The U.S. Infant Mortality Rate: International Comparisons, Underlying Factors, and Federal Programs

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Summary

The infant mortality rate (IMR)—the number of deaths occurring in the first year of life per 1,000 live births—is a widely used proxy for the health status of a nation, and is commonly used for international comparisons. As of 2008, the U.S. IMR was 6.6, a historically low rate of the United States, but a rate that is still higher than the Organization for Economic Cooperation and Development (OECD) average of 4.6. The relatively high U.S. rate—and the number of infant deaths it indicates—concerns some policymakers. In addition, there is concern that the U.S. IMR has leveled off after four decades of decline. Reducing the U.S. IMR has been—and continues to be—a recognized public health objective.

Researchers and policymakers debate the various factors that may explain the high U.S. IMR relative to other developed countries and its recent stagnation. Potential factors include international differences in the recording of live births, different rates of low birthweight and short gestational age births, and racial and ethnic disparities. Researchers conclude that international recording differences do not explain the relatively high U.S. IMR. In addition, the data suggest that racial disparities may only partially explain the relatively high U.S. IMR. Instead, researchers suggest that higher U.S. rates of low birthweight and short gestational age births may explain the relatively high U.S. IMR.

This report examines the U.S. IMR. It identifies the top three causes of U.S. infant death—congenital malformations, disorders related to low birthweight and short gestational age, and sudden infant death syndrome (SIDS). The report focuses on low birthweight and short gestational age, because the United States has relatively high and increasing rates of these births, and research has found that these births can be reduced through policy interventions.

The U.S. IMR varies geographically and is influenced by a number of factors, including the mother's demographic characteristics (e.g., education, income, or age) and health and health system characteristics. In general, southern states have the highest IMRs and states in New England and the Pacific Northwest have the lowest. The higher IMRs in southern states may be partially explained by higher rates of low birthweight and short gestational age births in these states. In addition, the racial and ethnic composition of a state's population affects its IMR because of higher IMRs among certain racial and ethnic groups. The IMR is also influenced by health and health system characteristics, including the mother's health behaviors, such as drinking and smoking, and her access to and use of prenatal care.

A number of federal programs that aim to improve the health status, and the economic and social circumstances, of low-income women and children may reduce the U.S. IMR. These programs include Healthy Start, Maternal and Child Health Services Block Grants, Medicaid, and the State Children's Health Insurance Program (CHIP). Evaluating whether a particular program reduces the IMR is challenging because individuals may be eligible for multiple programs and because programs target those with IMR risk. Given this, it is difficult to determine the effectiveness of a single program, and it is difficult to determine whether findings that a program does not reduce the IMR are due to characteristics of the program or to characteristics of its participants.

The Patient Protection and Affordable Care Act (ACA, P.L. 111-148) either establishes new or expands existing programs to reduce the IMR. For example, "Strong Start," funded by the new Center for Medicare & Medicaid Innovation created in the ACA, focuses on reducing the rate of pre-term births, which may also reduce the IMR once implemented.

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Introduction

The infant mortality rate (IMR)—the number of deaths occurring in the first year of life per 1,000 live births—is a widely used proxy for the health status of a nation, and is commonly used for international comparisons.[1] International comparisons in health status are often used by policymakers to formulate and guide the development of appropriate policy options and effective programmatic efforts. These comparisons are relied upon to help frame and assess the magnitude of a given health concern and the potential for remediation. For these reasons, policymakers may find it useful to understand the potential strengths and weaknesses of a specific indicator, including characteristics of its data sources and contextual factors that may affect the indicator.

The IMR has received the attention of policymakers in the United States for a number of reasons. As of 2008,[2] the U.S. IMR was 6.6,[3] which is a historically low rate for the United States but is higher than the Organization for Economic Cooperation and Development (OECD)[4] average of 4.6.[5] This relatively high rate concerns some policymakers because of the number of infant deaths it indicates. In addition, policymakers are concerned that the U.S. IMR appears to have leveled off after four decades of decline. The U.S. IMR declined by almost 75% from 1960 to 2000 (from 26.0 to 6.6); however, since 2000, the U.S. IMR has remained relatively stable. From 2000 to 2008, the U.S. IMR declined by 4% (from 6.9 to 6.6).

In partial response to these concerns, policymakers have recognized reducing the U.S. IMR as an important public health objective as signified by including it as one of the goals of Healthy People 2020[6]—a set of national health objectives developed by governmental and nongovernmental scientists to identify the most significant preventable threats to health and establish national goals for their reduction. The Healthy People 2020 goal is to reduce the U.S. IMR to 6.0 by 2020.

Researchers and policymakers debate various factors that may explain the high U.S. IMR. Some researchers have found that a number of social, economic, and demographic characteristics of the mother are associated with infant death. These characteristics include the mother's educational attainment, economic status, and age. Some have argued that the high U.S. IMR reflects racial and ethnic disparities, as evidenced by racial differences in IMRs.[7] Others suggest that the high

[1] See for example, Central Intelligence Agency, "The World Fact Book." https://www.cia.gov/library/publications/the-world-factbook.html or the World Health Organization, "World Health Statistics, 2011" http://www.who.int/gho/publications/world_health_statistics/en/index.html. There are a number of other health indicators used such as the overall mortality rate; life expectancy at birth; and rates of preventable infectious diseases.

[2] This report uses 2008 data, the most recent year of final U.S. data.

[3] Ariadi M. Minino, et al., *National Vital Statics Reports: Deaths: Final Data for 2008*, National Center for Health Statistics, Vol. 59, No. 10, Hyattsville, MD, December 7, 2011. Hereinafter *Deaths: Final Data 2008*.

[4] The Organization for Economic Cooperation and Development (OECD) is an intergovernmental economic organization in which the 30 member countries discuss, develop, and analyze economic and social policy; see CRS Report RS21128, *The Organization for Economic Cooperation and Development*, by James K. Jackson.

[5] Organization for Economic Cooperation and Development, OECD Health Data, 2010, http://www.oecd.org/dataoecd/4/36/46796773.pdf.

[6] See Healthy People 2020 Topics & Objectives, Maternal, Infant, and Child Health, at http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=26.

[7] James W. Collins, Jr. and Richard J. David, "Racial Disparities in Low Birth Weight and Infant Mortality," *Clinical Perinatology*, vol. 36, no. 1 (March 2009), pp. 63-73.

U.S. IMR may reflect variation in a number of health system characteristics, such as the adequacy of public health services and the availability of health care for women and infants.[8]

Interventions that seek to improve the IMR often do so by attempting to lower a particular cause of infant death. However, some causes of death, such as congenital malformations, the leading cause of U.S. infant death in 2008[9] may be less amenable to policy intervention.[10] Therefore, this report focuses on the second-leading cause of infant death—disorders related to low birthweight and short gestational age—because the United States has relatively high rates of these births, and research has found that these births can be reduced through policy intervention.[11] These two conditions are also linked because shorter gestation provides less time to attain a healthy birthweight.

This report examines the U.S. IMR. In doing so, it first identifies a number of causes of U.S. infant mortality. The report then examines international IMR comparisons and discusses geographic variation in state IMRs. Next, it examines the mother's demographic characteristics and various health system characteristics that may influence the U.S. IMR. The discussion of these factors is not exhaustive, and the report does not attempt to assess the relative contribution of each factor. The report then describes a number of federal programs that may indirectly reduce the IMR. Federal programs dedicated explicitly to reducing the IMR are rare; however, several programs target economically disadvantaged pregnant women. These women are more likely to experience an infant death; therefore, programs that aim to improve the economic or health status of this population may reduce infant mortality. Finally, the report summarizes federal initiatives included in the ACA that may reduce infant mortality.

Definitions of Low Birthweight and Short Gestational Age

Low Birthweight: Infants born at less than 2,500 grams (i.e., less than 5.5 lbs).

Short Gestational Age: Infants born prior to 37 completed weeks of gestation.

Note: Short gestational age births may also be referred to as premature or pre-term.

Source: Joyce A. Martin, et al., Births: Final Data for 2008, National Center for Health Statistics, National Vital Statistics Reports vol. 59, no.1, Hyattsville, MD, December 8, 2010, and United States Department of Health & Human Services, "CDC Features: Premature Birth" December 9, 2009, http://www.cdc.gov/Features/PrematureBirth/.

[8] Federal Interagency Forum on Child and Family Statistics, *America's Children: Key National Indicators of Health and Well-Being, 2011,* Washington, DC, July 2011, http://www.childstats.gov/americaschildren/health2.asp.

[9] Deaths: Final Data 2008.

[10] The United States reported a 46% decline in the number of infant deaths due to congenital malformations from 1980 to 2000. Consequently, some researchers believe that much of the reduction in death from reducing congenital malformations has already been achieved. For example, see Arnold Christianson, Christopher P. Howson, and Bernadette Modell, *Global Report on Birth Defects: The Hidden Toll of Dying and Disabled Children*, March of Dimes, White Plains, NY, 2006.

[11] United States Department of Health & Human Services, "Preventing Infant Mortality," press release, January 13, 2006, http://www.hhs.gov/news/factsheet/infant.html. Hereinafter, *Preventing Infant Mortality*.

U.S. Infant Mortality

Infant mortality refers to deaths that occur during infancy—the first year of life, or from a live birth to age one.[12] It is measured as a rate of infant deaths per 1,000 live births. In 2008, the U.S. IMR was 6.6. A number of sources collect infant mortality data and use those data to calculate the IMR. This report presents the most recent year of final data available (2008) from the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC). NCHS data are generally considered to be the most authoritative because they are drawn directly from birth and death records through the National Vital Statistics System, an interagency collaboration that collects birth and death certificate data obtained from state vital statistics offices.[13]

Calculating the U.S. IMR

[28,059 infant deaths/ 4,247,694 live births x 1,000 = 6.6]

A variety of conditions can cause infant death. In 2008, there were 28,059 infant deaths. Of these, 68.9% were due to the 10 leading causes of infant deaths shown in **Table 1**. One-fifth, or 20.1%, of U.S. infant deaths (5,638 deaths) were attributed to congenital malformations, the leading cause of infant death in 2008. The second-most common cause of infant death was disorders related to the infant being born at either a low birthweight, a short gestational age, or both. This accounted for 16.9% (4,754 deaths) of infant deaths. Sudden Infant Death Syndrome (SIDS) was the third-most frequent cause of death, accounting for 8.4% (2,353 deaths) of infant deaths.

Table 1. Ten Leading Causes of U.S. Infant Death, 2008

Rank	Cause of Death	Percent of Total Infant Deaths
1	Congenital malformations, deformations and chromosomal abnormalities (congenital malformations)	20.1
2	Disorders related to low birthweight and short gestational age	16.9
3	Sudden infant death syndrome (SIDS)	8.4
4	Newborn affected by maternal complications of pregnancy (maternal complications)	6.3
5	Accidents (unintentional injuries)	4.7
6	Newborn affected by complications of placenta, cord and membranes (cord and placenta complications)	3.8
7	Bacterial sepsis of newborn	2.5
8	Respiratory distress of newborn	2.2
9	Diseases of the circulatory system	2.1
10	Neonatal hemorrhage	2.0
Total	**Ten Leading Causes of U.S. Infant Death**	**68.9**

Source: Ariadi M. Minino, et al., *National Vital Statics Reports: Deaths: Final Data for 2008*, National Center for Health Statistics, Vol. 59, No. 10, Hyattsville, MD, December 7, 2011.

Note: The 10 leading causes of infant death have been relatively stable since 2006; however, there have been changes in the ranking of some causes of death.

[12] David Yaukey, *Demography: The Study of Human Populations* (Prospect Heights, IL: Waveland Press, 1985), pp. 126-127.

[13] See "National Vital Statistics System" at http://www.cdc.gov/nchs/nvss.htm.

International IMR Comparisons

This section compares the U.S. IMR to rates in other selected developed countries. It describes how the U.S. IMR compares to rates in these countries in 2008, how comparisons have changed since 1960, and some factors that may explain why the U.S. IMR is higher than rates in a number of other developed countries. These factors include international differences in how live births are recorded, differences in rates of low birthweight and short gestational age births, and racial and ethnic IMR disparities.

International IMR Comparisons and Trends

In the last year for which comparable data were available (2008) the U.S. IMR was 6.6 (see **Table 2**) and ranked 31st among OECD countries.[14] The U.S. IMR is higher than the rates found in many Western European and East Asian countries. In addition, the 2008 U.S. IMR of 6.6 was higher than the 2008 OECD average of 4.6.[15]

The U.S. IMR rank has declined over time and, in doing so, has fallen below the OECD average. Compared to the countries in **Table 2**, the U.S. rank has declined since 1960. In 1960, the United States was ranked 12th among the group. In 1980, the United States ranked 19th; fell to 30th in 2005; and 31st in 2008.[16] Prior to 1997, the U.S. IMR was lower than the OECD average; however, between 1997 and 2008, the U.S. IMR remained stable, while the OECD IMR declined. Given this, the U.S. IMR is now higher than the OECD average.[17]

[14] This ranking is relative to the OECD countries. Beginning in 2010, NCHS began comparing the U.S. IMR to OECD countries. Prior to that time, NCHS compared the U.S. to the rates in other developed countries that had comparable data available from 1960. In general, these countries are members of the OECD; however, NCHS excluded small OECD countries or those that do not have comparable data over time. For countries that had been included in comparisons, see Marian F. MacDorman and T.J. Mathews, *Behind International Rankings of Infant Mortality: How the United States Compares with Europe*, U.S. Department of Health and Human Services: Centers for Disease Control and Prevention: National Center for Health Statistics, NCHS Data Brief No.23, Hyattsville, MD, November 2009. Hereinafter, *Behind International Rankings of Infant Mortality*.

[15] Organization for Economic Cooperation and Development, OECD Health Data, 2010, http://www.oecd.org/dataoecd/4/36/46796773.pdf.

[16] U.S. Department of Health and Human Services: Centers for Disease Control and Prevention: National Center for Health Statistics, *Health United States, 2008, Table 24,* http://www.cdc.gov/nchs/data/hus/hus07.pdf#listtables

[17] Organization for Economic Cooperation and Development, *Health at a Glance 2009: OECD Indicators*, Paris, France, December 8, 2009, http://www.oecd.org/health/healthataglance.

Table 2. Infant Mortality Rates (Infant Deaths/1,000 Live Births) and Rankings for OECD and Other Selected Countries, 2008

Country	IMR	Rank
Luxembourg	1.8	1
Slovenia	2.1	2
Iceland	2.5	3
Sweden	2.5	3
Japan	2.6	5
Finland	2.6	5
Norway	2.7	7
Greece	2.7	7
Czech Republic	2.8	9
Ireland	3.0	10
Portugal	3.3	11
Belgium	3.4	12
Germany	3.5	13
Spain	3.5	13
Austria	3.7	15
Italy	3.7	15
France	3.8	17
Israel	3.8	17
Netherlands	3.8	17
Denmark	4.0	20
Switzerland	4.0	20
Australia	4.1	22
OECD Average	*4.6*	—
Korea	4.7	23
United Kingdom	4.7	23
New Zealand	4.9	25
Estonia	5.0	26
Hungary	5.6	27
Poland	5.6	27
Canada	5.7	29
Slovak Republic	5.9	30
United States	*6.6*	*31*
Chile	7.0	32
Mexico	15.2	33
Turkey	17.0	34

Source: Adapted from Organization for Economic Cooperation and Development, OECD Health Data, 2010, http://www.oecd.org/dataoecd/4/36/46796773.pdf. U.S. 2008 data from Ariadi M. Minino, et al., *National Vital*

Statics Reports: Deaths: Final Data for 2008, National Center for Health Statistics, Vol. 59, No. 10, Hyattsville, MD, December 7, 2011.

Notes: Countries with the same IMR receive the same rank. The country with the next highest IMR is assigned the rank it would have received had the lower-ranked countries not been tied, (i.e., it skips a rank). For example, Iceland and Sweden were both assigned a rank of 3. Japan, which has the next lowest IMR, is assigned the rank of 5.

Factors That May Contribute to a Relatively High U.S. IMR[18]

Analysts have suggested a number of reasons why the U.S. IMR may be higher than the rates found in other developed nations. This section examines three potential reasons: (1) inconsistent recording of live births, (2) different rates of low birthweight and short gestational age births, and (3) racial and ethnic IMR disparities. Racial and ethnic disparities are discussed briefly here and more fully later in this report (see "Factors That Influence the U.S. IMR"/"Mother's Demographic Characteristics"/"Race and Ethnicity").

Inconsistent Recording of Live Births[19]

Some suggest that international IMR differences, and the higher U.S. IMR, are caused by inconsistent recording of live births, because this is the only component of the IMR with international variation.[20] These analysts suggest that some countries record very small infants who die or infants who do not survive the first 24 hours as stillbirths, while other countries record these events as live births and include these deaths in the IMR.[21] To minimize recording differences and create comparable international infant mortality data, the United States and most developed countries have agreed to use the World Health Organization (WHO) definition of live births:

> Live birth is the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life—e.g., a beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles—whether or not the umbilical cord has been cut or the placenta is attached. Each product of such a birth is considered liveborn.[22]

Despite the use of the WHO definition, there is still some variation in the recording of live births among some European countries (see **Table 3**). Although 12 European countries record all live

[18] This discussion draws from U.S. and international IMR rates of various years. Neither the causes of infant death in the U.S. nor measurement of the IMR changed over this time period; therefore, the conclusions drawn based on research using prior years of IMR data should also apply to more current years of IMR data.

[19] Unless otherwise noted, this section is drawn from Behind International Rankings of Infant Mortality.

[20] There are three components of IMR calculation: (1) the numerator: the number of infant deaths; (2) the denominator: the number of live births; and (3) the way the rate is calculated: infant deaths/1,000 live births. The specifications for developing the numerator and the calculation do not vary internationally. However, there is some variation in the denominator—recording of live births—this variation may impact international comparisons of the IMR to a larger extent than would measurement differences in the numerator.

[21] Conrad F. Meier, "Lessons from Cuba on Infant Mortality," *The Heartland Institute*, January 13, 2005, or Editorial "Canada's Single-Prayer Health care," Investor's Business Daily, June 30, 2009.

[22] World Health Organization, *International Statistical Classification of Diseases and Health Related Problems*, 10th ed. (1993), see http://www.who.int/whosis/indicators/compendium/2008/3mr5/en/.

births,[23] other countries use weight, gestational age, or both in their definition of a live birth. For example, the Czech Republic records live births as infants born above 500 grams (1 pound and 1.63 ounces) or an infant at any birthweight that survives the first 24 hours.[24]

Table 3. Live Birth Recording Requirements, Selected Countries, 2004

Recording Requirements	Country
Differences by Gestational Age	
All live births	Austria, Denmark, England and Wales, Finland, Germany, Hungary, Italy, Northern Ireland, Scotland, Slovak Republic, Spain, Sweden, United States[a]
Live births at 12 weeks of gestation or more	Norway[b]
Differences by Birthweight	
Live births at 500 grams birthweight or more, and births at any weight if the infant survives for 24 hours	Czech Republic
Live births at 500 grams birthweight or more	Poland, Ireland
Differences by Birthweight and Gestational Age	
Live births at 22 weeks of gestation or more, or 500 grams birthweight or more	France
Live births at 22 weeks of gestation or more, or 500 grams birthweight or more if gestational age is unknown	Netherlands

Sources: Marian F. MacDorman and T.J. Mathews, *Behind International Rankings of Infant Mortality: How the United States Compares with Europe*, U.S. Department of Health and Human Services: Centers for Disease Control and Prevention: National Center for Health Statistics, NCHS Data Brief No.23, Hyattsville, MD, November 2009.

a. In addition to the countries noted in the table, Canada and Japan record all live births regardless of gestational age or weight. See Organization for Economic Cooperation and Development Health Data, 2009 at http://www.stats.oecd.org.

b. Norway records live births at 12 weeks of gestation or more, which the NCHS concludes is effectively the same as recording all live births since no live births occur before 12 weeks of gestation.

Differences in how live births are recorded may affect international IMR comparisons; however, it is unlikely that these recording differences would entirely explain the high U.S. IMR or the variation between the U.S. IMR and those of some European countries. This is because of both the widespread use of the WHO definition of live births and the small number of births that fall outside the WHO definition.[25] Researchers at NCHS conclude that for recording differences to completely explain the high U.S. IMR, European countries would have to misreport one-third of their infant deaths, which these researchers conclude is unlikely.

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[23] A 13th European country, Norway, counts live births at 12 weeks of gestation or more, which NCHS concludes is effectively the same as counting all live births since no live births occur before 12 weeks of gestation.

[24] See European Perinatal Health Report at http://www.europeristat.com/bm.doc/european-perinatal-health-report.pdf, page 40.

[25] For example, infants born below 500 grams are rare and account for 0.16% of all U.S. live births (e-mail from Reproductive Statistics Branch: National Center for Health Statistics, July 21, 2009).

After adjusting for recording differences, NCHS researchers found that the U.S. IMR was still higher than those in most European countries. Specifically, these researchers excluded deaths that occurred prior to 22 weeks of gestation. They found that excluding these very short gestational age births lowered the U.S. IMR to 5.8 (in 2004), but also lowered the IMR of European countries; therefore, it changed the U.S. ranking compared to European countries by only a small amount.[26] Given this finding, the NCHS researchers conclude that recording differences can explain only a small percentage of international IMR variation and do not entirely explain why the U.S. IMR is higher than the rates of a number of European countries.

Rates of Low Birthweight and Short Gestational Age Births

Researchers from the NCHS found that low birthweight and short gestational age births—a leading cause of infant death internationally[27]—were more common in the United States than in Europe.[28] Although outcomes for these births were similar, they found that the U.S. rate of low birthweight and short gestational age births was double that of Finland and Sweden.[29] After adjusting for potential recording differences by excluding very short gestational age births, they found that the U.S. IMR would be 3.9 if the United States had the same rate of low birthweight and short gestational age births as Sweden. Given this estimate, the researchers conclude that reducing the rate of these births would lower the U.S. IMR.[30] OECD researchers have also suggested that the increasing rates of low birthweight births may explain the recent stagnation in the U.S. IMR.[31]

Racial Disparities

The U.S. IMR differs among racial and ethnic groups, and these differences may contribute to the high U.S. IMR. Specifically, in 2008, the IMR for infants born to black mothers was 12.7, more than double the white IMR of 5.5. This difference has the effect of increasing the U.S. IMR, as births to black mothers make up 16% of U.S. births, but 30.4% of U.S. infant deaths in 2008.[32] In contrast, the U.S. IMR for white infants was 5.5.[33] This rate is closer to the Canadian IMR of 5.6; however, it is still higher than the OECD average of 4.6 and the IMRs of other English-speaking countries such as the United Kingdom and New Zealand (IMR of 4.7, rank of 23), and Australia (IMR of 4.1, rank of 22).[34]

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[26] In the NCHS recalculated rates, the U.S. IMR was higher than most European countries with the exception of Hungary, Poland, and Slovakia. The NCHS analysis excluded European countries that had unadjusted IMRs that were higher than the United States.

[27] See **Table 1** and Christopher P. Howson et al., *White Paper on Preterm Birth: The Global and Regional Toll*, March of Dimes, White Plains, NY, September 21, 2009.

[28] *Behind International Rankings of Infant Mortality*.

[29] Ibid.

[30] Ibid.

[31] Organization for Economic Cooperation and Development, OECD Health Data, 2010, http://www.oecd.org/dataoecd/4/36/46796773.pdf. Data from 2008 suggest that rates of low birthweight births have decreased; a change from prior years. **See** Joyce A. Martin, et al., Births: Final Data for 2008, National Center for Health Statistics, National Vital Statistics Reports vol. 59, no.1, Hyattsville, MD, December 8, 2010; hereinafter, *Births: Final Data for 2008*.

[32] Deaths: Final Data for 2008 and Births: Final Data for 2008.

[33] Deaths: Final Data for 2008. Non-Hispanic white infants make up 53% of U.S. births and 45% of U.S. infant deaths.

[34] See **Table 2**.

These comparisons provide some evidence that racial disparities raise the U.S. IMR. Eliminating these disparities would likely lower the U.S. IMR, but would not likely lower it below the OECD average, or below those countries with the lowest IMRs (those in Scandinavia).

Geographic Variation in U.S. Infant Mortality

There is large variation in IMRs among U.S. states. This variation may reflect differences in demographic and health system factors associated with infant death (as will be discussed further below; see "Factors That Influence the U.S. IMR"). Specifically, factors that may explain geographic variation in IMRs include (1) rates of low birthweight and short gestational age births and (2) the racial composition of the state's population. This section examines state-level geographic variation in the U.S. IMR.

In 2008, state IMRs ranged from a low of 3.95 in New Hampshire to a high of 10.84 in the District of Columbia (see **Table 4**).[35] **Figure 1** shows that 26 states (and the District of Columbia) are above the national average IMR of 6.61. Infant mortality rates are generally highest in the southern states, including Mississippi, Alabama, and Louisiana.[36] The higher IMRs in these states may be explained, in part, by demographic and health system characteristics of these states. For example, southern states have high poverty and uninsurance rates.[37] The opposite is generally true in states with low IMRs, such as those in the New England and the Pacific Northwest.[38]

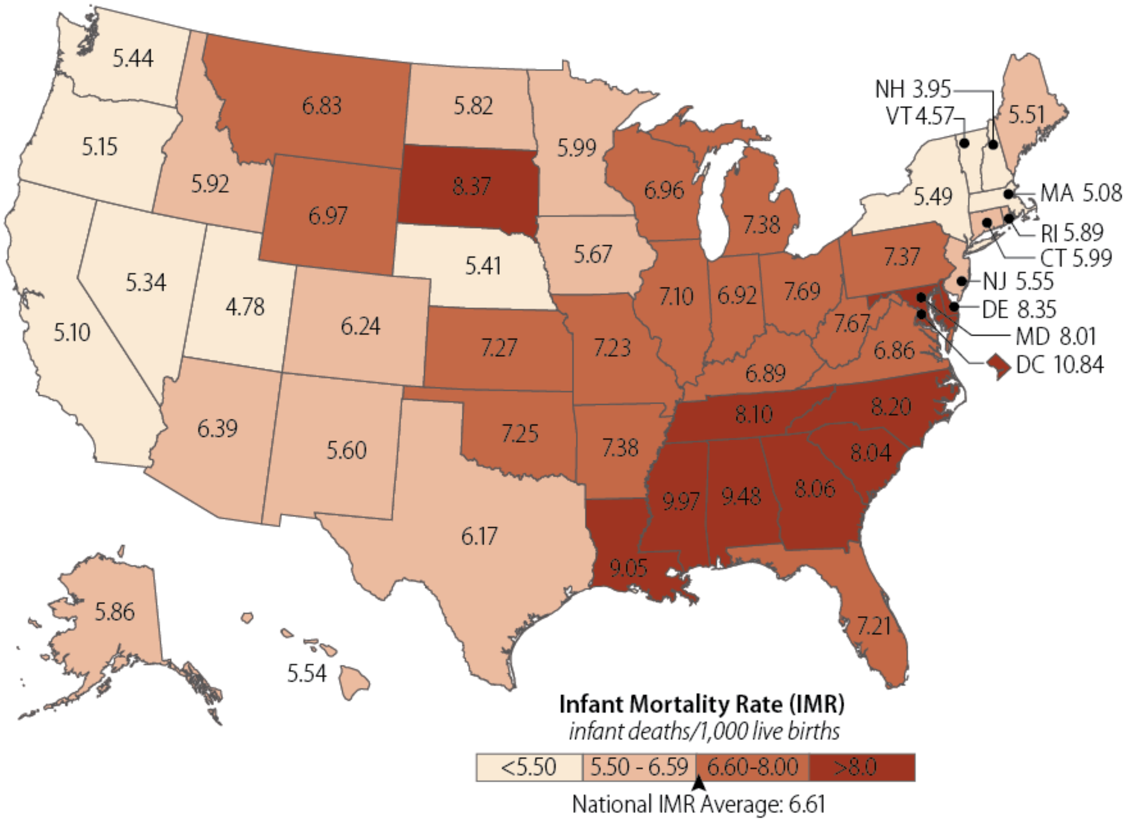
[35] Deaths: Final Data for 2008.

[36] Deaths: Final Data for 2008, and Charles E. Menifield and Jacob Dawson, "Infant Mortality in Southern States: A Bureaucratic Nightmare," *Journal of Health and Human Services*, vol. 31, no. 3 (Winter 2008), pp. 385-402.

[37] Ibid.

[38] Kaiser Family Foundation State Health Facts, http://www.statehealthfacts.org. California appears to be an exception to this general trend, because the state has a low IMR, but a high poverty rate. This may be explained by the state's large Hispanic population because the IMR for infants born to Hispanic mothers is lower than the overall U.S. IMR (see "Race and Ethnicity").

Figure 1. U.S. IMR (Infant Deaths/1,000 Live Births), by State, 2008



Source: Adapted by CRS from Ariadi M. Minino, et al., *National Vital Statics Reports: Deaths: Final Data for 2008*, National Center for Health Statistics, Vol. 59, No. 10, Hyattsville, MD, December 7, 2011.

Factors That May Contribute to State Variation in IMR

Geographic variation in the U.S. IMR results from, among other factors, variation in rates of specific causes of infant death and from variation in demographic factors associated with infant death. This section discusses variation in rates of low birthweight and short gestational age births and how different state rates of these births relate to IMR variation. It then discusses how variation in the racial composition of the state's population—specifically, variation in the relative size of a state's black[39] population—affects state IMR variation.

State Variation in Low Birthweight and Short Gestational Age Births

Geographic variation in the U.S. IMR results from different rates of infant death by state. As discussed above, low birthweight and short gestational age are a leading cause of infant death in the United States. Rates of low birthweight births (data not presented) vary by state, ranging from 11.8% in Mississippi (where the IMR is 10.0) to 6.0% in Alaska (where the IMR is 5.9). Rates of

[39] The NCHS data used compare the U.S. "black" and U.S. "white" populations.

low birthweight births influence state IMRs, as states with high IMRs, such as Mississippi and Alabama, generally have high percentages of low birthweight births. The opposite is also true, as states with low percentages of low birthweight births, such as New Hampshire and Utah have low IMRs.[40]

Table 4 shows state variation in rates of short gestational age births and its impact on state IMRs. With relatively few exceptions,[41] states that have high percentages of short gestational age births have high IMRs. The percentage of short gestational age births relative to total births in a state varies from 18.0% in Mississippi (where the IMR is 10.0) to 9.5% in Vermont (where the IMR is 4.6).

Table 4. Percent and Rank of State IMR (Infant Deaths/1,000 Live Births) and Short Gestational Age Births, 2008

State	IMR	Rank	Short Gestational Age Births as Percentage of Total Births	Rank
New Hampshire	4.0	1	9.6	2
Vermont	4.6	2	9.5	1
Utah	4.8	3	11.0	12
California	5.1	4	10.5	9
Massachusetts	5.1	4	10.8	11
Oregon	5.2	6	10.1	5
Nebraska	5.4	8	11.8	23
Nevada	5.3	7	13.5	41
Washington	5.4	8	10.7	10
Maine	5.5	10	10.3	6
New York	5.5	10	12.0	25
Hawaii	5.5	12	12.8	33
New Jersey	5.6	13	12.5	29
New Mexico	5.6	13	12.3	26
Iowa	5.7	15	11.5	20
North Dakota	5.8	16	11.1	13
Alaska	5.9	17	10.3	6
Rhode Island	5.9	17	11.2	15
Idaho	5.9	19	9.8	3
Connecticut	6.0	20	10.4	8

[40] Births: Final Data for 2008, data are not shown in **Table 4**.

[41] The exceptions are generally states with small populations, such as Alaska and Iowa.

State	IMR	Rank	Short Gestational Age Births as Percentage of Total Births	Rank
Minnesota	6.0	20	10.0	4
Colorado	6.2	22	11.4	19
Texas	6.2	22	13.3	38
Arizona	6.4	24	12.9	34
U.S.	*6.6*	—	*12.3*	—
Montana	6.8	25	11.5	20
Indiana	6.9	26	12.4	28
Kentucky	6.9	26	14.0	46
Virginia	6.9	26	11.3	18
Wisconsin	7.0	29	11.1	13
Wyoming	7.0	29	11.2	15
Illinois	7.1	31	12.7	31
Florida	7.2	32	13.8	45
Missouri	7.2	32	12.3	26
Kansas	7.3	34	11.2	15
Oklahoma	7.3	34	13.4	39
Arkansas	7.4	36	13.5	41
Michigan	7.4	36	12.7	31
Pennsylvania	7.4	36	11.6	22
Ohio	7.7	39	12.6	30
West Virginia	7.7	39	13.7	44
Maryland	8.0	41	13.0	37
South Carolina	8.0	41	14.3	47
Georgia	8.1	43	13.4	39
Tennessee	8.1	43	13.5	41
North Carolina	8.2	45	12.9	34
Delaware	8.4	46	12.9	34
South Dakota	8.4	46	11.9	24
Louisiana	9.1	48	15.4	48
Alabama	9.5	49	15.7	50
Mississippi	10.0	50	18.0	51
District of Columbia	10.8	51	15.5	49

Source: Joyce A. Martin, et al., Births: Final Data for 2008, National Center for Health Statistics, National Vital Statistics Reports vol. 59, no.1, Hyattsville, MD, December 8, 2010, and Ariadi M. Minino, et al., *National Vital*

Statics Reports: Deaths: Final Data for 2008, National Center for Health Statistics, Vol. 59, No. 10, Hyattsville, MD, December 7, 2011. Hereinafter *Deaths: Final Data 2008*.

Notes: States with the same IMR or percentage short gestational age births receive the same rank. The state with the next highest IMR/percentage of short gestational age births is assigned the rank it would have received had the lower-ranked states not been tied, (i.e., it skips a rank). For example, Massachusetts and California were both assigned a rank of 4. Oregon, which has the next lowest IMR, is assigned the rank of 6.

State Variation in Population Composition

Differences in state IMR may also, in part, reflect the racial composition of a state's population because of racial differences in the IMR and specifically, higher IMRs for infants born to black mothers. State IMR for infants born to black mothers ranges from 17.1 in Arizona to 9.4 in Massachusetts.[42] The IMR range for infants born to white mothers among states ranges from 3.35 in Alaska to 7.6 in Alabama.[43] Thus, states with a larger percentage of the population that is white have lower IMRs, whereas the opposite is true in states, such as those in the south, that have larger percentages of the population that are black.[44] Specifically, in Washington, DC—the jurisdiction with the highest IMR—51% of the population is black; in contrast, in New Hampshire—the state with the lowest IMR—1% of the population is black[45] (for further discussion of race and ethnicity, see "Factors That Influence the U.S. IMR," "Mother's Demographic Characteristics," and "Race and Ethnicity").

Factors That Influence the U.S. IMR

As previously discussed, the U.S. IMR is high due, in part, to high rates of low birthweight and short gestational age births. The high rates of both of these conditions are also linked to other factors that can be roughly grouped into two categories: (1) demographic characteristics of the mother such as race, education, and economic status, and (2) health and health system characteristics, such as the mother's health and health behaviors, and the mother's access to and receipt of prenatal care. Other causes of infant death, such as the rate of SIDS—the third-leading cause of infant death in 2008—may also vary by demographic characteristics. In addition, demographic characteristics may be correlated with each other, and with health and health system characteristics. For example, individuals who have low incomes may have inadequate access to prenatal care. These correlations make it difficult to examine the relative contribution of specific factors to the IMR. Consequently, though this report discusses these factors, it cannot conclusively attribute causality to any single factor or group of factors. Examination of other potential contributors to the IMR, such as environmental pollutants, is beyond the scope of this report.

[42] Deaths: Final Data for 2008, see Table 22. The national average black IMR is 12.7. A number of states do not have sufficient data to calculate black IMR. Data in this table were aggregated into the racial categories of "black" and "white."

[43] Ibid.

[44] Charles E. Menifield and Jacob Dawson, "Infant Mortality in Southern States: A Bureaucratic Nightmare," *Journal of Health and Human Services*, vol. 31, no. 3 (Winter 2008), pp. 385-402.

[45] Kaiser Family Foundation State Health Facts, http://www.statehealthfacts.org.

Mother's Demographic Characteristics

A number of demographic characteristics of expectant mothers may be correlated with the likelihood of having an infant die within the first year of life. Among those that researchers often consider are race, ethnicity, education, socioeconomic status, and age.

Race and Ethnicity[46]

Infant mortality rates vary by race and ethnicity. According to 2008 NCHS data, the IMR for infants born to white mothers (5.5) is almost half of the rate for infants born to black mothers (12.7). The overall IMR for infants born to Hispanic mothers (5.3) lower than the overall rate for the United States; however, this overall IMR masks variation among Hispanic subgroups. The IMR for infants born to Hispanics that are not classified ("other and unknown Hispanic") is 13.5, which is more than double the U.S. IMR average of 6.6. The IMRs for infants born to mothers of Mexican (5.1), Puerto Rican (6.1), and Central and South American descent (3.3) are lower than overall U.S. IMR.[47] The lower IMR for infants born to Hispanic mothers is considered by some to be an epidemiological paradox because some Hispanic groups (e.g., Mexican Americans) experience the same disadvantaged socioeconomic conditions as many blacks, yet have lower rates of infant mortality.[48] These racial and ethnic disparities in the IMR may reflect demographic or socioeconomic characteristics of the mother, health and health system characteristics, or other characteristics of the mother or her environment.

The high average IMR for non-Hispanic blacks can be partly explained by higher rates of low birthweight[49] and short gestational age births,[50] which, in turn, may be explained by demographic characteristics of the mother. Demographic characteristics such as being in poverty, having less than a high school education, or being unmarried are more common in the non-Hispanic black population, and these characteristics are correlated with having a low birthweight or short gestational age birth. Rates of SIDS are higher among non-Hispanic black and American Indian/Alaska Native infants. Research suggests that low rates of preventive behaviors—such as entering prenatal care early in pregnancy, taking folic acid supplements, and completing childhood vaccinations—may explain the elevated IMR among infants born to non-Hispanic

[46] This report uses the same racial and ethnic categories used by NCHS. How the federal government collects racial and ethnic data has changed over time. As of 2003, federal agencies were required to collect data on race and ethnicity separately and were required to collect data on individuals of one or more race. Office of Management and Budget, "Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity," 62 *Federal Register* 36873-36946, July 9, 1997. In some cases, data on race and ethnicity are not collected separately. This is generally done to maintain comparable data over time. This CRS report will use the same racial and ethnic categories as the source data described, which may vary from the Office of Management and Budget requirements.

[47] Deaths: Final Data for 2008.

[48] Robert A. Hummer et al., "Paradox Found (Again): Infant Mortality Among the Mexican-Origin Population in the United States," *Demography*, vol. 44, no. 3 (August 2007), pp. 441-457.

[49] Births: Final Data for 2008.

[50] See, for example, Anjel Vahratian, Pierre Buekens, and Greg R. Alexander, "State-Specific Trends in Preterm Delivery: Are Rates Really Declining Among Non-Hispanic African American Across the United States," *Maternal Child Health*, vol. 10, no. 1 (January 2006), pp. 27-32, and Michael Kramer and Carol R. Hogue, "Place Matters: Variation in the Black/White Very Preterm Birth Rate Across U.S. Metropolitan Areas, 2002-2004," *Public Health Reports*, vol. 123, no. 5 (September/October 2008), pp. 576-585.

black women.[51] Research also suggests that high rates of smoking and alcohol abuse may explain the elevated IMR among infants born to American Indian/Alaska Native women.[52]

Education

Studies have shown that women with higher levels of education are less likely to give birth to an infant who dies within the first year of life.[53] Researchers at the Robert Wood Johnson Foundation found that infants born to mothers with at least a high school education are less likely to die in their first year of life than are infants born to mothers who have not completed high school. These gaps are more dramatic in some states; for example, the researchers found the widest gap in South Carolina, where infants born to mothers who were not high school graduates were twice as likely to die as infants born to mothers who had graduated.[54]

Education may influence the IMR in a variety of ways. Education is often a pathway to better employment opportunities and higher incomes, so it may indirectly affect health status through income.[55] It may also affect the IMR through marital status, as college-educated mothers are more likely to be married, and the IMR is lower for infants born to married mothers. Lower educational attainment may also be correlated with higher rates of certain negative health behaviors, such as tobacco and alcohol consumption, which may increase the risk of having an infant die, or of having conditions linked with infant death. Researchers have found that declining smoking rates among less-educated women have reduced infant mortality. Conversely, increasing rates of excessive weight gain among less-educated women during pregnancy have offset some of these gains. More highly educated women are also less likely to smoke and are more likely to gain the appropriate amount of weight during pregnancy.

Some recent trends may be altering the relationship between education and the IMR. More highly educated women are more likely to be older mothers (over age 40), have multiple births, and use fertility treatments. All of these factors may increase infant mortality, as discussed below (see "Age").

Economic Status

Women with higher incomes are less likely to have an infant die. The inverse relationship between economic status and the IMR is part of the larger finding, in general, that people with higher incomes are in better health.[56] Economic status may also be related to access to health

[51] U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau 2006, *Evidence of Trends, Risk Factors, and Intervention Strategies, A Report from the Healthy Start National Evaluation 2006: Racial and Ethnic Disparities in Infant Mortality*, Rockville, MD.

[52] Ibid.

[53] See, for example, Rebecca Din-Dzietham and Irva Hertz-Picciotto, "Infant Mortality Differences between Whites and African Americans: The Effects of Maternal Education," *American Journal of Public Health*, vol. 88 (1998), pp. 651-55.

[54] Robert Wood Johnson Foundation, "New State-by-State Report Finds Shortfalls in Children's Health Tied to Parents' Income and Education," press release, October 8, 2008, http://www.rwjf.org/pr/product.jsp?id=35208.

[55] This paragraph is drawn from John Mirowsky and Catherine E. Ross, *Education, Social Status, and Health* (New York: Aldine De Gruyter, 2003) and Wanchaun Lin, "Why Has the Health Inequality Among Infants in the US Declined? Accounting for the Shrinking Gap," *Health Economics*, vol. 18 (September 24, 2008), pp. 823-841.

[56] See, for example, Brian Karl Finch, "Early Origins of the Gradient: The Relationship Between Socioeconomic Status and Infant Mortality in the United States," *Demography*, vol. 40, no. 4 (November 2003), pp. 675-699.

insurance and to the quality of health care received, and can affect infant health both directly and indirectly through health and health system characteristics.[57] Researchers have found that increasing access to health care for women at all income levels has served to narrow the income gap in infant mortality.[58]

Age

The changing age composition of women giving birth may increase the average U.S. IMR.[59] Births to women ages 40 to 44 have increased since 1990, which may increase the IMR.[60] Women over age 30 are more likely to have multiple births. This occurs both because of the use of fertility treatments and because the likelihood of twins increases with age.[61] Infants of multiple births are more likely to die and to be both of low birthweight and short gestational age.[62] In addition to the increased risk of multiple births, increasing maternal age may raise the IMR because the risk of a number of health conditions, including birth defects and congenital abnormalities, increases with maternal age.[63]

Health and Health System Characteristics

A number of characteristics of an expectant mother's health and the health care she receives could influence infant mortality. Such characteristics include whether the mother used fertility treatments (called assisted reproductive technology, or ART) to conceive,[64] the mother's health and health behaviors, and the amount and timing of prenatal care received.[65] These characteristics may be interrelated and may also be influenced by the expectant mother's demographic characteristics. In addition, health system characteristics may affect infant mortality and the IMR. These factors include access to care and quality of care received.

Assisted Reproductive Technology

Increased use of ART may raise the IMR through increasing rates of multiple births, which may increase the percentages of infants born at low birthweight or short gestational age.[66] ART may also increase low birthweight births among single births. The CDC found, in a study of single births, that a 2% increase in ART births resulted in a 7% increase in low birthweight births.[67] ART

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[57] Ibid.

[58] Wanchaun Lin, "Why Has the Health Inequality Among Infants in the US Declined? Accounting for the Shrinking Gap," *Health Economics*, vol. 18 (September 24, 2008), pp. 823-841.

[59] More discussion of recent changes in fertility can be found at Births: Final Data for 2008.

[60] For example, in 2008, the birthrate for women over age 40 for was the highest report in more than 40 years.

[61] See http://www.marchofdimes.com/14332_1155.asp.

[62] Births: Final Data for 2008.

[63] See http://www.marchofdimes.com/14332_1155.asp.

[64] Centers for Disease Control and Prevention, "Assisted Reproductive Technology and Trends in Low Birthweight—Massachusetts, 1997—2004," *Morbidity and Mortality Weekly,* vol. 58, no. 03 (January 30, 2009).

[65] Charles E. Menifield and Jacob Dawson, "Infant Mortality in Southern States: A Bureaucratic Nightmare," *Journal of Health and Human Services*, vol. 31, no. 3 (Winter 2008), pp. 385-402.

[66] See http://www.marchofdimes.com/professionals/14332_4545.asp and http://ww2w.marchofdimes.com/prematurity/21326_1157.asp.

[67] Centers for Disease Control and Prevention, "Assisted Reproductive Technology and Trends in Low Birthweight—(continued...)

may also increase short gestational age births, and one study by the March of Dimes Foundation attributed part of the 25-year, 36% increase in short gestational age births in the United States to the increasing use of ART.[68] The increase in ART births may confound the relationship between the mother's demographic characteristics and the IMR, because ART is more commonly used by women who would otherwise be less likely to have an infant die—that is, women who are older, more educated, and more financially secure.[69]

Health and Health Behaviors

Since 1990, a number of maternal lifestyle and health characteristics that may raise the IMR have increased. These include inappropriate weight gain during pregnancy,[70] tobacco use, gestational diabetes, and hypertension. There has been a 30% increase in women gaining too much weight during pregnancy and a 50% increase in women gaining too little weight.[71] Weight gains outside of the recommended guidelines have been associated with a number of adverse outcomes, including infant mortality.[72] Research has found that tobacco use during pregnancy increases rates of low birthweight and short gestational age births, and the rate of SIDS.[73] Rates for gestational diabetes have increased 3% per year on average since 1990, and rates of both pregnancy-associated and chronic hypertension have increased by an average of 1% annually since 1990. These conditions are associated with greater risk of pregnancy complications and adverse outcomes.[74]

Health behaviors following pregnancy, such as breastfeeding and the duration between pregnancies, can affect the IMR, and differences in these health behaviors may partially explain racial and ethnic IMR differences. From 2000 to 2007, breastfeeding rates have increased; however, there are racial and ethnic differences in breastfeeding rates. Non-Hispanic black women have consistently lower rates of breastfeeding when compared to white or Hispanic women. [75] Short duration between pregnancies (less than six months) increases the risk of infant

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Massachusetts, 1997—2004," *Morbidity and Mortality Weekly,* vol. 58, no. 03 (January 30, 2009).

[68] The March of Dimes Foundation. Christopher P. Howson, Mario Merialdi, and Joy E. Lawn, et al., *White Paper on Preterm Birth: The Global and Regional Toll*, March of Dimes, White Plains, NY, September 21, 2009. The 25-year period was from 1985 to 2009. The authors cannot determine what percentage of the 36% increase was due to ART because the time period corresponds with other factors that may increase short gestational age births. These factors include advances in neonatal technology, increases in the percentage of women giving birth over age 35, and changes in clinical practice that might contribute to early induction of labor or performing Cesarean sections prior to full-term.

[69] Elizabeth Harvey Stephen and Anjani Chandra, "Use of Infertility Services in the United States: 1995," *Family Planning Perspectives*, vol. 32, no. 3 (May/June 2000).

[70] Recommended weight gain during pregnancy is between 16 and 40 lb., see Births: Final Data for 2008.

[71] Unless otherwise noted, material in this section is drawn from Births: Final Data for 2006.

[72] National Institutes of Health, Eunice Kennedy Shriver National Institute of Child Health & Human Development, "Pregnancy and Healthy Weight," press release, April 7, 2010, http://www.nichd.nih.gov/news/resources/spotlight/040710-pregnancy-healthy-weight.cfm.

[73] TJ Mathews, "Smoking During Pregnancy—United States, 1990—2002," *MMWR*, vol. 53, no. 39, pp. 911-915. From 1990 to 2002, the rate of women smoking during pregnancy appears to have declined; however, between 2002 and 2006 the rate appears to have increased (from 11.4% to 13.2%). This apparent increase may be the result of methodological changes in how these data were collected.

[74] Elizabeth Baraban, Lucie McCoy, and Paul Simon, "Increasing Prevalence of Gestational Diabetes and Pregnancy-Related Hypertension in Los Angeles County, California, 1991–2003," *Preventing Chronic Disease*, vol. 5, no. 2 (July 2008), p. http://www.cdc.gov/pcd/issues/2008/.

[75] Centers for Disease Control and Prevention, "Breastfeeding Among U.S. Children Born 2000-2008, CDC National (continued...)

death, of being born at a low birthweight or short gestational age, and of dying of SIDS. Duration between pregnancy varies by racial and ethnic groups, with non-Hispanic blacks and American Indian/Alaska Native women having shorter durations between pregnancies.[76]

Prenatal and Preconception Care

Prenatal care has been demonstrated to be an effective intervention to reduce infant mortality because it includes health care as well as education and counseling about how to handle various aspects of pregnancy, including nutrition, physical activity, and basic infant care skills.[77] Women who did not receive any prenatal care are more likely to have an infant die in the first month after birth. In addition, research has found that prenatal care reduces the incidence of low birthweight and short gestational age births, and of deaths due to accidents or SIDS.[78]

Delayed prenatal care may increase infant mortality. Prenatal care may be particularly important at earlier points in the pregnancy because health education to encourage appropriate weight gain or to discourage alcohol or tobacco use will have more effect on the fetus at early stages of the pregnancy, when the fetus is developing most rapidly. For example, researchers found that young women who initiated prenatal care early in pregnancy were less likely to use alcohol, cigarettes, or marijuana.[79] Prenatal care receipt may explain some observed racial differences in IMR, since non-Hispanic black mothers are 2.5 times more likely to begin prenatal care in the third trimester, or to receive no prenatal care.[80]

Some researchers and policymakers suggest that prenatal care should begin prior to pregnancy; this is called "preconception care." These researchers suggest that such care can ensure that the to-be expectant mother receives the proper vitamins and vaccinations, and that she engages in healthy behaviors such as exercising and abstaining from smoking, drinking, and drugs.[81] Some

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Immunization Survey," August 1, 2011, http://www.cdc.gov/breastfeeding/data/NIS_data/index.htm.

[76] U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau, *Evidence of Trends, Risk Factors, and Intervention Strategies, A Report from the Healthy Start National Evaluation 2006: Racial and Ethnic Disparities in Infant Mortality*, Rockville, MD.

[77] Eunice Kennedy Shriver National Institute of Child Health and Human Development. "Care Before and During Pregnancy—Prenatal Care." http://www.nichd.nih.gov/womenshealth/research/pregbirth/prenatal_care.cfm.

[78] See, for example, *Prenatal Care: Reaching Mothers, Reaching Infants*, ed. Sarah S. Brown (Washington, DC: National Academy Press, 1988) and Greg R. Alexander and Milton Kotelchuck, "Assessing the Role and Effectiveness of Prenatal Care: History, Challenges, and Directions for Future Research," *Public Health Reports*, vol. 116 (July/August 2001), pp. 306-316.

[79] Joyce C. Abma and Frank L. Mott, "Substance Use and Prenatal Care During Pregnancy Among Young Women," *Family Planning Perspectives*, vol. 23, no. 3 (May/June 1991), pp. 117-128.

[80] U.S. Department of Health and Human Services, The Office of Minority Health, "Infant Mortality and African Americans," factsheet, July 22, 2011, http://www.minorityhealth.hhs.gov/templates/content.aspx?lvl=3&lvlID=8&ID=3021. However, even in cases where non-Hispanic black mothers began primary care at the beginning of pregnancy, the IMR is higher for babies born to these women. This suggests that increasing access to prenatal care for non-Hispanic black pregnant women will not be sufficient to decrease racial disparities in the IMR. There are a number of reasons why prenatal care may be less effective for non-Hispanic black pregnant women, such as differences in the quality of health care received by non-Hispanic blacks as compared to other pregnant women. See Andrew J. Healy et al., "Early Access to Prenatal Care: Implications for Racial Disparity in Perinatal Mortality," *Obstetrics & Gynecology*, vol. 107, no. 3 (March 2006), pp. 625-631.

[81] Eunice Kennedy Shriver National Institute of Child Health and Human Development. "Care Before and During Pregnancy—Prenatal Care," http://www.nichd.nih.gov/womenshealth/research/pregbirth/prenatal_care.cfm.

experts have suggested that prenatal care occurs too late to effectively improve the health of the expectant mother or her infant. This may occur because many women have health conditions such as obesity or asthma prior to pregnancy, or because women typically do not visit a doctor until 6 to 12 weeks after conception.[82] Preconception care, in addition to prenatal care, may reduce infant mortality by improving the health and health behaviors of the expectant mother, thereby reducing the risks of a number of causes of infant mortality.[83]

Quality of Care

Variation in the IMR by race, education, and socioeconomic status may be related to both the quality of prenatal care and the quality of care at delivery. Specifically, the hospital at which an infant is delivered may affect health outcomes, particularly for low birthweight or short-gestational-age infants, who may require specialized care such as neonatal intensive care.[84] Researchers have found that black infants were more likely to be born at hospitals with higher overall mortality rates. These researchers conclude that if black infants were to be born at the same hospitals as white infants, mortality rates for black infants would be lower.[85] Some researchers have also found that hospital-level improvements, such as the adoption of health information technology that may standardize treatment and improve monitoring, reduce the number of infant deaths and improve the IMR.[86] In addition, insurance status, which is related to socioeconomic characteristics, may influence the quality of care received. For example, women enrolled in Medicaid—a joint federal and state program that provides health insurance coverage to certain low-income pregnant women and infants—are more likely to give birth at public hospitals that may be of lower quality than the hospitals used by women with private insurance.[87]

Access to Care

A pregnant woman's access to health care is also important for reducing infant mortality. The availability of physicians, particularly those providing primary care, is associated with lower infant mortality.[88] In a study examining the factors associated with the higher rates of infant mortality in southern states, the authors found that state IMR decreased when the number of doctors and hospitals per capita increased. The authors found that states with larger total uninsured populations had higher IMRs. A large uninsured population[89] may increase the IMR

[82] Jeffrey Levi, Marlene Cimons, and Kay Johnson, *Healthy Women, Healthy Babies*, An Issue Brief from Trust for America's Health, Washington, DC, June 2008.

[83] Ibid.

[84] Elizabeth A. Howell, et al., "Black/White Differences in Very Low Birth Weight Neonatal Mortality Rates Among New York City Hospitals," *Pediatrics*, vol. 121, no. 3 (March 2008), pp. e407-e415 and Leo S. Morales et al., "Mortality Among Very Low-Birthweight Infants in Hospitals Serving Minority Populations," *American Journal of Public Health*, vol. 95, no. 12 (December 2005), pp. 2206-2212.

[85] Ibid.

[86] Amalia R. Miller and Catherine E. Tucker, "Can Health IT Save Babies?" *MIT Sloan Research Paper*, vol. 4686-08 (January 1, 2008).

[87] Nancy E. Moss and Karen Carver, "The Effects of WIC and Medicaid on Infant Mortality in the United States," *American Journal of Public Health*, vol. 88, no. 9 (September 1998), pp. 1354-1361.

[88] Unless otherwise noted, this paragraph is drawn from a literature review by Barbara Starfield, Leiyu Shi, and James Macinko, "Contribution of Primary Care to Health and Health Systems," *The Milbank Quarterly*, vol. 83, no. 3 (2005), pp. 457-502.

[89] See for example, data from the Health Care Cost & Utilization Project (HCUP) from Agency for Health Care (continued...)

because uninsured pregnant women are less likely to receive prenatal care and report having greater difficulty obtaining prenatal care than do insured women.[90] In general, insurance status, which is related to access to care and the quality of care received, may affect infant mortality. Researchers have found that IMRs are the lowest for infants born to women enrolled in private insurance, that IMRs are higher for women enrolled in Medicaid, and that IMRs are highest for infants born to women who were uninsured.

Researchers also have found that access to primary care can influence the national IMR. In general, countries with more primary care services available have lower national IMRs. In addition, countries that have implemented health reforms to increase primary care access have lower IMRs after implementation.

Federal Programs That May Reduce Infant Mortality

Research has shown that some federal programs may reduce the IMR by improving the financial status or the health of low-income women and infants, who, as discussed above, may be at higher risk of having an infant die within the first year of life.[91] It is also speculated that other programs that focus on providing income and material support, improving health or health behaviors, or increasing access to health services may also reduce infant mortality. This section describes some of these federal programs; it then briefly summarizes some of the research evaluating the effects of federal programs on reducing infant mortality, and discusses some of the challenges associated with assessing program effectiveness.

Income and Material Support Programs

Income and material support programs may reduce the IMR by providing direct financial or material resources to low-income families. These programs include the Temporary Assistance for Needy Families program (TANF),[92] which, through block grants to states, funds a wide range of benefits (including cash), services, and activities; and two nutrition programs—the Women, Infants, and Children program (WIC) and the Supplemental Nutrition Assistance Program (SNAP, formerly the Food Stamps program).[93] In addition, federal programs that provide material

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Research and Quality (AHRQ), http://hcupnet.ahrq.gov/; findings from an analysis of births in Hawaii covered by Medicaid in A. Schempf, D. Hayes, and L. Fuddy, *Medicaid/QUEST Birth Outcome Fact Sheet: Hospital Discharge Data, Hawaii Health Information Corporation*, Hawaii State Department of Health, Family Health Services Division, Honolulu, HI, October 2008 and Louie Albert Woodbright, *Method of Payment for Delivery*, Alabama Department of Public Health, Montgomery, AL, July 2007, http://www.adph.org.

[90] Jeffrey Levi, Marlene Cimons, and Kay Johnson, *Healthy Women, Healthy Babies*, An Issue Brief from Trust for America's Health, Washington, DC, June 2008.

[91] See "Do Federal Programs Reduce Infant Mortality?"

[92] CRS Report RL32760, *The Temporary Assistance for Needy Families (TANF) Block Grant: Responses to Frequently Asked Questions*, by Gene Falk.

[93] CRS Report R42353, *Domestic Food Assistance: Summary of Programs*, by Randy Alison Aussenberg and Kirsten J. Colello and CRS Report R41354, *Child Nutrition and WIC Reauthorization: P.L. 111-296*, by Randy Alison Aussenberg.

resources to low-income families, such as access to low-income housing and financial assistance with heating costs, may also improve infant health and reduce the IMR.[94]

Health Programs

Various agencies within the Department of Health and Human Services (HHS) sponsor programs to reduce infant mortality. This section describes some of these programs, including programs that sponsor public health education, promote access to prenatal and infant care, and sponsor research to reduce the IMR.[95] The majority of these programs do not focus on reducing infant mortality. Rather, reducing infant mortality may be one of many program goals or may be included in an overall goal of improving health. One program, Healthy Start, focuses explicitly on reducing infant mortality, and another, Maternal and Child Health Services Block Grants,[96] focuses on improving maternal and child health.

Healthy Start[97]

The Healthy Start Program is the only federal program that specifically aims to lower the IMR by reducing racial and ethnic IMR disparities. The program, administered by the Health Resources and Services Administration (HRSA), an agency within HHS, awards grants to non-profit organizations, state and local health departments, and other entities to support projects to improve maternal and child health in communities with high IMRs. In addition to addressing the community IMR, Healthy Start sites focus on intermediate goals that may also reduce the IMR, such as decreasing the percentage of low birthweight births and increasing prenatal care use among program recipients. The program seeks to achieve these goals by both direct services—home visits and case management—to pregnant women and by reducing gaps in health care and support services available community-wide. In order to address community-wide gaps in services, Healthy Start programs are required to coordinate with other federal health programs (described below), including Maternal and Child Health Services Block Grants, Medicaid, and the State Children's Health Insurance Program (CHIP). This coordination attempts to avoid duplication and to ensure that Healthy Start clients are enrolled in the programs for which they are eligible. Healthy Start sites may also offer other services, such as transportation to medical or other appointments, smoking cessation services, and programs to increase male involvement in pregnancy and parenting.

[94] CRS Report R41654, *Introduction to Public Housing*, by Maggie McCarty and CRS Report RL33275, *The LIHEAP Formula: Legislative History and Current Law*, by Libby Perl.

[95] Preventing Infant Mortality. The discussion below provides examples of programs that HHS administers; other HHS programs not discussed may also prevent infant mortality.

[96] CRS Report R42428, *The Maternal and Child Health Services Block Grant: Background and Funding*, by Amalia K. Corby-Edwards.

[97] This section is based on the following sources, U.S. General Accounting Office, *Healthy Start: Preliminary Results from National Evaluation are Not Conclusive*, HEHS-98-167, June 1998; Barbara Devaney et al., *Reducing Infant Mortality Lessons Learned from Healthy Start*, Mathematica Policy Research, Inc., Final Report, Princeton, NJ, July 2000; White House, Office of Management and Budget, *Detailed Information on the Healthy Start Assessment*, Washington, DC, http://www.whitehouse.gov/omb/expectmore/; United States Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau, *A Profile of Health Start: Findings From Phase I of the Evaluation 2006*, Rockville, MD, 2006, http://mchb.hrsa.gov/healthystart/phase1report/; and U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau, *Evidence of Trends, Risk Factors, and Intervention Strategies, A Report from the Healthy Start National Evaluation 2006: Racial and Ethnic Disparities in Infant Mortality*, Rockville, MD.

Maternal and Child Health Services Block Grants

HRSA also administers the Maternal and Child Health Services Block Grant program.[98] States receive block grant funds and have discretion in the specific activities they fund, although grants are awarded to meet a number of maternal and child health goals, including reducing the state's IMR. Block grant funds are used to fund a variety of services, including health, health education, and prevention services mentioned below (e.g., health screenings and vaccinations). Another purpose of the program is to coordinate the maternal and child health grant services with the state's Medicaid program.[99]

Health Education Efforts

HHS sponsors a number of health education efforts designed to improve maternal and child health and thereby reduce the IMR:[100]

- **Toll-free prenatal care line:** HHS sponsors a toll-free hotline—in English and Spanish—that provides information on prenatal care, including referrals to local clinics or providers. The Center for Medicare & Medicaid Services (CMS) has also partnered with Text4Babies, which provides health information to pregnant women to encourage enrollment in Medicaid and the State Children's Health Insurance Program (CHIP).[101]
- **SIDS prevention:** HHS sponsors a health education campaign to encourage parents to place infants to sleep on their backs. This campaign—called "Back to Sleep"—increased the percentage of infants sleeping on their backs from 13% to 76% from 1992 to 2006 and has reduced the number of deaths from SIDS from 1.40 deaths per 1,000 births in 1988 to 0.55 deaths per 1,000 births in 2006.[102]
- **Folic acid campaign:** The CDC, in conjunction with private organizations, promotes the consumption of folic acid among women of child-bearing age in order to reduce birth defects.
- **Preventing mother-to-child HIV transmission:** HHS provides information to pregnant women and to providers on HIV testing and treatment options to reduce mother-to-child HIV transmission.

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[98] Preventing Infant Mortality and CRS Report R42428, *The Maternal and Child Health Services Block Grant: Background and Funding*, by Amalia K. Corby-Edwards. This program is authorized under Title V of the Social Security Act.

[99] CRS Report R42428, *The Maternal and Child Health Services Block Grant: Background and Funding*, by Amalia K. Corby-Edwards.

[100] Unless otherwise specified, the information in this section is drawn from Preventing Infant Mortality.

[101] Department of Health and Human Services, "Obama Administration and Text4Baby Join Forces to Connect Pregnant Women and Children to Health Coverage and Information," press release, February 28, 2012, http://www.hhs.gov/news/press/2012pres/02/20120228c.html.

[102] See http://www.nichd.nih.gov/SIDS/upload/SIDS_rate_back_sleep_2006.pdf released by the Eunice Kennedy Shriver National Institute of Child Health and Human Development.

Prevention Programs

HHS sponsors a number of prevention programs, which may indirectly lower the IMR. For example, the CDC, through the Preventive Health and Health Services Block Grant (PHHSBG) program, provides funding to states to support state-determined prevention efforts.[103] The Social Services Block Grant (SSBG) program—a flexible source of funds for states to support social service activities[104]—may also provide funds for prevention efforts. PHHSBG or SSBG funds may be used to support prevention efforts such as those discussed below:

- **Teen pregnancy:** HHS supports a number of programs to reduce teen pregnancy.[105] These include health education programs, including both sex education and abstinence-only education programs. Educational efforts to prevent teen pregnancy may reduce the IMR, because infants born to teenage mothers are more likely to die in the first year of life.[106]
- **Family planning:** HHS provides block grants to states to support family planning efforts, such as providing contraception, screening, counseling, and referral for treatment of sexually transmitted infections, including HIV/AIDS.[107] This program may reduce the IMR because research has shown that women who have unintended pregnancies are more likely to delay prenatal care and to have adverse outcomes, including low birthweight births and infant deaths.[108]
- **Programs to prevent child abuse and neglect:** HHS sponsors a number of programs to reduce child abuse and neglect. These include programs that provide education and support to new low-income parents through home visiting by nurses or other trained health professionals. These programs aim to improve parenting skills and to reduce infant death by preventing accidents or SIDS.[109] In addition, programs sponsored by the Administration for Children and Families seek to prevent, identify, and intervene in instances of child abuse and neglect. Such programs may reduce the IMR because they may prevent accidents or other unintentional or intentional deaths.[110]
- **Childhood immunization programs:** HHS administers the National Vaccine Program, a coordinated effort among several federal departments and agencies to prevent infectious diseases through immunization, and to prevent adverse reactions to vaccines.[111] As a result of these efforts, childhood vaccination levels have increased and deaths from preventable diseases have decreased.[112]

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[103] See "Preventive Health and Health Services Block Grant" at http://www.cdc.gov/nccdphp/blockgrant/about.htm.

[104] CRS Report 94-953, *Social Services Block Grant: Background and Funding* , by Karen E. Lynch.

[105] CRS Report RS20301, *Teenage Pregnancy Prevention: Statistics and Programs*, by Carmen Solomon-Fears.

[106] Births, Final Data, 2008.

[107] CRS Report RL33644, *Title X (Public Health Service Act) Family Planning Program*, by Angela Napili.

[108] Deanna L. Pagnini and Nancy E. Reichman, "Psychosocial Factors and the Timing of Prenatal Care Among Women in New Jersey's HealthStart Program," *Family Planning Perspectives*, vol. 32, no. 2 (March/April 2002), pp. 56-64 and Prakesh S. Shah et al., "Intention to Become Pregnant and Low Birth Weight and Preterm Birth: A Systematic Review," *Maternal Child Health Journal*, vol. 15 (2011), pp. 205-216.

[109] CRS Report R40705, *Home Visitation for Families with Young Children*, by Emilie Stoltzfus and Karen E. Lynch.

[110] CRS Report R40899, *The Child Abuse Prevention and Treatment Act (CAPTA): Background, Programs, and Funding*, by Emilie Stoltzfus.

[111] HHS, National Vaccine Program Office, http://www.hhs.gov/nvpo/. The National Vaccine Program activities (continued...)

Research Efforts

HHS also supports health research to prevent infant mortality through the National Institutes of Health (NIH) and the CDC.[113] The Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) is the primary NIH institute that supports research to prevent infant mortality. For example, NICHD has supported research demonstrating the effects of progesterone injections in reducing short gestational age births and has supported projects to identify risk factors for IMR, such as poor air quality.[114] In addition to NICHD, another NIH institute, the National Heart, Lung, and Blood Institute, has supported research that may reduce the IMR by improving outcomes for pregnant women with hypertension and improving outcomes for short gestational age infants with respiratory distress syndrome.[115] The CDC also sponsors or conducts research on infant mortality, such as a study on behavioral and environmental factors related to short gestational age births among African American women.[116]

Health Care Access Efforts

HHS sponsors programs to increase access to health services for low-income pregnant women or low-income infants. Programs may provide services directly or may expand access by increasing health insurance coverage. The federal health center program[117] is one example of a program that provides services directly to low-income pregnant women and their infants. Health centers are facilities located in health professional shortage areas or medically underserved areas that provide primary health care, including prenatal care, at reduced or no cost to low-income and uninsured individuals. Health centers may provide care to women who would otherwise forgo prenatal care or may provide primary and preventive care to infants, which could reduce infant mortality.[118] Health centers also aim to reduce the number of low birthweight births among the pregnant women they serve. Health centers have generally been successful in doing so, because the rate of low birthweight births among women served by health centers is 5% below the national average.[119]

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include, but are not limited to (1) assurance of a vaccine's safety and effectiveness before licensing; (2) development of expert recommendations regarding the use of approved vaccines; (3) financing of recommended vaccines for certain low-income children; and (4) a compensation program for individuals who suffer vaccine related injuries.

112 Preventing Infant Mortality.

113 Other agencies, such as AHRQ, may also sponsor IMR-related research. For example, AHRQ awards grants to support the Excellence Centers To Eliminate Ethnic/Racial Disparities (EXCEED) program. These centers examine causes of health disparities for a number of health conditions including infant mortality. See http://www.ahrq.gov/research/exceed.htm.

114 Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, "Infant Mortality: Reducing Infant Deaths," http://www.nichd.nih.gov/news/resources/advances/2005/infant.cfm.

115 Preventing Infant Mortality.

116 Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, "Infant Mortality: Reducing Infant Deaths," press release, September 9, 2006.

117 CRS Report R42433, *Federal Health Centers*, by Elayne J. Heisler.

118 Ibid and Jeffrey Levi, Marlene Cimons, and Kay Johnson, *Healthy Women, Healthy Babies*, An Issue Brief from Trust for America's Health, Washington, DC, June 2008.

119 Department of Health and Human Services, Health Resources and Services Administration, *Justification of Estimations for Appropriations Committees, FY2013, Rockville, MD.*

The CDC, in partnership with state and local health departments, offers preconception services to women. Some of these programs target women who have recently given birth in order to lengthen the duration between a subsequent pregnancy, which may reduce the risk of infant mortality as discussed above (see "Prenatal and Preconception Care").[120]

Medicaid and CHIP provide health insurance coverage to certain low-income pregnant women and infants.[121] These programs may reduce the IMR by improving access to health care services. Medicaid provides health benefits that cover prenatal care, birth, and health care costs for low-income infants in the first year of life. The CHIP program covers low-income children with no health insurance in families with income above Medicaid eligibility levels.

Do Federal Programs Reduce Infant Mortality?

Researchers found ambiguous results when they examined the effects of federal programs on infant mortality and the IMR. Some researchers found that some programs, such as WIC, reduce infant mortality; however, others found inconsistent results when examining the effects of Medicaid. Determining whether a given income and material support program or health program prevents infant mortality—and lowers the IMR—is difficult for a number of reasons, for example, because data are unavailable or participants are enrolled in more than one program. This section briefly summarizes some related research and then discusses some of the challenges associated with assessing program effectiveness.

Evidence of Effects on Infant Mortality

Research on the effects of federal programs on infant mortality has generally examined the effects of three programs: WIC, Medicaid, and Healthy Start. Researchers have found that women who participate in WIC were less likely to have an infant die in the first year of life when compared to similar women who did not participate in the program.[122] WIC program participation resulted in declines in conditions associated with infant mortality, such as low birthweight births.[123] Another study found that infants born to mothers enrolled in WIC were less likely to die from genetic conditions or delivery complications, but WIC participation did not lower the risk of dying from SIDS or accidents.[124]

Researchers and policymakers have questioned the effectiveness of Medicaid for reducing the IMR.[125] Some researchers have found that Medicaid participation improves outcomes for low-

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[120] See "Preconception Care" at http://www.cdc.gov/ncbddd/preconception/.

[121] CRS Report RL33202, *Medicaid: A Primer*, by Elicia J. Herz, and CRS Report R40444, *State Children's Health Insurance Program (CHIP): A Brief Overview*, by Elicia J. Herz and Evelyne P. Baumrucker.

[122] Marianne P. Bitler and Janet Currie, "Does WIC Work? The Effect of WIC on Pregnancy and Birth Outcomes," *Journal of Policy Analysis and Management*, vol. 24, no. 1 (Winter 2005), pp. 73-91; Hillary W. Hoynes, Marianne E. Page, and Ann Huff Stevens, "Is a WIC Start a Better Start? Evaluating WIC's Impact on Infant Health Using Program Introduction," *National Bureau of Economic Research,* Working Paper Series, No. 15589 (December 2009); and Intisar Khanani et al., "The Impact of Prenatal WIC Participation on Infant Mortality and Racial Disparities," *American Journal of Public Health*, vol. 100, no. S1 (September 1, 2010), pp. S204-S209.

[123] Ibid.

[124] Nancy E. Moss and Karen Carver, "The Effects of WIC and Medicaid on Infant Mortality in the United States," *American Journal of Public Health*, vol. 88, no. 9 (September 1998), pp. 1354-1361.

[125] See, for example, review in Dhaval M. Dave, et al., "Re-Examining The Effects of Medicaid Expansions for (continued...)

income women and their infants,[126]and that increased Medicaid eligibility reduces infant mortality.[127] Others have found that Medicaid has little or not effect on infant mortality.[128] Medicaid may reduce infant mortality by providing access to prenatal care and health care in the first year of life.[129] However, the evidence that Medicaid increases access to prenatal care is mixed. NCHS reported that between 1990 and 2003, rates of prenatal care utilization increased. These researchers found gains among groups that typically have low prenatal care utilization—the poor and racial and ethnic minorities—and linked these gains to Medicaid expansions that began in the late 1980s.[130] Others also found that Medicaid expansion increased prenatal care use,[131] and lowered the rate of low birthweight babies born to women at high risk for these births.[132] However, some researchers found that enrolling in Medicaid has little or no association with the timing or number of prenatal care visits.[133] This may occur because, as some researchers have found, physicians and other providers will not accept Medicaid for a variety of reasons, including low reimbursement rates;[134] or because women may enroll in Medicaid after the first trimester or at the time of the infant's birth.[135] These delays, or lack of access to care, in turn, would mitigate the effectiveness of Medicaid coverage on infant health and the IMR.[136]

Evaluations of the Healthy Start program have also found conflicting outcomes. In general, this has occurred because the evaluations were preliminary or focused on intermediate outcomes such as low birthweight or short gestational births.[137] A 2000 evaluation of the Healthy Start program

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Pregnant Women," *National Bureau of Economic Research Working Paper Series*, No. 14591 (December 2008).

[126] Nancy E. Moss and Karen Carver, "The Effects of WIC and Medicaid on Infant Mortality in the United States," *American Journal of Public Health*, vol. 88, no. 9 (September 1998), pp. 1354-1361.

[127] Seung-Eun Song, "Black and White Differences in Infant Mortality Risk Focusing on the Impact of the States' Income Inequalities and Medicaid Eligibility," Annual Meeting of the American Sociological Association, Philadelphia, PA, August 2005.

[128] Dhaval M. Dave et al., "Re-Examining The Effects of Medicaid Expansions for Pregnant Women," *National Bureau of Economic Research Working Paper Series*, No. 14591 (December 2008) and Jennifer Hollowell et al., "The Effectiveness of Antenatal Care Programmes to Reduce Infant Mortality and Preterm Birth in Socially Disadvantaged and Vulnerable Women in High-Income Countries: A Systematic Review," *Biomed Center: Pregnancy & Childbirth*, vol. 11, no. 13 (2011), pp. http://www.biomedcrentral.com/1471-2392/11/13.

[129] U.S. Government Accountability Office, *Poverty in America: Economic Research Shows Adverse Impacts on Health Status and Other Social Conditions as well as the Economic Growth Rate*, 07-344, January 24, 2007.

[130] Births: Final Data 2008.

[131] Janet Currie and Jeffrey Grogger, "Medicaid Expansion and Welfare Contractions: Offsetting Effects of Prenatal Care and Infant Health?" *National Bureau of Economic Research Working Paper Series*, No. 7667 (April 2000).

[132] Laura-Mae Baldwin et al., "The Effect of Expanding Medicaid Prenatal Services on Birth Outcomes," *American Journal of Public Health,* vol. 88, no. 11 (November 1998), pp. 1623-1629 and Lisa Dubay et al., "Changes in Prenatal Care Timing and Low Birth Weight by Race and Socioeconomic Status: Implications for the Medicaid Expansion for Pregnant Women," *Health Services Research*, vol. 362, no. 2 (June 2001), pp. 373-398.

[133] See, for example, Dhaval M. Dave, et al., "Re-Examining The Effects of Medicaid Expansions for Pregnant Women," *National Bureau of Economic Research Working Paper Series*, No. 14591 (December 2008). This article reviewed some prior research in this area and also includes new analyses.

[134] Peter J. Cunningham and Ann S. O'Malley, "Do Reimbursement Delays Discourage Medicaid Participation by Physicians?" *Health Affairs*, vol. 28, no. 1 (November 18, 2008), p. w17–w28.

[135] Janet Currie and Jeffrey Grogger, "Medicaid Expansion and Welfare Contractions: Offsetting Effects of Prenatal Care and Infant Health?" *National Bureau of Economic Research Working Paper Series*, No. 7667 (April 2000).

[136] Jeffrey Levi, Marlene Cimons, and Kay Johnson, *Healthy Women, Healthy Babies*, Trust for America's Health, An Issue Brief from Trust for America's Health, Washington, DC, June 2008.

[137] Information regarding the effectiveness of the Healthy Start program is drawn from the following sources: U.S. General Accounting Office, *Healthy Start: Preliminary Results from National Evaluation are Not Conclusive*, HEHS-
(continued...)

found that although the IMR declined in the Healthy Start sites, the declines were similar to what had occurred in matched comparison areas—areas that had similar IMRs and economic conditions as the Healthy Start sites—and in the nation as a whole. However, a 2006 evaluation conducted by the Office of Management and Budget found some preliminary evidence that Healthy Start reduced the IMR.[138] Healthy Start may be more effective at reducing potential causes of infant mortality and encouraging healthy behaviors in pregnant women. A 2006 HRSA evaluation found that Healthy Start participation lowered the rates of low birthweight and short gestational age births and increased prenatal care use, but this evaluation did not assess whether participating in the program lowered the IMR. Similarly, a 2011 evaluation of an Arizona Healthy Start site found that participants were less likely to have a low birthweight birth than demographically similar non-participants.[139] An evaluation of eight Healthy Start sites found that participation in the program was associated with a number of healthy behaviors in pregnant women. Specifically, women who participated in Healthy Start were, when compared to pregnant women with similar demographic and economic characteristics, more likely to receive early prenatal care, put their infants to sleep on their back, and engage in healthy behaviors during pregnancy, such as not smoking or drinking.[140]

Challenges Assessing Program Effectiveness

The main goal of the federal programs discussed above is to improve the economic well-being or health of low-income individuals, not to reduce the IMR. Although improving the economic well-being or the health of low-income individuals may, by consequence, reduce infant death, measuring this outcome and attributing it to a specific program is difficult. First, the data required to do so are limited. Second, it is methodologically difficult to determine indirect outcomes. Third, individuals are generally eligible for, and enrolled in, more than one program, making it difficult to evaluate the effectiveness of a single program.[141] Fourth, these programs generally target those with IMR risk—low-income women and their infants—making it difficult to assess

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98-167, June 1998; Barbara Devaney et al., *Reducing Infant Mortality Lessons Learned from Healthy Start*, Mathematica Policy Research, Inc., Final Report, Princeton, NJ, July 2000; White House, Office of Management and Budget, *Detailed Information on the Healthy Start Assessment*, Washington, DC, http://www.whitehouse.gov/omb/expectmore/; United States Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau, *A Profile of Health Start: Findings From Phase I of the Evaluation 2006*, Rockville, MD, 2006, http://mchb.hrsa.gov/healthystart/phase1report/; and U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau, *Evidence of Trends, Risk Factors, and Intervention Strategies, A Report from the Healthy Start National Evaluation 2006: Racial and Ethnic Disparities in Infant Mortality*, Rockville, MD. Four evaluations have examined the program since its inception in 1991: (1) a 1996 General Accounting Office (GAO, now the Government Accountability Office) review; (2) a 2000 review conducted by the Mathematica Policy Research, Inc. under contract from HRSA; (3) a 2006 Office of Management and Budget (OMB) program assessment; and (4) a HRSA evaluation of the program from 2001-2005. Phase I of this evaluation was published in 2006; the Phase II evaluation has not yet been published. Some recent research articles have evaluated some Healthy Start Sites since 2006, some of these evaluations are described above.

[138] White House, Office of Management and Budget, *Detailed Information on the Healthy Start Assessment*, Washington, DC, http://www.experctmore.gov.

[139] Syed K. Hussaini, Paul Holley, and Douglas Ritenour, "Reducing Low Birth Weight Infancy: Assessing the Effectiveness of the Healthy Start Program in Arizona," *Maternal Child Health J*, vol. 15 (2011), pp. 225-233.

[140] Margo Rosenback et al., "Characteristics, Access, Utilization, Satisfaction, and Outcomes of Healthy Start Participants in Eight Sites," *Maternal Child Health Journal*, vol. 14 (2010), pp. 666-679.

[141] One goals of Healthy Start is connecting participants with other services such as WIC and Medicaid. Given this goal, a successful program would mean that applicants are enrolled in a number of programs.

whether inconclusive findings or findings that a program does not reduce infant mortality occur because a program is ineffective or whether the findings are due to the low socioeconomic status of the program's participants.[142] A 2006 HRSA evaluation of Healthy Start suggests another reason why Healthy Start, or any program that targets pregnant women, may not reduce the IMR. In doing so, they summarize the life course perspective of research, saying that

> [because] a woman's birth outcome and subsequent pregnancies are influenced by the accumulated life exposure of her mother and female ancestors before her, a short period of intervention during the pregnancy period may not be able to cause a dramatic decrease in the risk of poor birth outcomes. According to this model, the racial/ethnic disparities in birth outcomes we see today can be explained by many lifetimes of amassed racism, poverty, and stress.[143]

According to this perspective, interventions during pregnancy may be too late or insufficient to reduce the risk of infant mortality among high risk pregnant women.

New Federal Initiatives

The Patient Protection and Affordable Care Act of 2010 (~~PP~~ACA, P.L. 111-148) aims to expand access to health insurance, which could reduce the IMR by expanding access to health care to some individuals who are now uninsured. The law also establishes new, or expands existing, programs that may reduce the IMR.[144] Relevant sections include:

- Section 2951 established a program to award grants to states, Indian tribes, and other entities, such as non-profit organizations, to implement home visitation programs, including programs that target pregnant women. The section requires an assessment of the new program to examine a number of child health outcomes, such as infant mortality and low birthweight.
- Section 2953 established a new grant program for states to establish "Personal Responsibility Education" programs.[145] These programs, which target adolescents, include instruction in both abstinence and contraception for the prevention of pregnancy and sexually transmitted infections. Among other things, states are required to establish a plan to reduce teen pregnancy and the teen birth rate within the state.
- Section 3021 established a new Center for Medicare and Medicaid Innovation within the CMS. This new center has broad authority to test new approaches for delivering care to Medicare and Medicaid beneficiaries. Under this authority, the

[142] There may be further challenges associated with evaluating Medicaid because it is a joint federal-state program so states have flexibility in designing and administering their Medicaid programs. This creates variation that may complicate Medicaid evaluations.

[143] U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau, *Evidence of Trends, Risk Factors, and Intervention Strategies*, A *Report from the Healthy Start National Evaluation 2006: Racial and Ethnic Disparities in Infant Mortality*, Rockville, MD, see page 29.

[144] The ACA (P.L. 111-148) was signed into law on March 23, 2010, it was subsequently by the Health Care and Education Reconciliation Act of 2010 (HCERA, P.L. 111-152).

[145] HHS announced grant awards made under this program at http://www.hhs.gov/news/press/2010pres/09/20100930a.html.

Center launched "Strong Start," which will test the effectiveness of various strategies to deliver enhanced prenatal care to reduce short gestational age births among Medicaid recipients.[146]

- Section 4101 expanded Medicaid coverage of smoking cessation services for pregnant women by making counseling and pharmacotherapy to promote tobacco cessation a mandatory benefit for pregnant women beginning October 1, 2010.[147]
- Sections 10211-10214 established and appropriate funding for a "Pregnancy Assistance Fund" that creates and funds a new competitive grant program to states to help pregnant and parenting teens and women. States, in turn, will award funds to institutions of higher education or other entities to establish programs and services to support pregnant or parenting students.[148]

Conclusion

The United States has a higher infant mortality rate (IMR) than most European countries, and the U.S. IMR has remained relatively constant since 2000 despite declines in prior decades. Reasons for the high U.S. IMR and its recent stability are difficult to discern. However, experts believe that differences in how live births are recorded internationally cannot fully explain the high U.S. IMR. Instead, experts suggest that it might be explained by higher U.S. rates of low birthweight and short gestational age births. Within the United States, IMR varies by racial and ethnic group. The disproportionately high rates among certain racial and ethnic groups may partially explain the high U.S. IMR. The U.S. IMR also varies geographically. In general, southern states have the highest IMRs and states in the West and in New England have the lowest. The higher IMRs in southern states may be partially explained by higher rates of low birthweight and short gestational age births in these states. In addition, the racial and ethnic composition of a state's population affects its IMR, as the IMR for infants born to black mothers is more than double the rate for infants born to white mothers. A number of demographic characteristics of the mother, including race, education, and age, may directly or indirectly influence the IMR. In addition, the IMR may be affected by health and health system characteristics such as the mother's health behaviors or whether she receives prenatal care.

Research indicates that a number of federal programs may reduce the IMR. These programs generally target low-income women and children, and may improve their economic circumstances and health status, thereby reducing the IMR. However, the effectiveness of these programs is debated, and is difficult to evaluate. The ACA also establishes new programs that may reduce the IMR. For example, the law appropriates funding for home visitation programs for

[146] Centers for Medicare & Medicare Services: Center for Medicare & Medicaid Innovation, "Strong Start for Mothers and Newborns," press release, March 20, 2012, http://innovations.cms.gov/initiatives/strong-start/.

[147] CRS Report R41210, *Medicaid and the State Children's Health Insurance Program (CHIP) Provisions in ACA: Summary and Timeline*, by Evelyne P. Baumrucker et al.

[148] These provisions are summarized in CRS Report R41278, *Public Health, Workforce, Quality, and Related Provisions in PPACA: Summary and Timeline*, coordinated by C. Stephen Redhead and Erin D. Williams. For information on grants awarded, see Department of Health and Human Services, "HHS Awards $27 Million for the Support of Pregnant and Parenting Teens and Women," press release, September 28, 2010, http://www.hhs.gov/news/press/2010pres/09/20100928d.html.

pregnant women or new parents.[149] It also requires that Medicaid cover smoking cessation services for pregnant women.

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[149] For information about funding allocated under this program, see http://www.hhs.gov/news/press/2010pres/07/20100721a.html.