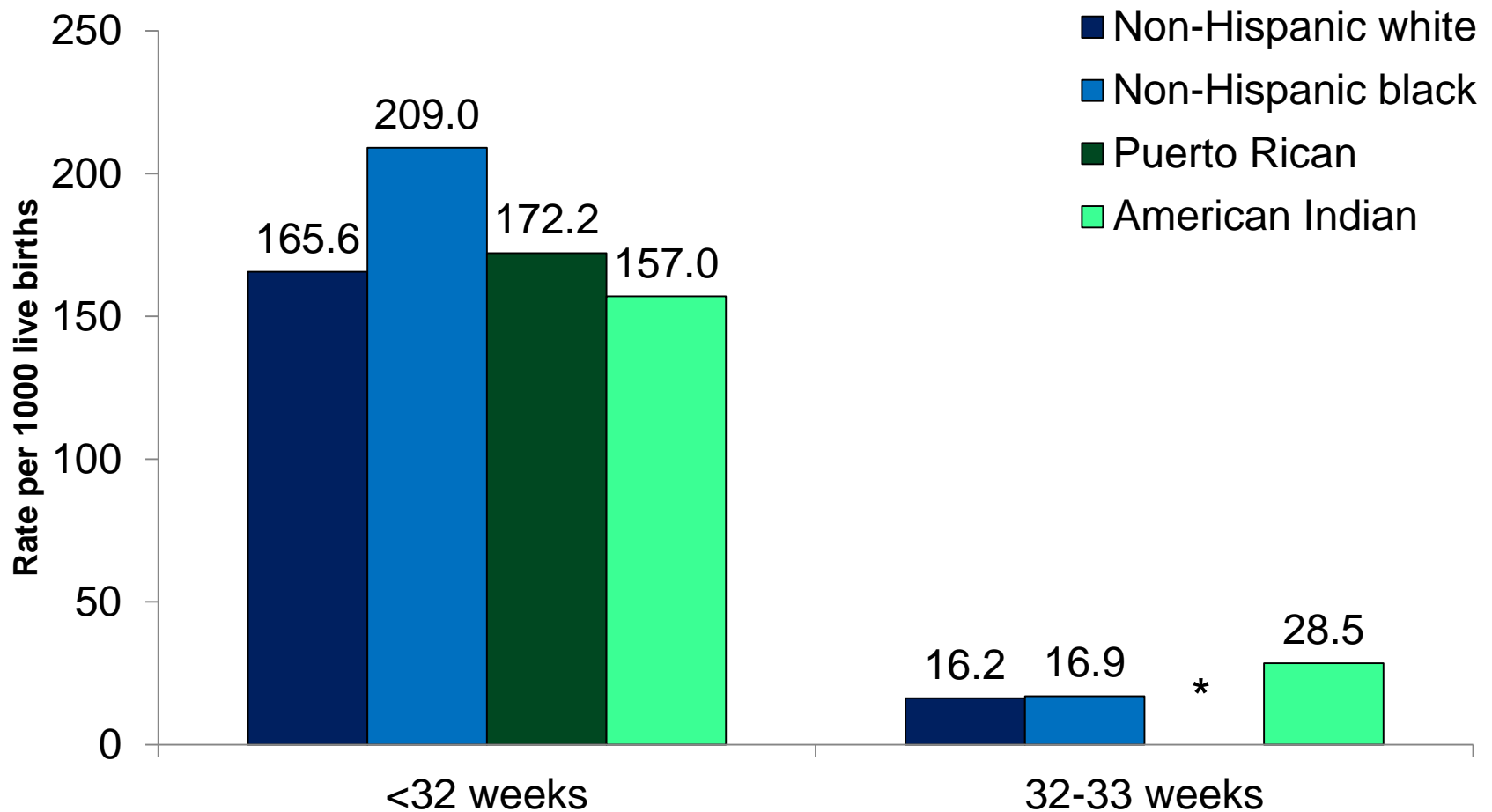


Source: CDC/NCHS linked birth/infant death data set, 2007.

Infant mortality can be partitioned into two key components:

1. Gestational age-specific infant mortality rates (i.e. the mortality rate for infants at a given gestational age).
2. Distribution of births by gestational age.

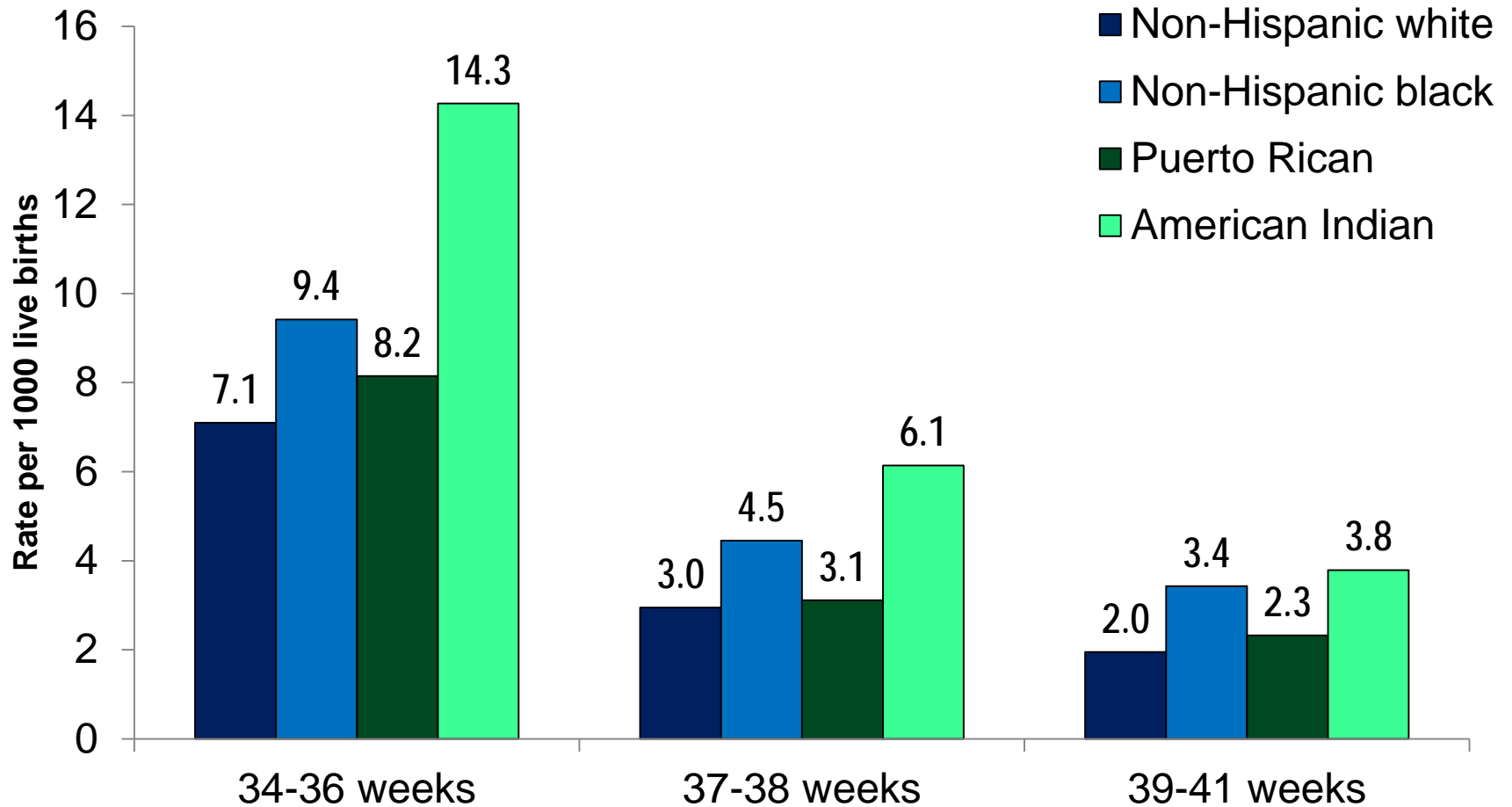
Gestational age-specific infant mortality rates by race/ethnicity, US, 2007



Source: CDC/NCHS linked birth/infant death data set, 2007

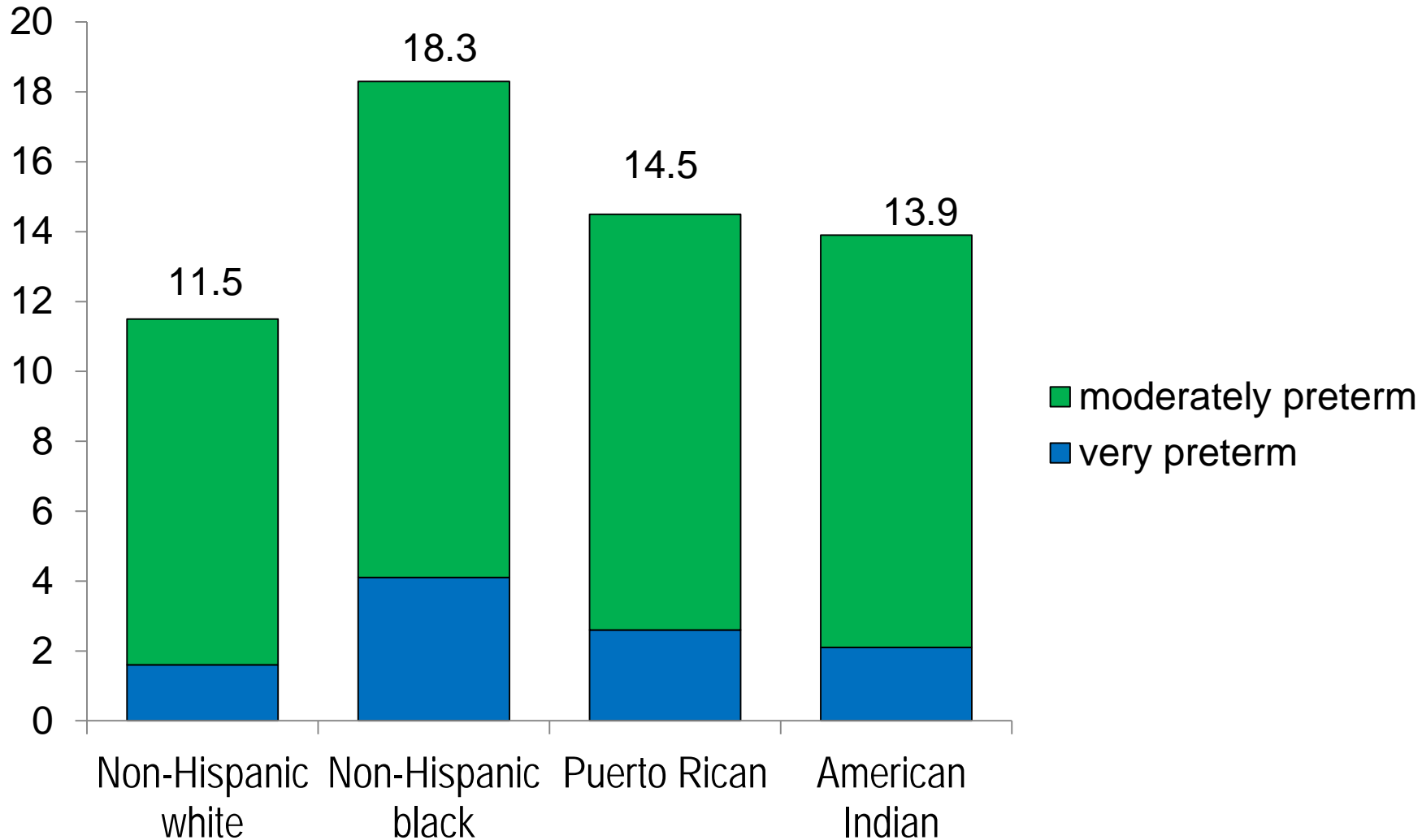
* Figure does not meet standard of reliability or precision: based on <20 deaths in the numerator.

Gestational age-specific infant mortality rates by race/ethnicity, US, 2007



Source: CDC/NCHS, linked birth/infant death data set, 2007

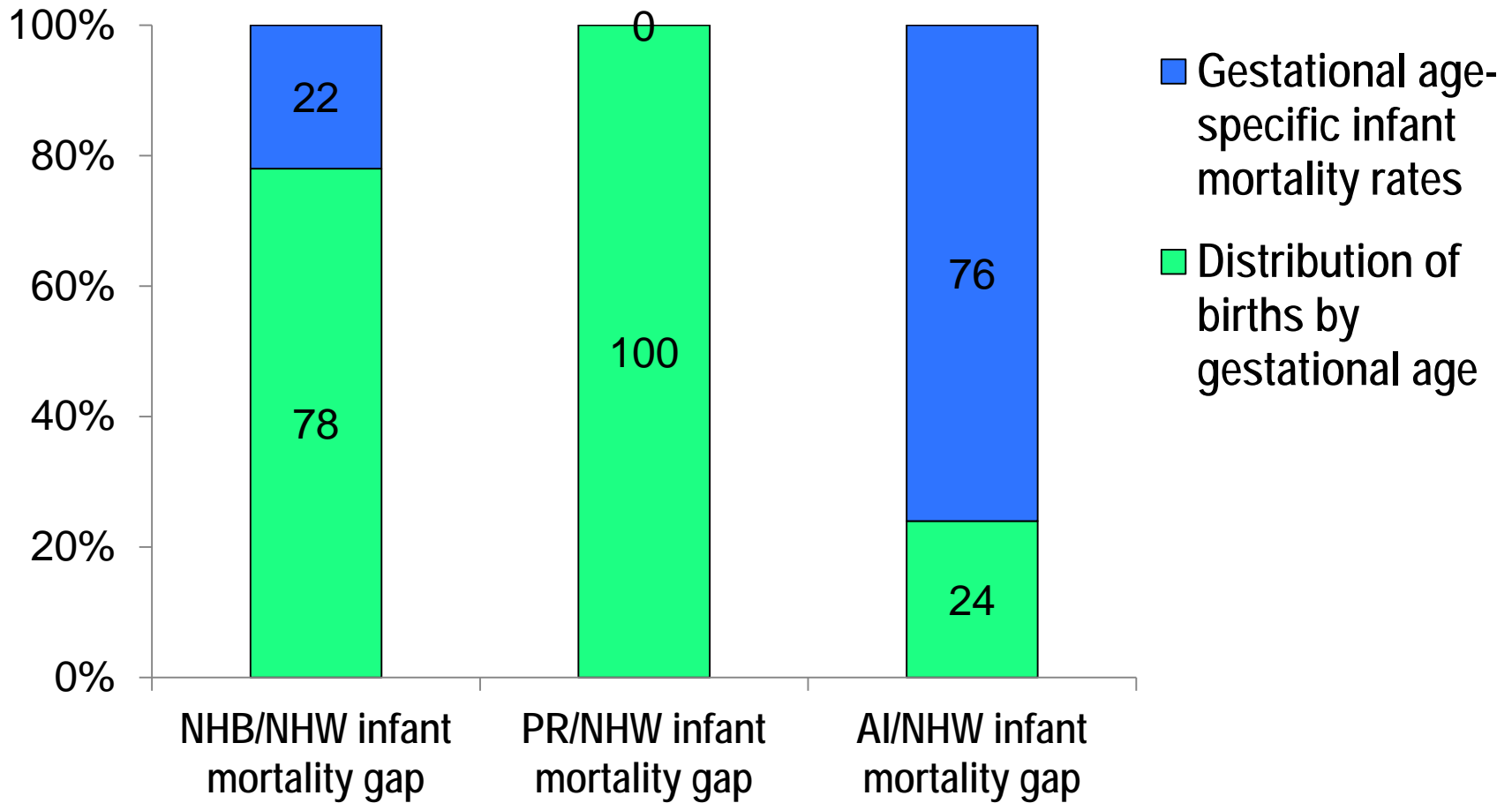
Percent of preterm births by race and Hispanic origin of mother, United States, 2007



Note: Preterm: <37 weeks of gestation; very preterm: <32 weeks; moderately preterm: 32-36 weeks

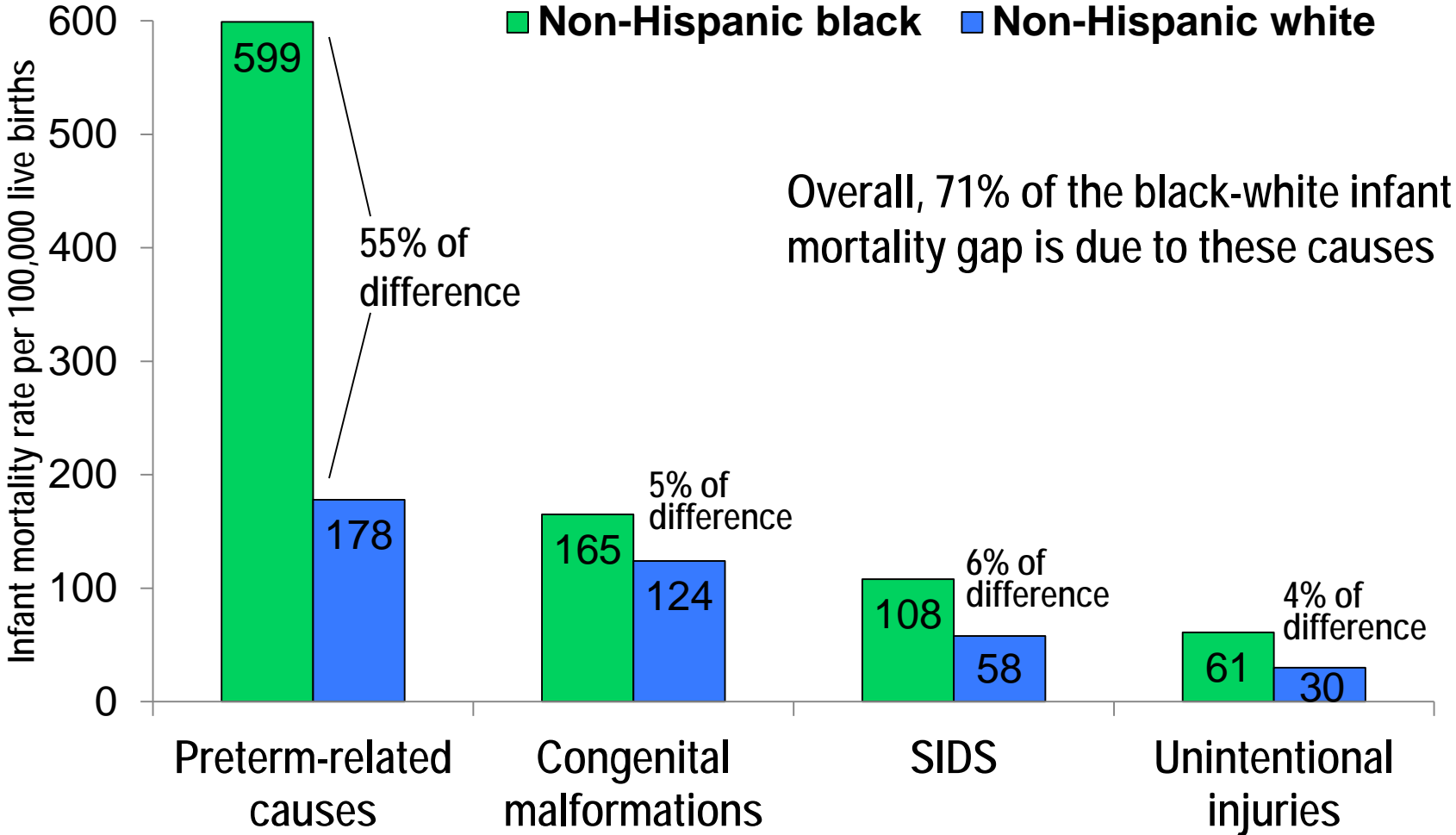
Source: CDC/NCHS linked birth/infant death data set, 2007

Percent contribution of gestational-age specific infant mortality rates and the distribution of births by gestational age to race/ethnic differences in infant mortality rates



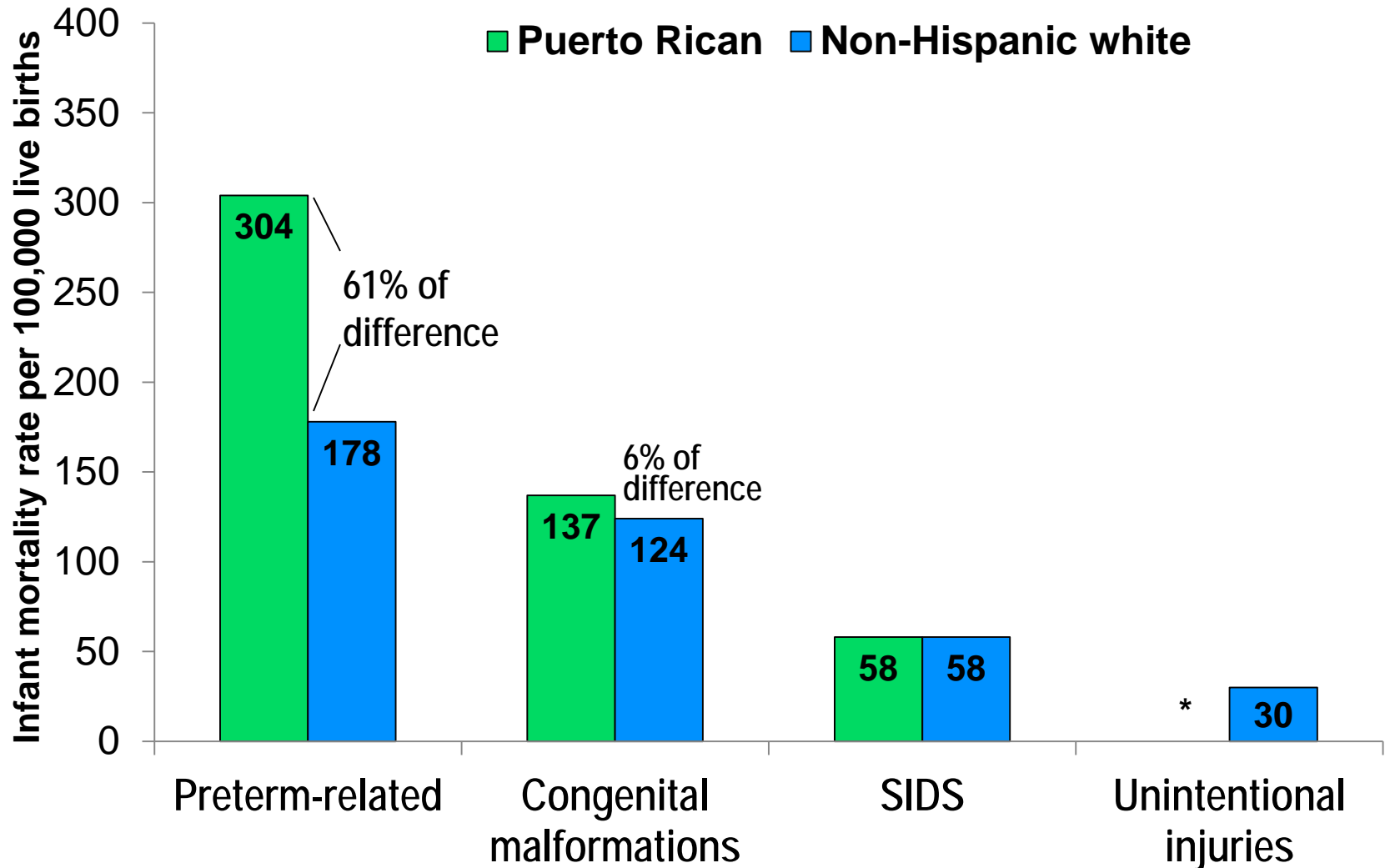
Note: NHW=non-Hispanic white, NHB=non-Hispanic black, PR=Puerto Rican, AI=American Indian
Source: NCHS linked birth/infant death data set, 2007

Contribution of causes of death to the non-Hispanic black – non-Hispanic white infant mortality gap, 2007



Source: CDC/NCHS linked birth/infant death data set, 2007

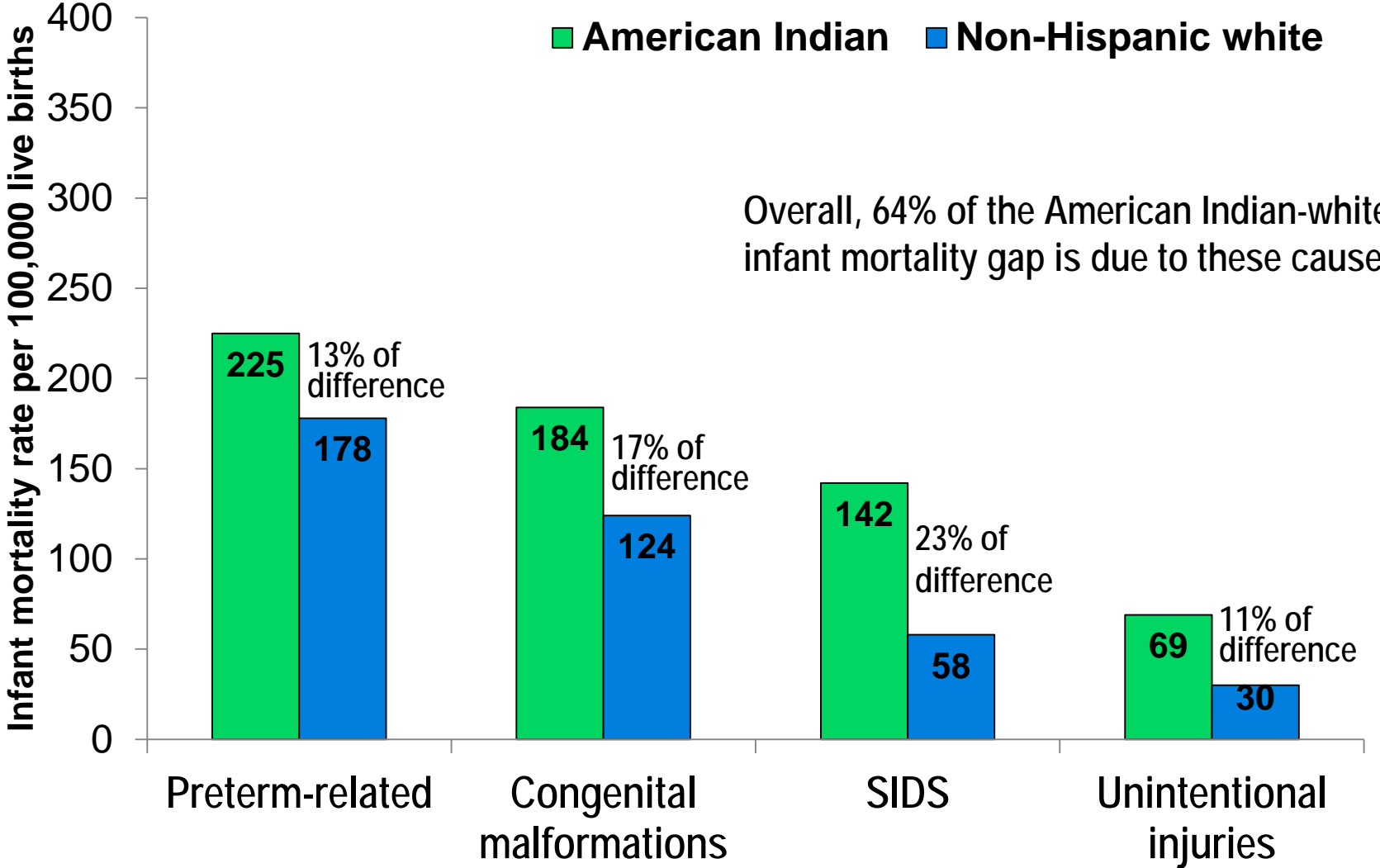
Contribution of causes of death to the Puerto Rican -- non-Hispanic white infant mortality gap, US, 2007



Source: CDC/NCHS linked birth/infant death data set, 2007.

* Figure does not meet standard of reliability or precision – based on <20 deaths in the numerator.

Contribution of causes of death to the American Indian -- non-Hispanic white infant mortality gap, US, 2007



Source: CDC/NCHS linked birth/infant death data set, 2007.

Infant Mortality:

International comparisons

Behind International Rankings of Infant Mortality: How the United States Compares with Europe

Marian F. MacDorman, Ph.D., and T.J. Mathews, M.S.

Key findings

Data from the United States' Linked Birth/Infant Death Data Set and the European Perinatal Health Report

- Infant mortality rates for preterm (less than 37 weeks of gestation) infants are lower in the United States than in most European countries; however, infant mortality rates for infants born at 37 weeks of gestation or more are higher in the United States than in most European countries.

- One in 8 births in the United States were born preterm, compared with 1 in 18 births in Ireland and Finland.

- If the United States had Sweden's distribution of births by gestational age, nearly 8,000 infant deaths would be averted each year and the U.S. infant mortality rate would be one-third lower.

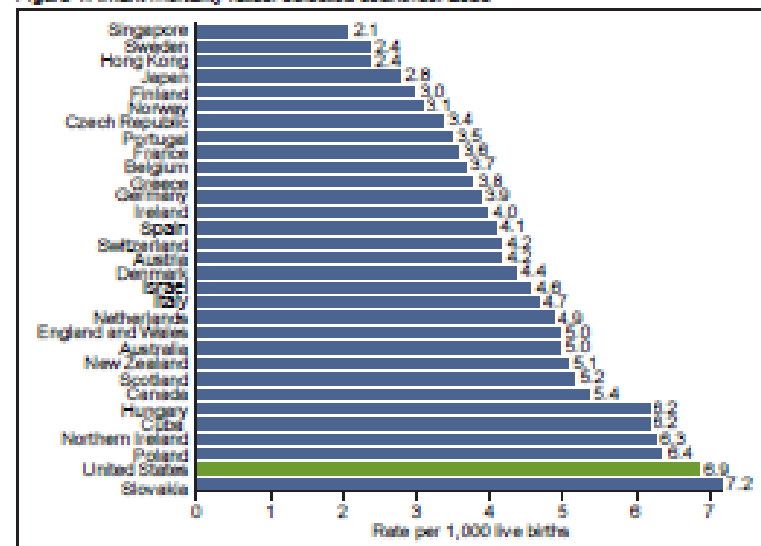
- The main cause of the United States' high infant mortality rate when compared with Europe is the very high percentage of preterm births in the United States.

Infant mortality is an important indicator of the health of a nation, and the recent stagnation (since 2000) in the U.S. infant mortality rate has generated concern among researchers and policy makers. The percentage of preterm births in the United States has risen 36% since 1984 (1). In this report we compare infant mortality rates between the United States and Europe. We also compare two factors that determine the infant mortality rate—gestational age-specific infant mortality rates and the percentage of preterm births. U.S. data are from the Linked Birth/Infant Death Data Set (2,3), and European data for 2004 are from the recently published *European Perinatal Health Report* (4). We also examine requirements for reporting a live birth among countries to assess the possible effect of reporting differences on infant mortality data.

Keywords: infant mortality • international comparisons • preterm birth • gestational age-specific infant mortality rates

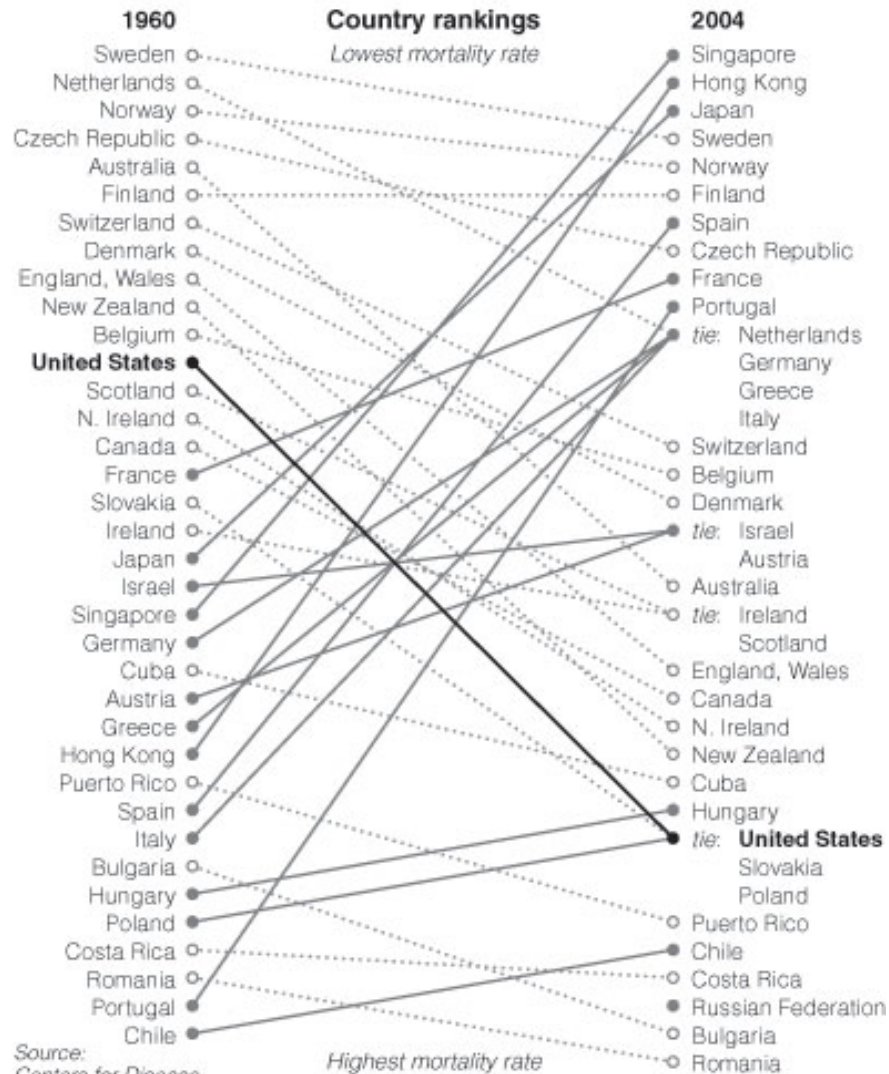
In 2005, the United States ranked 30th in infant mortality.

Figure 1. Infant mortality rates, selected countries, 2005



Rankings of Infant Mortality

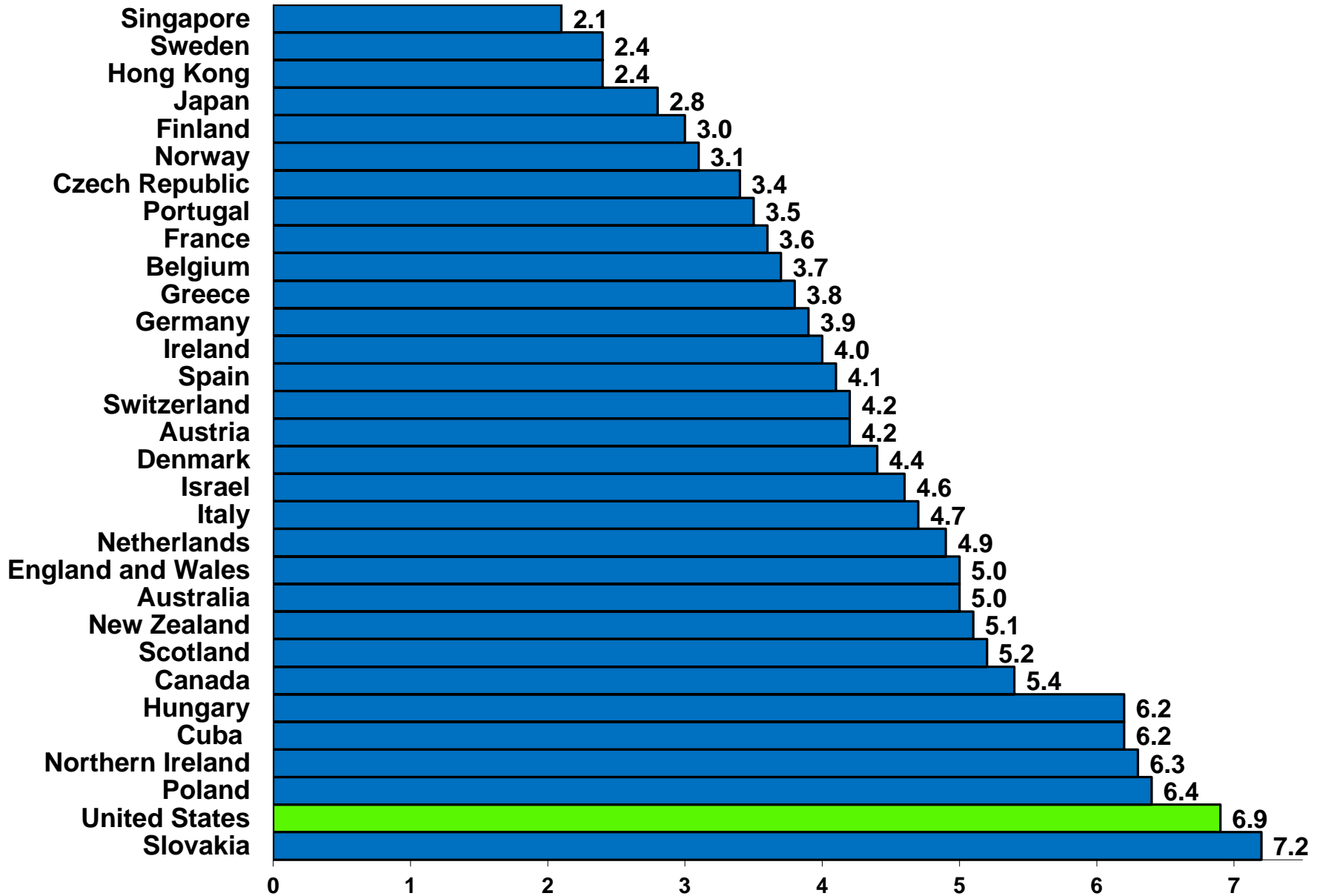
A new report ranks the United States 29th for infant mortality, tied with Slovakia and Poland. In 1960 the United States was ranked 12th.



Source:
Centers for Disease
Control and Prevention

THE NEW YORK TIMES

Infant mortality rates, selected countries, 2005



Source: Health, United States, 2008

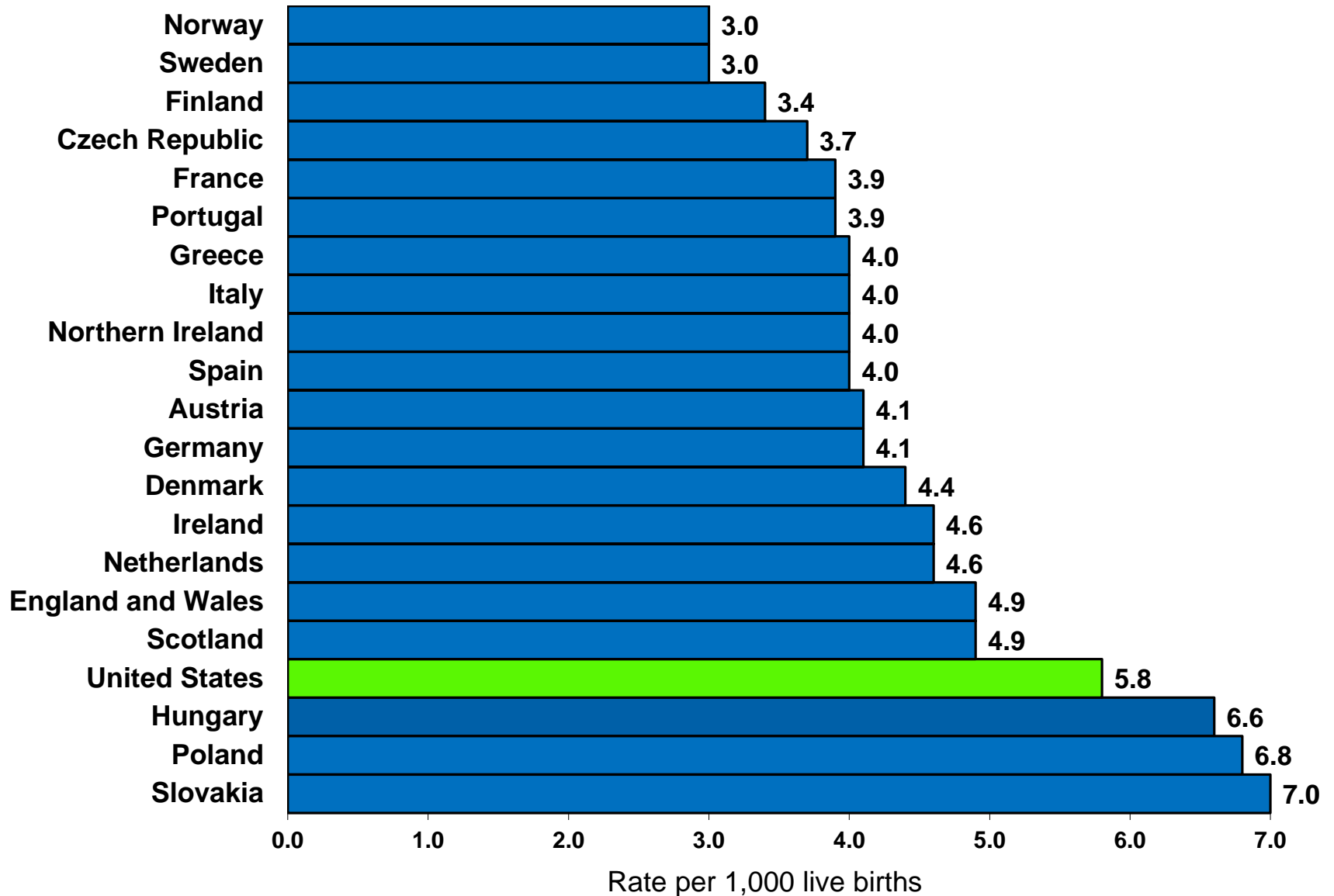
Rate per 1,000 live births

Table 1. Requirements for reporting a live birth, United States and selected European countries, 2004

Reporting requirement	Country
All live births	Austria, Denmark, England and Wales, Finland, Germany, Hungary, Italy, Northern Ireland, Portugal, Scotland, Slovak Republic, Spain, Sweden, United States
Live births at 12 weeks of gestation or more	Norway
Live births at 500 grams birthweight or more, and less than 500 grams if the infant survives for 24 hours	Czech Republic
Live births at 22 weeks of gestation or more, or 500 grams birthweight or more	France
All live births for civil registration, births at 500 grams birthweight or more for the national perinatal register	Ireland
Live births at 22 weeks of gestation or more, 500 grams birthweight or more if gestational age is unknown	Netherlands
Live births at 500 or more grams birthweight	Poland

SOURCE: NCHS/National Vital Statistics System for U.S. data and European Perinatal Health Report, p. 40 for European data: <http://www.europeristat.com/bm.doc/european-perinatal-health-report.pdf>.

Infant mortality rates excluding births at <22 weeks of gestation, US and selected European countries, 2004



Source: NCHS linked birth/infant death data set (for US data), and European Perinatal Health Report (for European data).

Table 2. Gestational age-specific infant mortality rates, United States and selected European countries, 2004

Selected countries	22–23 weeks ¹	24–27 weeks	28–31 weeks	32–36 weeks	37 weeks or more
United States	707.7	236.9	45.0	8.6	2.4
Austria	888.9	319.6	43.8	5.8	1.5
Denmark	947.4	301.2	42.2	10.3	2.3
England and Wales ²	880.5	298.2	52.2	10.6	1.8
Finland	900.0	315.8	58.5	9.7	1.4
Northern Ireland	1,000.0	268.3	54.5	13.1	1.6
Norway	555.6	220.2	56.4	7.2	1.5
Poland	921.1	530.6	147.7	23.1	2.3
Scotland	1,000.0	377.0	60.8	8.8	1.7
Sweden	515.2	197.7	41.3	12.8	1.5

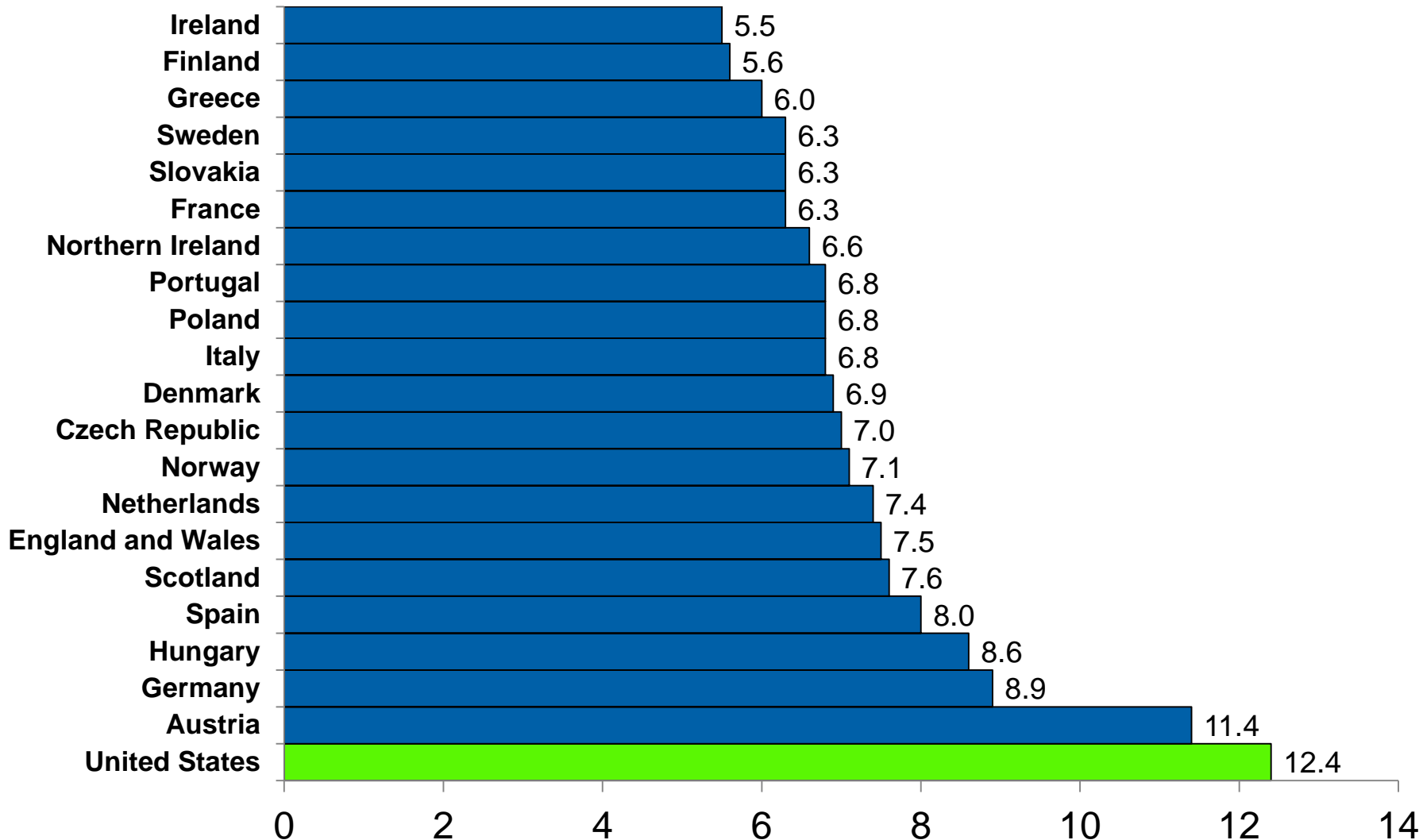
¹Infant mortality rates at 22–23 weeks of gestation may be unreliable due to reporting differences.

²England and Wales provided 2005 data.

NOTE: Infant mortality rates are per 1,000 live births in specified group.

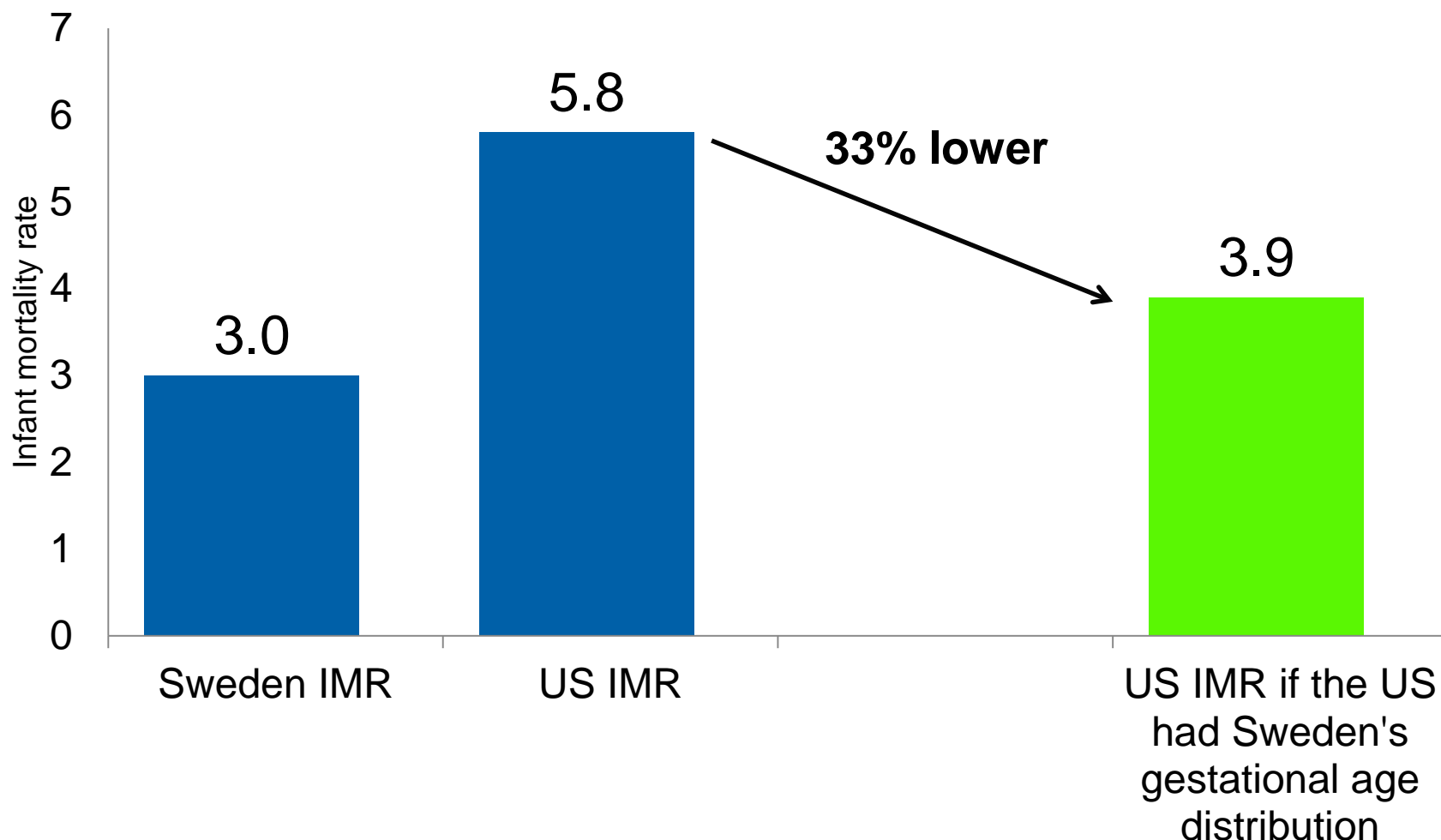
SOURCE: NCHS linked birth/infant death data set (for U.S. data), and *European Perinatal Health Report* (for European data).

Percentage of preterm births, United States and selected European countries, 2004



Note: Excludes births at <22 weeks of gestation to promote comparability between countries. Preterm births are those from 22 to 36 weeks of gestation. Source: NCHS linked birth/infant death data set (for US data), and European Perinatal Health Report (for European data).

Infant mortality rate for the US and Sweden, and the US infant mortality rate standardized for Sweden's gestational age distribution, 2004



Note: Excludes births at <22 weeks of gestation. Source: NCHS linked birth/infant death data set (for US data), and European Perinatal Health Report (for Swedish data).

Discussion – International Rankings

- Although there are reporting differences between countries, they are not the primary explanation for the United States' relatively low international ranking.
- In 2005, 22 countries had infant mortality rates ≤ 5.0 .
- One would have to assume that these countries did not report more than 1/3 of their infant deaths for their infant mortality rates to equal or exceed the US rate.
- This level of underreporting appears unlikely for most developed countries.
- The main cause of the US' high infant mortality rate when compared to Europe is the very high percentage of preterm births in the US, the period when infant mortality is greatest.

Maternal Mortality: What's the real story?

Definitions

Maternal death: Death of a woman while pregnant or within 42 days of the end of pregnancy from any cause related to or aggravated by the pregnancy.

Late maternal death: Death of a woman from direct or indirect obstetric causes more than 42 days but less than one year after the end of the pregnancy.

Maternal mortality rate:
$$\frac{\text{Number of maternal deaths} \times 100,000}{\text{Number of live births}}$$

(also known as maternal mortality ratio)

Two Main Maternal Mortality Data Systems

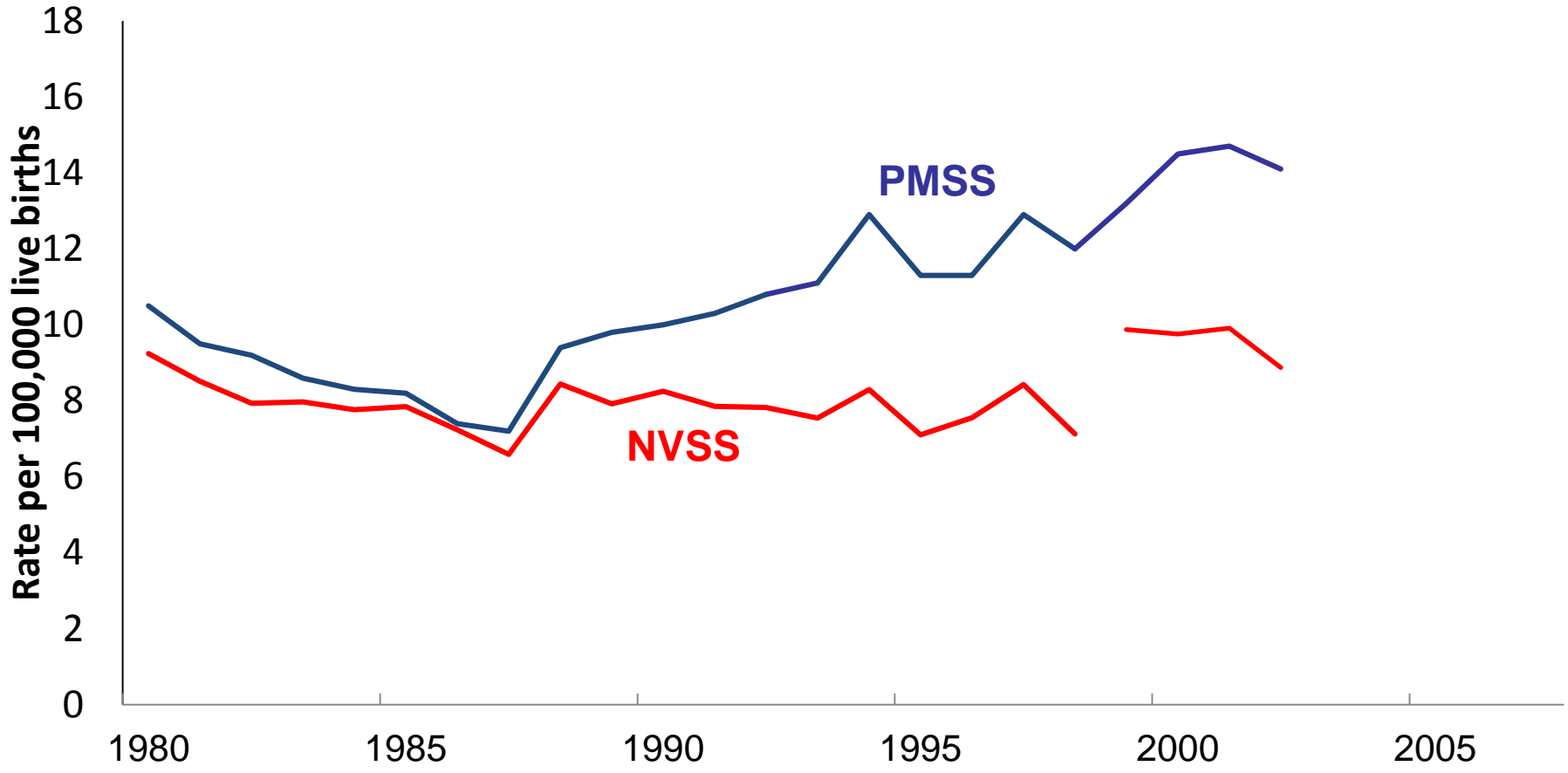
National Vital Statistics System (NVSS):

- Official maternal mortality rate for US
- Based upon death certificates
- Maternal deaths, late maternal deaths, sequelae of maternal death
- Coded according to WHO rules

Pregnancy Mortality Surveillance System (PMSS):

- Complementary activity to NVSS
- Based upon death certificates, matched records, media reports, maternal mortality review committee reports etc.
- Pregnancy-related deaths, pregnancy associated deaths
- Reviewed and coded according to system developed by ACOG/CDC Maternal Mortality Study Group

Maternal mortality rates from the National Vital Statistics System and the Pregnancy Mortality Surveillance System, US, 1980-2002

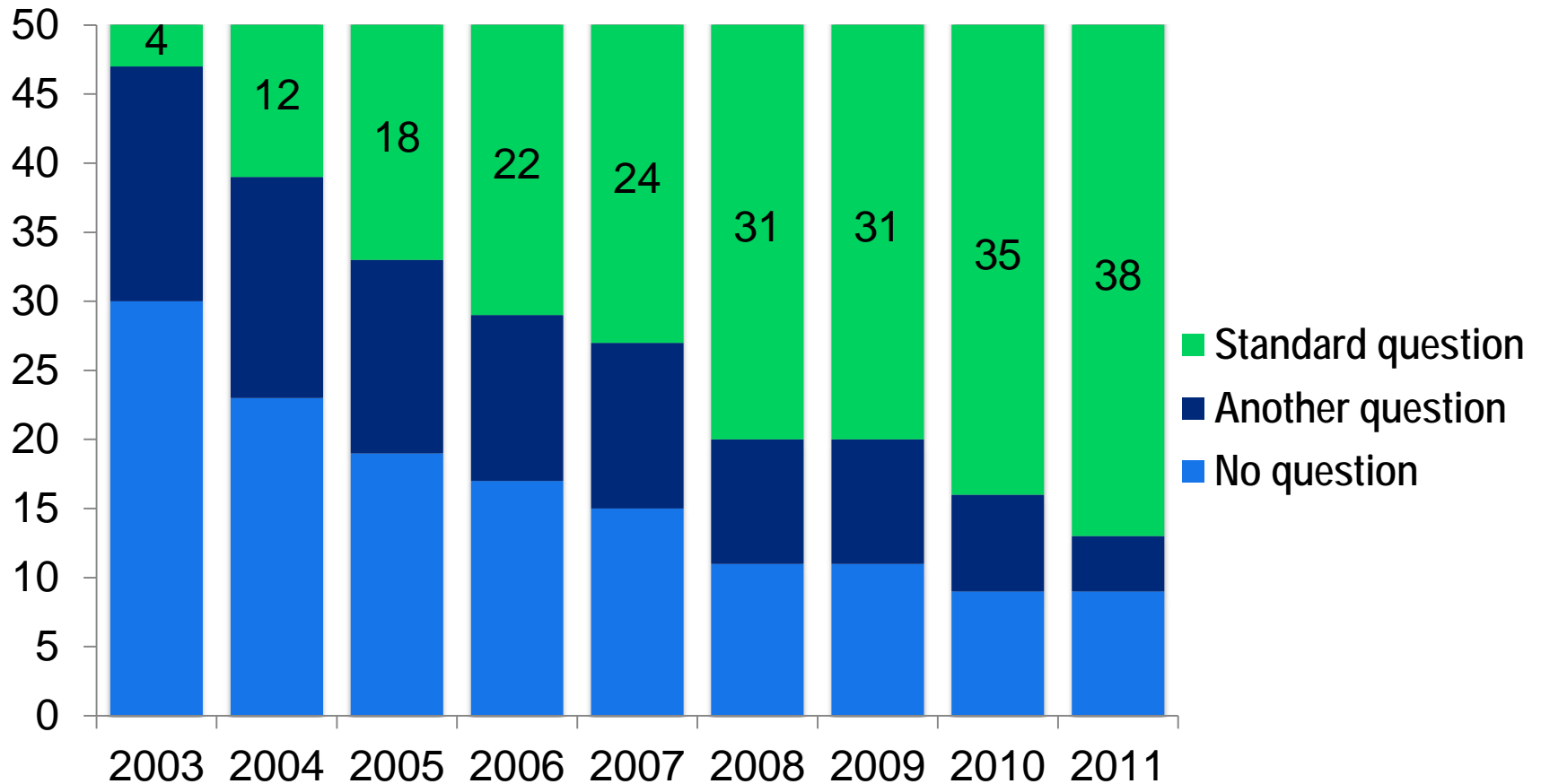


Source: CDC/NCHS National Vital Statistics System, and CDC Pregnancy Mortality Surveillance System.

Recent change involving separate question

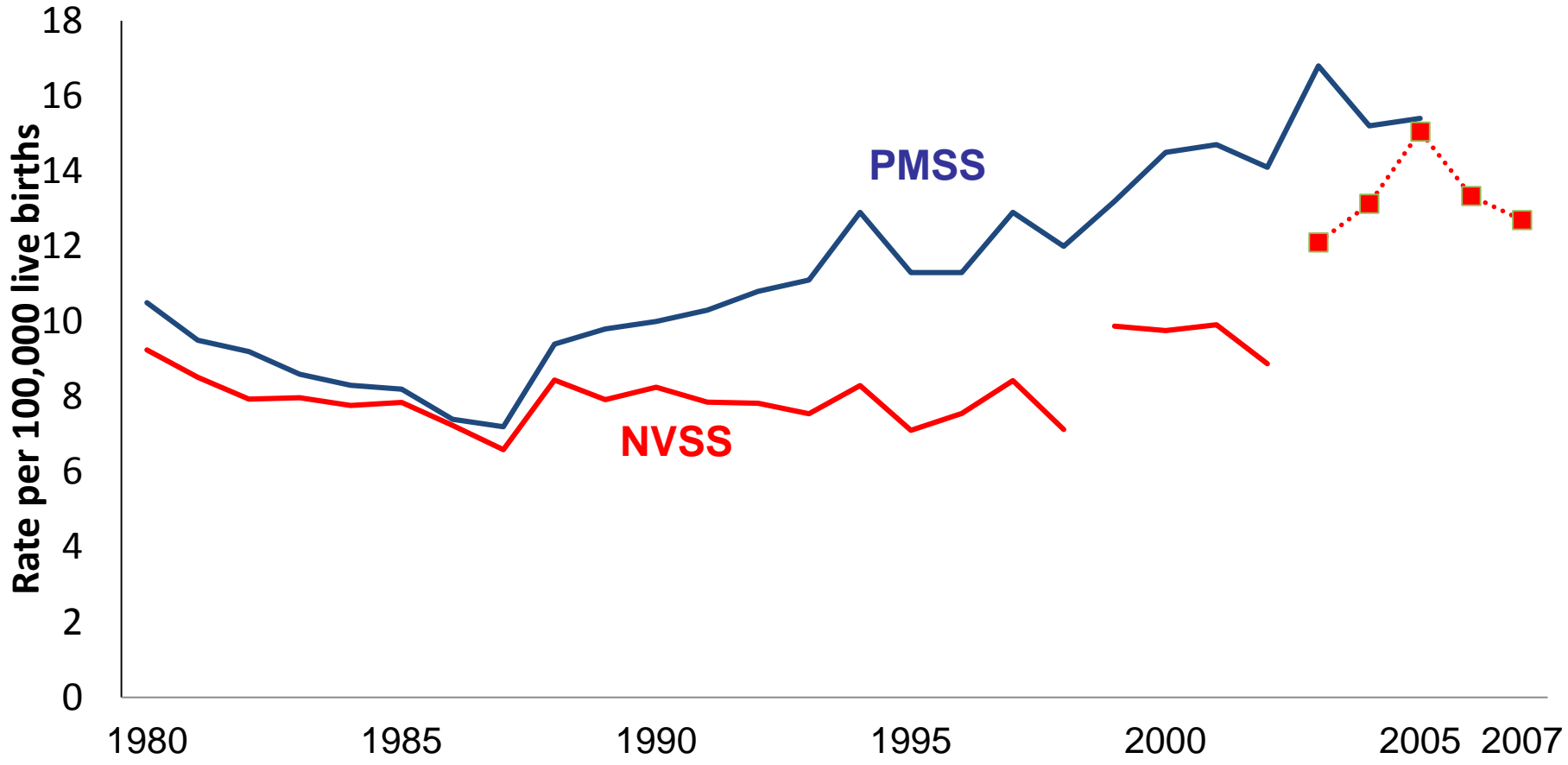
- Beginning with data for 2003, states have been adopting a separate question on their death certificates on whether a woman was pregnant at the time of death or within 42 days of death.
- Information from the question is used to supplement what is reported on the cause-of-death statement to improve ascertainment of maternal deaths
- The new question increases ascertainment of maternal deaths leading to higher maternal mortality rates.

Number of states with pregnancy question on the death certificate, 2003-2011



Source: CDC/NCHS National Vital Statistics System.

Maternal mortality rates from the National Vital Statistics System and the Pregnancy Mortality Surveillance System, US, 1980-2007

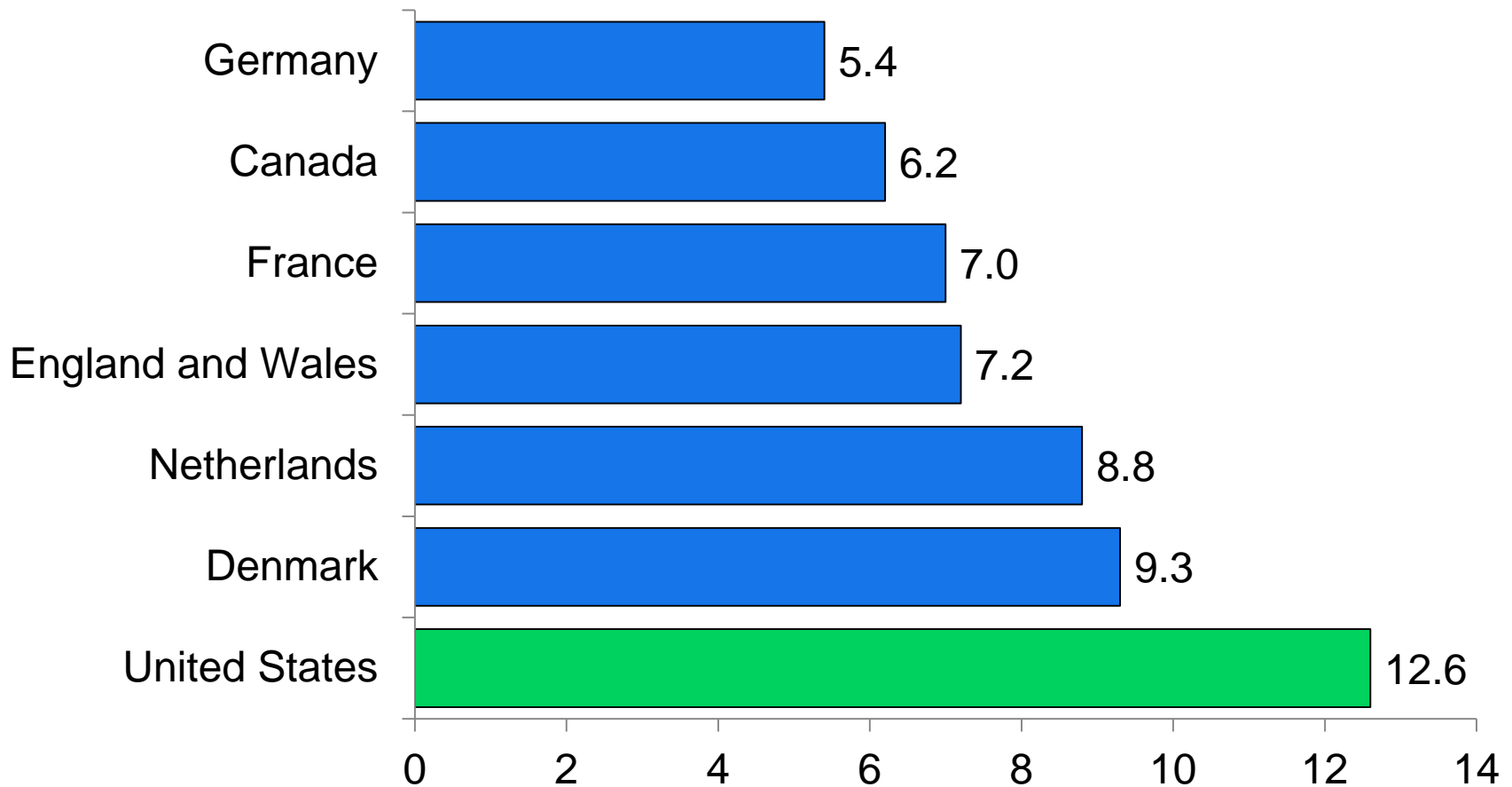


Source: CDC/NCHS National Vital Statistics System, and CDC Pregnancy Mortality Surveillance System.

Maternal Mortality is Still a Major Public Health Problem

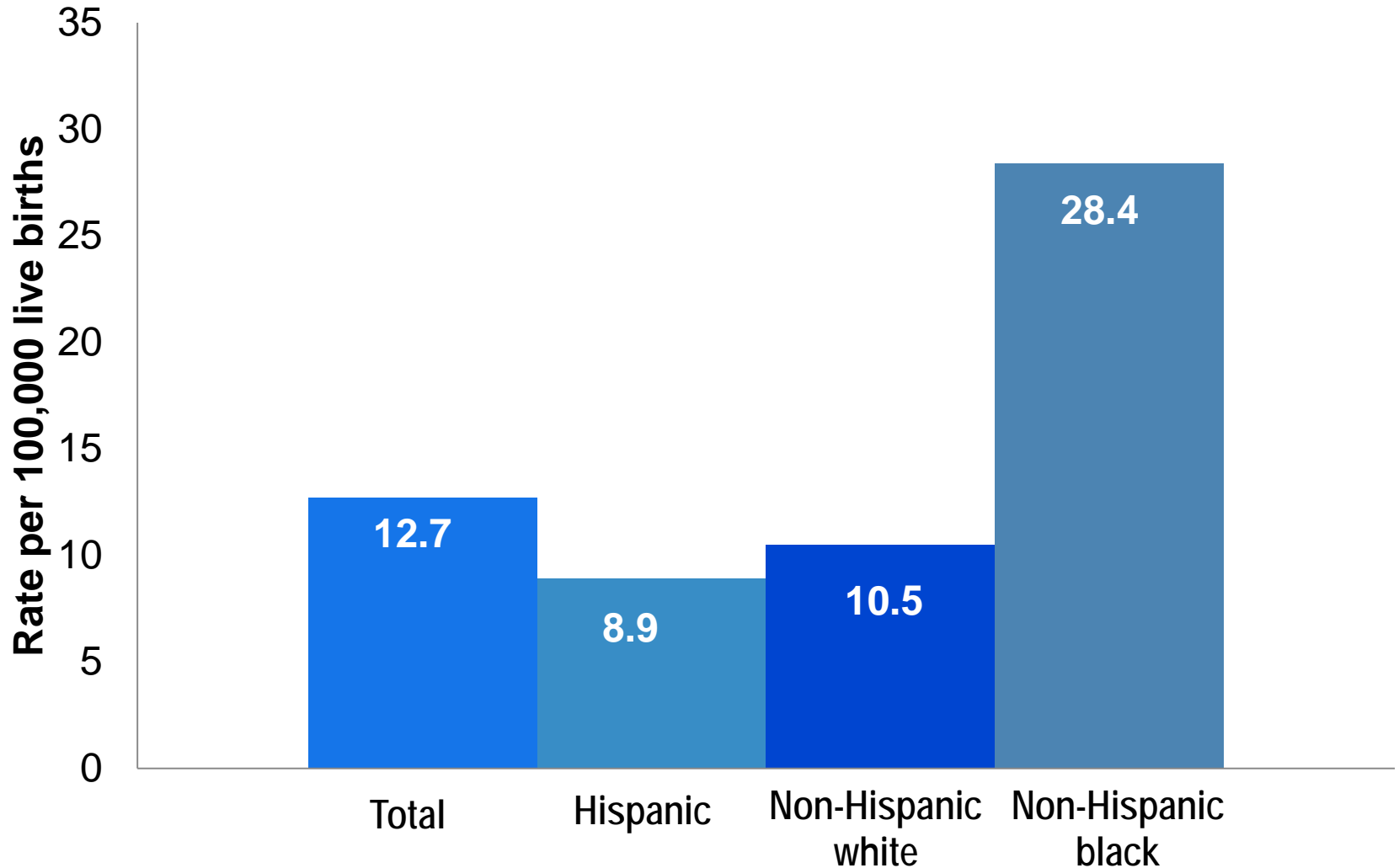
- Maternal mortality rates in the US are high compared to other industrialized countries.
- No improvement in maternal mortality rates in the US since the 1980's
- 500-600 maternal deaths each year in the United States
- Unexpected deaths of young women many in their 20s and 30s, many with families and other children
- There are large race and ethnic disparities in maternal mortality – some of the widest disparities found in public health.
- At least 40% of pregnancy-related deaths are preventable (Berg, 2005). Many due to common problems such as hemorrhage or complications of maternal chronic diseases (i.e. diabetes, hypertension).

Maternal mortality rates, selected industrialized countries, 2003-2004 data



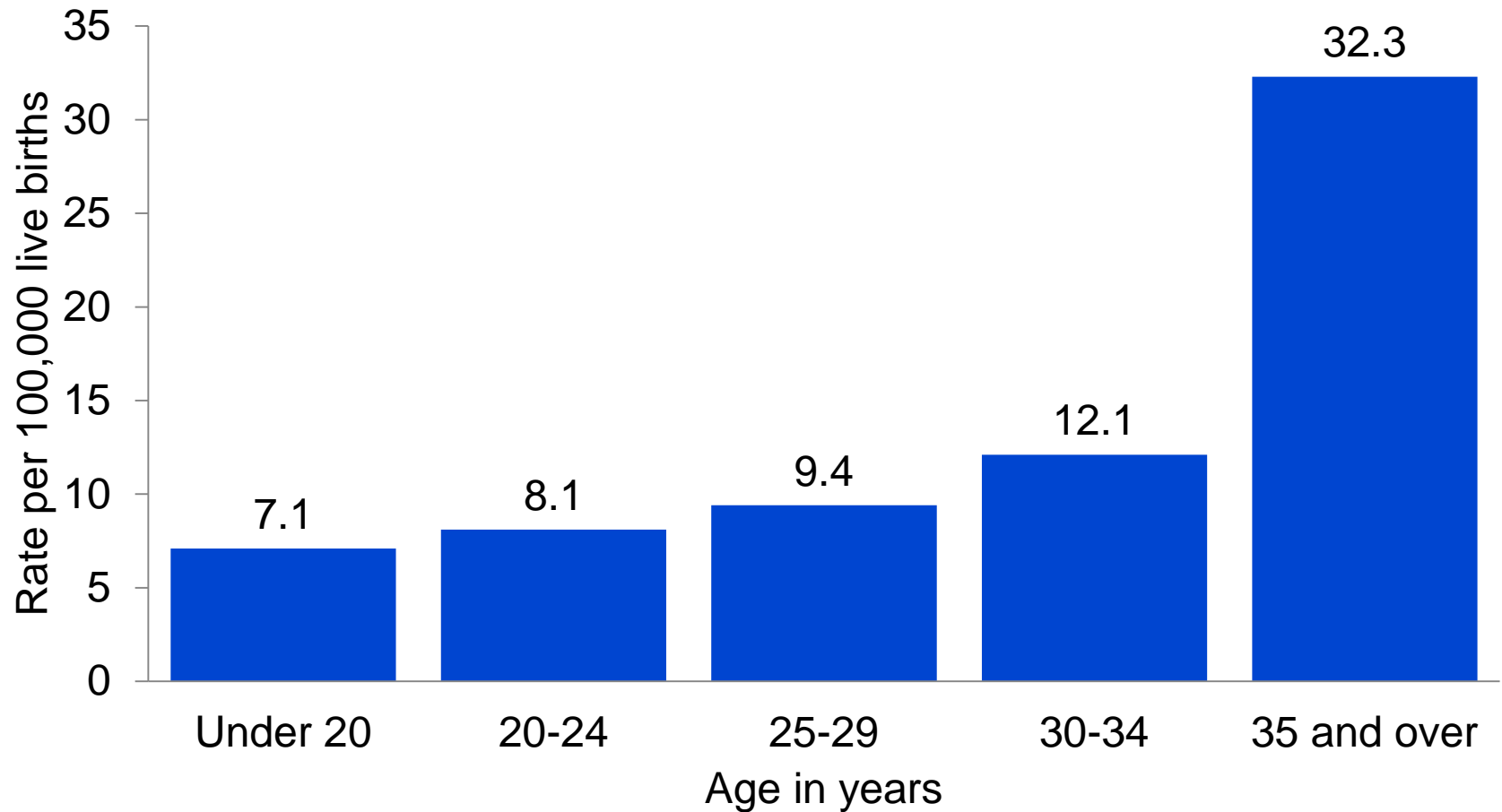
Source: European data from the European Perinatal Health Report; Canadian data from Statistics Canada, Canadian vital statistics, death database; US data from the National Vital Statistics System.

Maternal mortality rates by race and Hispanic origin, US, 2007



Source: CDC/NCHS, National Vital Statistics System, Mortality

Maternal mortality rates by age, US, 2007



Source: CDC/NCHS National Vital Statistics System, Mortality

Summary

- Stagnation in the rate of decline of both infant (2000-2007) and fetal (2003-2005) mortality rates
- No detectible decline in maternal mortality rate since 1982
- Recent modest decline in preterm birth (2006-9) and infant mortality (2007-9)
- Still, preterm birth rates and infant mortality rates are much higher in the US than in most developed countries.

Summary (cont.)

- Large race and ethnic disparities in fetal, infant and maternal mortality suggest that not all race/ethnic groups have benefited equally from social and medical advances.
- Preterm birth is a primary cause of high infant mortality in the US, and contributes substantially to both race and ethnic disparities and the US' poor international ranking.
- Interventions to address the nation's high preterm birth rate must address prevention of both spontaneous preterm labor and iatrogenic preterm birth.

Questions?

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2007 linked file report available at :

http://www.cdc.gov/nchs/data/nvsr/nvsr59/nvsr59_06.pdf

Some copies in the back of the room.