Congressional Research Service

MEMORANDUM October 14, 2009

To: Senator Tom Coburn
Attention: Josh Trent, Legislative Assistant for Health Policy

From: Elayne J. Heisler, Analyst in Health Services, 7-4453

Subject: **Infant Mortality Rates**

This memorandum responds to your request for information about the U.S. infant mortality rate (IMR). It is divided into four sections as follows: (1) background and measurement issues related to the IMR; (2) international IMR comparisons; (3) a discussion of various demographic and health-related variables that may affect the IMR; and (4) a discussion of the relationship between infant mortality and Medicaid participation.

Information for this memorandum was obtained through communication with the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC), a review of research studies from peer reviewed journals, and a review of reports released by relevant associations such as the National Governors Association.

This memorandum will not attempt to evaluate the relative importance of demographic or health system factors in explaining the IMR or in explaining cross-national differences observed in the IMR. A number of demographic and health system factors associated with the IMR are correlated with each other. These correlations make it difficult to determine causality and to adequately assess the relative contribution of specific factors.

Since the subject of this memorandum is of general interest to Congress, excerpts may be provided to other congressional requesters or may be used to generate a general distribution report to Congress. In such situations, your confidentiality as a requester will be preserved.

I hope this memorandum addresses your request. If you would like further information, please contact eheisler@crs.loc.gov or at the number above.

Background

Infant mortality refers to deaths that occur within the first year of life (from a live birth to age 1). The infant mortality rate (IMR) is the number of deaths occurring in the first year of life per 1,000 live births.[1] In 2006, the last year for which final data are available, the U.S. IMR was 6.69 according to the National Center for Health Statistics (NCHS). NCHS uses data obtained directly from its National Vital Statistics System—an interagency collaboration that collects birth and death certificate data obtained from state vital statistics offices.[2] These data are widely used, and, because they are drawn directly from birth and death records, are considered to be the most authoritative figure. Consequently, 2006 NCHS data will be used throughout this memorandum except as otherwise indicated.

NCHS also collects data on the common causes of death for infants. Interventions that seek to improve the IMR often do so by attempting to lower a particular cause of infant death. Given this fact, it is necessary to examine the causes of infant death so as to understand causes that may be most amenable to policy interventions. In 2006, there were 28,527 infant deaths. Of these, 69.2% were from the top 10 causes of infant deaths (see **Table 1**).

Table 1. Top 10 Causes of U.S. Infant Death, 2006

Rank	Cause of Death	Percent of Total Deaths
1	Congenital malformations, deformations and chromosomal abnormalities (congenital malformations)	20.4%
2	Disorders related to short gestation and low birthweight (low birthweight)	17.0%
3	Sudden infant death syndrome (SIDS)	8.1%
4	Newborn affected by maternal complications of pregnancy (maternal complications)	5.9%
5	Accidents (unintentional injuries)	4.0%
6	Newborn affected by complications of placenta, cord and membranes (cord and placenta complications)	4.0%
7	Respiratory distress of newborn	2.9%
8	Bacterial sepsis of newborn	2.8%
9	Neonatal hemorrhage	2.2%
10	Diseases of the circulatory system	1.9%

Source: : Melonie Heron, Donna L. Hoyert, and Sherry L. Murphy, et al., *National Vital Statics Reports: Deaths: Final Data for 2006*, National Center for Health Statistics, Vol. 57, No. 4, Hyattsville, MD, April 17, 2009 (Herein after Deaths: Final Data 2006).

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

[2] See http://www.cdc.gov/nchs/nvss.htm.

Notes: The top 10 causes of death were relatively stable between 2004, 2005, and 2006 with one exception: maternal complications, which decreased nearly 8% between 2005 and 2006.

Definition and Measurement

Some have suggested that cross-national differences in IMR are caused by definitional differences in how live births are counted. These analysts suggest that some countries classify very small infants or infants that do not survive the first 24 hours as stillbirths while other countries count these events as live births and include the deaths in the IMR.[3] In order to minimize measurement differences and create comparable international infant mortality data, the U.S. and most developed countries have agreed to use the World Health Organization (WHO) definition of live births which is:

> 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.[4]

Despite using this WHO definition, there is still some variation in the classification of live births, although definitional differences would likely only account for a small percentage of reported infant deaths. For example, the Czech Republic records live births as infants born above 500 grams or an infant at any birthweight that survives the first 24 hours.[5] Infants that are born below 500 grams are rare and only account for 0.16% of all U.S. births.[6] Both the widespread use of the WHO definition of live birth[7] and the small number of births that fall outside of this definition make it less likely that international variation in IMR can be explained by differences in how the IMR is calculated from country to country. [8] Given these circumstances, researchers at the NCHS conclude that definitional differences between the U.S. and other developed countries can only explain a small percentage of cross-national IMR differences.[9]

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

[4] 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/.

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

[6] Email from Reproductive Statistics Branch: National Center for Health Statistics, July 21, 2009.

[7] In cases where the standard definition is not used, there are instances where other countries use a more restrictive definition than the U.S. For example, Norway will count any infant born after 12 weeks of gestation as a live birth, whereas the U.S. will count a live birth only after 16 weeks of gestation. Births are recorded by a birth attendant, so it is possible that birth attendants vary in how they classify the births of very small infants. Such variation would likely occur universally and should not bias particular countries' IMR. Email from Reproductive Statistics Branch: National Center for Health Statistics, July 21, 2009.

[8] Email from Reproductive Statistics Branch: National Center for Health Statistics, July 21, 2009.

[9] Marian MacDorman and T.J. Mathews, "International Comparisons of Infant and Neonatal Mortality Rates by Birthweight and Gestational Age" Memo prepared by Reproductive Statistics Branch, Division of Vital Statistics, National Center for Health Statistics, CDC, 2009.

International Infant Mortality Rate Comparisons

At an estimated 6.69 infant deaths per 1,000 live births, the U.S. IMR is higher than the estimated IMR for most other developed nations, a fact that some consider a cause for policy concern (see **Table 2**).[10] NCHS examined U.S. infant mortality in comparison to other developed countries using data from 2004—the last year for which comparable international data are available.[11] In 2004, the U.S. IMR ranked 29th in the world—tied with Poland and Slovakia.[12] Countries in East Asia (Japan, Hong Kong, and Singapore) and Scandinavia (Sweden, Norway, and Finland) had the lowest IMRs in 2004.[13] As will be discussed further below, within the U.S., the IMR differs among racial and ethnic groups. These disproportionate rates among some subpopulation groups may contribute to the higher overall U.S. rate. Specifically, in 2004, the IMR for non-Hispanic black infants was 13.6 while the IMR for non-Hispanic white infants was 5.66.[14] While the rate for non-Hispanic white infants is higher than the rates observed in countries with the lowest IMR, it is closer to the 2004 IMR rates observed in Canada (5.3), New Zealand (5.7), and England and Wales (5.0).[15]

Table 2. Infant Mortality Rates (Infant Deaths/1,000 Live Births) and Rankings for Selected Countries, 2004

Country	IMR	Rank
Singapore	2.0	1
Hong Kong	2.5	2
Japan	2.8	3
Sweden	3.1	4
Norway	3.2	5
Finland	3.3	6
Spain	3.5	7
Czech Republic	3.7	8
France	3.9	9
Portugal	4.0	10

[10] Marian F. MacDorman and T.J. Mathews, *Recent Trends in Infant Mortality in the United States.*, U.S. Department of Health and Human Services: Centers for Disease Control and Prevention: National Center for Health Statistics, NCHD Data Brief No.9, Hyattsville, MD, October 2008. Herein after cited as Recent Trends in Infant Mortality in the United States.

[11] Recent Trends in Infant Mortality in the United States.

[12] Recent Trends in Infant Mortality in the United States.

[13] Recent Trends in Infant Mortality in the United States. NCHS used data from the OECD, the WHO, the United Nations and specific countries' vital statistics offices.

[14] U.S. Department of Health and Human Services: Centers for Disease Control and Prevention: National Center for Health Statistics, *Health United States, 2007, Table 19, http://www.cdc.gov/nchs/data/hus/hus07.pdf#listtables.*

[15] U.S. Department of Health and Human Services: Centers for Disease Control and Prevention: National Center for Health Statistics, *Health United States, 2007, Table 25 , http://www.cdc.gov/nchs/data/hus/hus07.pdf#listtables.*

Country	IMR	Rank
Germany	4.1	11
Greece	4.1	11
Italy	4.1	11
Netherlands	4.1	11
Switzerland	4.2	15
Belgium	4.3	16
Denmark	4.4	17
Austria	4.5	18
Israel	4.5	18
Australia	4.7	20
Ireland	4.9	21
Scotland	4.9	21
England and Wales	5.0	23
Canada	5.3	24
Northern Ireland	5.5	25
New Zealand	5.7	26
Cuba	5.8	27
Hungary	6.6	28
Poland	6.8	29
Slovakia	6.8	29
United States	6.8	29
Puerto Rico	8.1	32
Chile	8.4	33
Costa Rica	9.0	34
Russian Federation	11.5	35
Bulgaria	11.7	36
Romania	16.8	37

Source: Adapted from U.S. Department of Health and Human Services: Centers for Disease Control and Prevention: National Center for Health Statistics, *Health United States, 2007, Table 25, http://www.cdc.gov/nchs/data/hus/hus07.pdf#listtables.*

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., skip a rank. For example, Germany, Greece, Italy, and the Netherlands are all assigned the rank 11. Switzerland, which has the next lowest IMR, is assigned the rank of 15.

Researchers from the NCHS examined possible reasons for the differences between the U.S. and other developed countries. They found that both the percent of infants born at a low birthweight—born less than 2,500 grams[16]—and the percent born at short gestational ages—born at less than 36 weeks of gestation[17]— in the U.S. were much higher than the percentages found in Western Europe. As noted in **Table 1**, disorders related to low birthweight and short gestational age are the second largest cause of infant death in the U.S. and 28% of all infant deaths internationally are due to short gestational age births.[18] Given this fact, rates of low birthweight births and short gestational age births should influence the number of infant deaths and, in turn, the IMR. In the U.S. the percent of infants born at low birthweight is almost twice that of Sweden and Finland.[19] NCHS researchers found that while the U.S. and Western European countries had similar outcomes for low birthweight infants—that is, low birthweight infants were as likely to survive in the U.S. as in other developed countries—the large percentage of U.S. infants born at low birthweight adversely affects the IMR. Similarly, the percentage of infants born at short gestational age was higher in the U.S. than in a number of European countries with lower IMRs. The NCHS researchers noted that while the U.S. does have better outcomes for infants born at short gestational ages, the U.S's higher rates of these births is one of the main factors explaining why the U.S. IMR is higher than the IMRs for a number of developed countries.[20] They concluded that reducing low birthweight and short gestational age births would improve the U.S. IMR.

Factors Influencing the U.S. Infant Mortality Rate

As discussed above, the U.S. IMR is higher than the IMRs of a number of developed nations, due, in part, to high rates of low birthweight and a high rate of short gestational age births. These two conditions are linked because short gestational age would mean less time to attain a healthy birthweight. They are also linked to other factors that can be roughly grouped into two categories: (1) demographic characteristics of the mother such as race, age or socioeconomic status; and (2) health and health system characteristics such as access to prenatal care, health behaviors, and the use of fertility treatments. Other factors that may be related to the IMR, such as the rate of Sudden Infant Death Syndrome (SIDS), may vary by these demographic characteristics. In addition, demographic characteristics may be correlated with each other and with various health and health system characteristics. For example, those with low income may have poorer access to prenatal care. These correlations make it difficult to examine the relative contribution of factors influencing the IMR. Consequently, this memorandum will not attempt to assess the relative influence of each factor.

[16]Joyce A. Martin, Brady E. Hamilton, and Paul D. Sutton, et al., *Births: Final data for 2006*, National Center for Health Statistics, National Vital Statistics Reports vol. 57, no.7, Hyattsville, MD, January 7, 2009. Herein after, Births: Final Data for 2006.

[17] "CDC Features: Premature Birth" at http://www.cdc.gov/Features/PrematureBirth/.

[18] 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.

[19] Recent Trends in Infant Mortality in the United States.

[20] Recent Trends in Infant Mortality in the United States.

Mother's Demographic Characteristics

A number of demographic characteristics of expectant mothers could 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. While these characteristics will be discussed separately, a number of these characteristics may be linked. For example, higher poverty rates are correlated with lower educational attainment.

Race and Ethnicity[21]

Infant mortality rates vary by race and ethnicity. According to 2006 data from NCHS, the IMR for white non-Hispanic infants (5.56) is less than half of the rate for black non-Hispanic infants (13.29). The overall IMR for Hispanic infants (5.52) is lower than the overall rate for the U.S. and there is also variation within Hispanic subgroups. The IMR for Puerto Rican infants (7.69) is higher than the rate for infants born of Mexican, Cuban, and Central and South American descent (5.67, 5.26, and 2.84, respectively.[22]

The high rates of infant mortality among non-Hispanic blacks is partly explained by higher rates of low birthweight[23] and short gestational age infants[24] among this population, as these factors cause a large number of infant deaths (see **Table 1**). The non-Hispanic black population also experiences higher rates of factors correlated with low birthweight or short gestational age infants such as being in poverty, having less than a high school education, and being unmarried. Rates of SIDS are also higher among non-Hispanic black infants and non-Hispanic black mothers are 2.5 times more likely to begin prenatal care in the 3rd trimester or to receive no prenatal care, factors that are also related to the IMR.[25] Some suggest that racial disparities in infant mortality may contribute to the U.S. rank among other developed nations. They note that the U.S. drop in international rankings parallels the growth in racial IMR disparities.[26]

[21] This memorandum uses the same racial and ethnic categories used by NCHS. How the federal government currently collects racial and ethnic data and how this has changed over time is discussed in CRS Report RL32701, *The Changing Demographic Profile of the United States*, by Laura B. Shrestha and Elayne J. Heisler.

[22] Melonie Heron, Donna L. Hoyert, and Sherry L. Murphy, et al., National Vital Statics Reports: Deaths: Final Data for 2006, National Center for Health Statistics, Vol. 57, No. 4, Hyattsville, MD, April 17, 2009. Herein after, Deaths: Final Data for 2006.

[23] Births: Final Data for 2006.

[24] 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.

[25] U.S. Department of Health and Human Services: The Office of Minority Health, "Infant Mortality and African Americans," factsheet, August 31, 2009, http://www.omhrc.gov/templates/content.aspx?ID=3021.

[26] 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. Since 1950, the U.S. rank in infant mortality has dropped from 5th to 29th, during that time period the gap between black and white infant mortality has grown from black IMR being 1.6 times higher to 2.4 times higher.

Education

Women with higher levels of education are less likely to have an infant die within the first year of life.[27] For example, a report published by the Robert Wood Johnson Foundation found that infants born to mothers with at least 16 years of education are less likely to die in the 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 widest gap is in South Carolina where infants born to mother's who were not high school graduates were twice as likely to die as infants born to mothers with at least 16 years of schooling.[28]

Education may influence the IMR in a variety of ways. Education is often a pathway to better employment opportunities and to higher incomes so may affect health status through income.[29] College educated women are more likely to be married, and being a single mother is among the factors related to infant mortality.[30] Educational level may also be linked to higher rates of certain negative health behaviors, such as smoking or alcohol consumption,[31] which may increase the risk of having an infant death or of having conditions linked with infant death. Declining rates of smoking among less educated women have improved infant health.[32] Conversely, increasing rates of excessive weight gain among less educated women during pregnancy have offset some of these gains.[33] College-graduated women are also less likely to smoke, and more likely to gain the appropriate amount of weight during pregnancy.[34] However, more highly educated women are also more likely to be older mothers (over age 40) which may be linked with some adverse outcomes as discussed below.

Economic Status

Women with higher incomes are less likely to have a infant die within the first year of life.[35] 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.[36] Economic status may also be related to access to health

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[27] 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 and see footnote 16.

[28] 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.

[29] John Mirowsky and Catherine E. Ross, *Education, Social Status, and Health* (New York: Aldine De Gruyter, 2003).

[30] 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.

[31] John Mirowsky and Catherine E. Ross, *Education, Social Status, and Health* (New York: Aldine De Gruyter, 2003).

[32] 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.

[33] 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.

[34] 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.

[35] 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.

[36] 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 quality health care and can therefore affect infant health both directly and indirectly through health and health system characteristics.[37] Increasing access to health care among women at all income levels has served to narrow the income gap in infant mortality.[38]

Age

The changing age composition of women giving birth may influence the IMR. There have been increases in women giving birth at both the youngest and oldest ages.[39] The birth rate to teenagers increased 3% from 2005 to 2006; the first increase since 1991. Infants born to teen mothers are at an elevated risk for a number of health conditions, including death.[40] Births to women at older ages have also been increasing since 1990, which may adversely impact the IMR. Women over age 30 are more likely to have multiple births—both because of the use of fertility treatments and because the risk of twins increases with age.[41] Multiple births are more likely to be both of short gestational age and low birthweight.[42] Births to women over age 40 have increased. In 2006, there were 70% more births to women over the age of 40 than there were in 1990.[43] Births to women over age 35 carry increased risks including higher risk of birth defects, short gestational age, being low birthweight, and certain delivery complications. These risks also increase as maternal age increases.[44]

State and Regional Variation

There is large state-to-state variation in IMR ranging from 4.68 deaths per 1,000 live births in Washington state, to 11.26 deaths per 1,000 live births in the District of Columbia.[45] Infant mortality rates are highest in the southern states, Mississippi, Alabama, Louisiana, Tennessee and Arkansas.[46] Higher IMR in the south may be explained, in part, by demographic and health system characteristics that affect this area. Specifically, the south has the highest national poverty rates, unemployment rates, percentage of single parent households and the lowest per capita income.[47] These states also had low per capita spending on

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[37] 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.

[38] 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.

[39] More discussion of recent changes in fertility can be found at Births: Final Data for 2006.

[40] Births: Final Data for 2006.

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

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

[43] Births: Final Data for 2006.

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

[45] Deaths: Final Data for 2006.

[46] Deaths: Final Data for 2006 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.

[47] 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.

health care, low average numbers of doctors and hospitals, and high percentages of the population that were uninsured.[48]

Differences in state IMR persist by race, with large variation in the rates observed for African Americans. The IMR among whites is lowest in Washington at 4.38 and highest in Mississippi at 7.11.[49] In contrast, the IMR rates among blacks ranges from a low of 7.37 in Washington to a high of 28.57 in West Virginia.[50] The racial composition of a state's population affects its IMR. States with larger white populations had lower IMRs whereas the opposite was true in states with larger African American populations.[51] Some suggest that in order to improve IMR in southern states, it is necessary to focus on the social and economic conditions that are driving the states' high rates.[52]

Health and Health System Characteristics

A number of characteristics of an expectant mother's healthcare could be related to the likelihood of having an infant die within the first year of life. Among the characteristics are whether the mother used fertility treatments (called assisted reproductive technology or ART) to conceive,[53] the mother's health and health behaviors, the amount and timing of prenatal care received, and the quality of healthcare received during pregnancy.[54] These characteristics may be interrelated and may also be influenced by demographic characteristics. For example, fertility treatments are more likely to be used by older women.

Additionally, state health system characteristics also influence IMR. In a study examining the factors associated with the higher rates of infant mortality in southern states, the authors found that state IMR decreased with decreasing rates of uninsurance and increasing number of doctors and hospitals.[55]

Assisted Reproductive Technology

Increased use of assisted reproductive technology (ART) may impact the IMR through increasing rates of multiple births, which in turn may affect low birthweight and short gestational ages.[56] This is partially

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[48] 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.

[49] Deaths: Final Data for 2006.

[50] Deaths: Final Data for 2006. A number of states do not have sufficient data to calculate black IMR.

[51] 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.

[52] 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.

[53] 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).

[54] 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.

[55] 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.

explained by higher rates of multiple births among births attributed to ART, but ART may be associated with low birthweight even in cases of single births.[57] The CDC examined Massachusetts birth records linked with fertility clinic data and found that the number of births from ART in Massachusetts increased by 2% from 1997 to 2004, which corresponded with a 7% increase in low birthweight infants. Recent analysis of WHO data by the March of Dimes Foundation suggests that the U.S. increase in births at short gestational ages can be partially explained by ART.[58]

Multiple Births

Since 1980, multiple births have increased dramatically with the rate of twins increasing 70%.[59] This increase may contribute to the IMR as multiple births are more likely to be both low birthweight and of short gestational age.[60] Two-thirds of the rapid increase in multiple births is due to the use of ART.[61] The remaining one-third is due to the rising numbers of women having children in their thirties as the likelihood of a multiple birth increases with age. Multiple births are more likely to die within the first year of life than are single births. In 2006, according to NCHS, the death rate for single births was 6.0 per 1,000 whereas it was 59.8 per 1,000 for triplets.[62] Multiple births are more likely to have a short gestational age and be low birthweight. In 2006, the mean gestational age for quadruplets was 29.3 weeks[63] and 98% of quadruplets born in the U.S. were low birthweight.[64]

Health and Health Behaviors

A number of maternal lifestyle and health characteristics that could adversely affect infant health have increased since 1990. These include inadequate weight gain during pregnancy, tobacco use, gestational diabetes, and pregnancy-associated and chronic hypertension. There has been a 30% increase in women gaining too much weight during pregnancy—defined as more than 40 pounds—and a 50% increase in

(...continued)

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

[57] 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).

[58] 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. These data examine the U.S. increase in premature birth over a 25 year period and find a 36% increase in the percentage of premature births observed. Not all of this increase is due to ART, since this 25 year time period corresponds with advances in neonatal technology. Some of the increase in premature birth is likely due to the ability to deliver infants as a live birth earlier because of advances in technology. Prior to these advances, these pregnancies might have resulted in a fetal death instead of a premature birth.

[59] Births: Final Data for 2006.

[60] Births: Final Data for 2006.

[61] See http://www.marchofdimes.com/professionals/14332_4545.asp. Recent data suggests that these increases may be leveling off (see Births: Final Data for 2006).

[62] Births: Final Data for 2006.

[63] Births: Final Data for 2006.

[64] Births: Final Data for 2006.

women gaining too little weight—less than 16 pounds.[65] Weight gains outside of the recommended guidelines have been associated with a number of adverse outcomes including infant mortality. Rates for gestational diabetes have increased 3% per year on average since 1990 and rates of pregnancy-associated and chronic hypertension increased on average 1% per year since 1990.[66] Both of these conditions are associated with greater risk of pregnancy complications and adverse outcomes for the infant born.[67]

Tobacco use during pregnancy is associated with an increased likelihood of having a low birthweight infant, shorter gestational ages, and higher rates of SIDS.[68] In 2002, 11.4% of women who gave birth reported smoking during pregnancy, a decline from 1990.[69]

Prenatal Care

Clinical studies indicate that prenatal care is an effective intervention to decrease the IMR because screening for risk factors and interventions can help reduce the risk of having a short gestational age birth.[70] Conversely, forgoing or delaying prenatal care is associated with having a low-birthweight infant[71]and a short gestational age birth.[72] 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 cigarette use will have more effect on the fetus at early stages of the pregnancy when the fetus is developing most rapidly. In 2006, African Americans were twice as likely as non-Hispanic whites to receive late or no prenatal care.[73] Researchers have found that these differences in prenatal care receipt can explain some, but not all, of the higher IMR for African American infants.[74]

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 birth received. Specifically, the hospital at which an infant is delivered may affect health outcomes,[75] particularly for short gestational age or low birthweight infants

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[65] Births: Final Data for 2006.

[66] Births: Final Data for 2006.

[67] 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/.

[68] TJ Mathews, "Smoking During Pregnancy---United States, 1990--2002," *MMWR*, vol. 53, no. 39, pp. 911-915.

[69] The rate was 13.2% in 2006, an apparent increase since 2002, but there have been methodological changes in how these data were collected. (See Births: Final Data for 2006.)

[70] *Prenatal Care: Reaching Mothers, Reaching Infants*, ed. Sarah S. Brown (Washington, DC: National Academy Press, 1988).

[71] 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.

[72] See "CDC Features: Premature Birth" at http://www.cdc.gov/Features/PrematureBirth/.

[73] Births: Final Data for 2006.

[74] 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.

[75] Elizabeth A. Howell, Paul Herbert, and Samprit Chatterjee, et al., "Black/White Differences in Very Low Birth Weight (continued...)

who may require specialized care such as neonatal intensive care units.[76] In a study of New York City hospitals, researchers found that black infants were more likely to be born at hospitals with higher mortality rates (from all causes). These researchers conclude that the hospitals at which black infants are born may contribute to racial disparities in infant mortality.[77] Researchers have also found that technology and hospital-level improvements, such as the adoption of health information technology, can reduce the number of infant deaths and improve IMR at the county-level.[78]

Medicaid and the Infant Mortality Rate

Medicaid is the joint federal and state program that provides health coverage to certain low-income pregnant women and infants.[79]Since the program targets pregnant women and children, some suggest that Medicaid coverage may affect infant health and birth outcomes. This section will review Medicaid policy related to pregnant women and infants and examine the relationship between Medicaid coverage and the IMR. It will also include a discussion of factors that may confound this relationship and a review of selected state studies.

Medicaid Eligibility

Because Medicaid is a joint federal-state program, states have some flexibility in designing their Medicaid programs and this variability may complicate efforts to evaluate the effects of Medicaid on the IMR. States may change their Medicaid programs in response to a particular health concern or state public health campaigns may affect population health in ways separate from the Medicaid program. Additionally, federal program mandates make it difficult to assess how state programs affect outcomes. Some researchers have concluded that such national policy changes make it difficult to assess the relationship between state Medicaid program variations and health care outcomes.[80] This section examines the implications of variation in eligibility on the Medicaid population.

Medicaid will pay for prenatal care birth and health care costs for infants in the first year of life. Although the Medicaid program statute, requires states to cover pregnant women and infants up to 133%

(...continued)

Neonatal Mortality Rates Among New York City Hospitals," *Pediatrics*, vol. 121, no. 3 (March 2008), pp. e407-e415.

[76] Elizabeth A. Howell, Paul Herbert, and Samprit Chatterjee, 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.

[77] Elizabeth A. Howell, Paul Herbert, and Samprit Chatterjee, 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.

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

[79] It is also possible that the Children's Health Insurance Program (CHIP) could affect the IMR. For a description of the CHIP program see CRS Report R40444, *State Children's Health Insurance Program (CHIP): A Brief Overview*, by Elicia J. Herz, Chris L. Peterson, and Evelyne P. Baumrucker. The role of the CHIP program will not be examined in this memorandum.

[80] Dhaval M. Dave, Sandra Decker, and Robert Kaestner, et al., "Re-Examining The Effects of Medicaid Expansions for Pregnant Women," *NBER Working Paper Series*, No. 14591 (December 2008).

of the federal poverty level, states may choose to cover pregnant women and infants at higher income levels.[81] The current range of state coverage for children under the age of 6 is between 150 and 350% of the federal poverty level with the median eligibility level of 200% of the federal poverty level.[82] There is also variation in how states administer their Medicaid programs; for example, enrollment procedures and the duration of coverage without the need for renewal may vary.[83] Both eligibility and administrative variation could affect infant health outcomes, but determining the relative contribution of these factors is difficult. By definition Medicaid targets the economically disadvantaged—those living below, near, or just above the federal poverty level. As this population is most at risk for adverse birth outcomes, it is difficult to evaluate the independent effect of Medicaid coverage on infant mortality.

Variation in eligibility across states means differences in the percentage of births covered by the program, and this variability also confounds efforts to evaluate the effect of Medicaid on infant health and infant mortality. Nationally, 36.8% of children under the age of 6 were covered by a public insurance program such as Medicaid and CHIP in 2008, an increase from 2007.[84] Some state Medicaid programs have also estimated the percentage of state births that were paid for by Medicaid. For example, the Alabama Department of Public Health estimated that Medicaid paid for 48.1% of all 2005 deliveries.[85] Hawaii estimated that their Medicaid program paid for 31% of all deliveries between 2004 and 2006.[86] Differences in coverage make direct state to state comparisons problematic.

Measuring Medicaid Status and the Effect of Medicaid

The relationship between Medicaid and the IMR is complex and often debated. Some researchers have found that Medicaid participation improves outcomes for low-income women and their infants,[87]and that increased Medicaid eligibility reduces infant mortality.[88]Others have found that Medicaid is associated with higher IMR relative to having private health insurance[89] and that there is no discernable relationship

[81] CRS Report R40490, *Medicaid Checklist: Considerations in Adding a Mandatory Eligibility Group*, by Chris L. Peterson, Elicia J. Herz, and Julie Stone.

[82] CRS Report R40490, *Medicaid Checklist: Considerations in Adding a Mandatory Eligibility Group*, by Chris L. Peterson, Elicia J. Herz, and Julie Stone.

[83] Gabriela Garcia, *Maternal and Child Health (MCH) Update: States Increase Eligibility for Children's Health in 2007*, National Governor's Association, Washington, DC, November 25, 2008.

[84] CRS Report 97-975, *Health Insurance Coverage of Children, 2008*, by Chris L. Peterson.

[85] Louie Albert Woodbright, *Method of Payment for Delivery*, Alabama Department of Public Health, Montgomery, AL, July 2007, www.adph.org.

[86] 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.

[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] 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.

[89] Louie Albert Woodbright, *Method of Payment for Delivery* , Alabama Department of Public Health, Montgomery , AL, July 2007, www.adph.org.

between the expansion of Medicaid coverage and IMR.[90] Some have argued that this is because of the poor quality of care that Medicaid provides and fraud within the program.[91]

How Medicaid coverage is recorded for an infant who dies during the first few days after birth—the most frequent time of infant death—can affect analyses of the relationship between Medicaid and IMR. For example, an analysis of North Carolina birth records linked to Medicaid records found different outcomes based on whether the mother's or the infant's Medicaid status was used. Specifically, rates of infant death were lower for Medicaid births when Medicaid status was defined based on the newborn. Death rates were higher than those observed for the non-Medicaid population when Medicaid status was defined based on the mother. The researcher speculated that infants who were potentially Medicaid eligible, but die shortly after birth are never enrolled in Medicaid, which may bias examinations of the relationship between Medicaid coverage and infant death.[92]

Another factor complicating the measurement of Medicaid effects is the availability of other programs aimed at improving health outcomes. For example, those who are eligible for Medicaid may also be eligible for the Women, Infants, and Children program,[93] which provides supplemental nutrition and the Temporary Assistance for Needy Families program,[94] which provides cash benefits to low-income families. Researchers have found a relationship between participation in these programs and infant mortality[95]and that these programs had different, and in some cases stronger, effects than Medicaid on infant health.

Medicaid and Health Services

One of the ways that Medicaid may affect the IMR is by providing access to prenatal care. As discussed above, prenatal care is important for pregnancy outcomes because early care during pregnancy can reduce the risk of low birthweight and short gestational age births. NCHS reported that between 1990 and 2003 rates of prenatal care utilization have increased and that gains were found particularly among groups that typically have low prenatal care utilization—the poor and racial and ethnic minorities. They link these gains to Medicaid expansion for pregnant women which began in the late 1980s.[96] Despite the possibility that Medicaid could improve infant health by providing access to prenatal care, there may be reasons why

[90] Dhaval M. Dave, Sandra Decker, and Robert Kaestner, et al., "Re-Examining The Effects of Medicaid Expansions for Pregnant Women," *NBER Working Paper Series*, No. 14591 (December 2008).

[91] See Scott Gottlieb, "What Medicaid Tells Us About Government Health Care," *Wall Street Journal*, January 8, 2009, p. A15 at http://online.wsj.com/article/SB123137487987962873.html

[92] Paul A Buescher, "Method of Linking Medicaid Records to Birth Certificates May Affect Infant Outcome Statistics," *American Journal of Public Health*, vol. 89, no. 4 (April 1999), pp. 564-566.

[93] CRS Report R40397, *Child Nutrition and WIC Programs: A Brief Overview*, by Joe Richardson.

[94] CRS Report RL32748, *The Temporary Assistance for Needy Families (TANF) Block Grant: A Primer on TANF Financing and Federal Requirements*, by Gene Falk.

[95] 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 and Dhaval M. Dave, Sandra Decker, and Robert Kaestner, et al., "Re-Examining The Effects of Medicaid Expansions for Pregnant Women," *NBER Working Paper Series*, No. 14591 (December 2008).

[96] Births: Final Data 2006.

this does not occur. Such reasons could include providers not accepting Medicaid, delayed Medicaid enrollment, or poor quality of care received through Medicaid.

Access to Care

It is possible that Medicaid coverage has weak or little effect on infant health because Medicaid coverage does not guarantee access to physicians or other providers. Many physicians and other providers will not accept Medicaid for a variety of reasons including low reimbursement rates.[97] In one of the few studies that investigate this issue, Currie, Gruber and Fischer found that increases in Medicaid fees to obstetricians/gynecologist were associated with declines in the IMR. They note that increasing provider payment may be an effective strategy to reduce the IMR. They also suggest that this strategy may be as effective as expanding Medicaid eligibility in lowering the IMR.[98]

Prenatal Care Use

One of the pathways through which Medicaid coverage should improve infant health and reduce infant mortality is through increased use of prenatal care; however, the evidence that this occurs is mixed. One study found that Medicaid participation had only small effects on the timing or number of prenatal care visits.[99] Others have found that the expansion of Medicaid eligibility beyond 133% of the federal poverty level does increase the utilization of prenatal care and that increased utilization has small effects on the incidence of low birthweight for non-Hispanic whites, but no significant effects on the rates of low birthweight for non-Hispanic blacks.[100]The finding of conflicting or weak effects of Medicaid on prenatal care may occur because those who enroll in Medicaid often do so after the first trimester[101] and some will only do so at the time of the infant's birth.[102] These delays would mitigate the effectiveness of Medicaid coverage on infant health and the IMR.

Quality of Care

Another potential explanation for why the relationship between Medicaid coverage and IMR is weak is that the quality of prenatal care and care during the first year of life may vary by insurance status. Researchers have found differences in the quality of care that Medicaid provides for a number of causes,

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[97] 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.

[98] Janet Currie, Jonathan Gruber, and Michael Fischer, "Physician Payments and Infant Mortality: Evidence From Medicaid Fee Policy," *NBER Working Paper Series*, No. 4930 (November 1994).

[99] Dhaval M. Dave, Sandra Decker, and Robert Kaestner, et al., "Re-Examining The Effects of Medicaid Expansions for Pregnant Women," *NBER Working Paper Series*, No. 14591 (December 2008).

[100] Dhaval M. Dave, Sandra Decker, and Robert Kaestner, et al., "Re-Examining The Effects of Medicaid Expansions for Pregnant Women," *NBER Working Paper Series*, No. 14591 (December 2008).

[101] Dhaval M. Dave, Sandra Decker, and Robert Kaestner, et al., "Re-Examining The Effects of Medicaid Expansions for Pregnant Women," *NBER Working Paper Series*, No. 14591 (December 2008).

[102] Janet Currie and Jeffrey Grogger, "Medicaid Expansion and Welfare Contractions: Offsetting Effects of Prenatal Care and Infant Health?," *NBER Working paper*, No. 7667 (April 2000).

including some directly related to the IMR. One study found that poor and uninsured women are more likely to give birth at public hospitals[103] which may be of lower quality than the hospitals that women with private insurance use.

A number of researchers have examined the relationship between Medicaid and quality of care for conditions unrelated to the IMR. For a number of health conditions, Medicaid coverage was associated with differences in care received. These researchers suggest that this finding may indicate that the quality of care received is lower for Medicaid patients.[104] Others have found that Medicaid provides lower quality in managed care plans when compared to commercial health plans.[105]

Medicaid Population Composition

The nature of the Medicaid population may explain some of the relationship between the IMR and Medicaid coverage. As discussed above, the Medicaid population shares many of the same demographic characteristics as the population who are likely to experience an infant death. These characteristics may also influence the quality of care that Medicaid patients receive. For example, low income and minority groups are generally more likely to refuse interventional procedures.[106] Those with less education may also be less able to navigate a complicated health care system such as a managed care plan. Given these characteristics, findings of lower quality or fewer services received in Medicaid managed care plans when compared to private plans may be partly explained by differences in the educational level of the Medicaid population.[107] Additionally, studies comparing outcomes between Medicaid and other payers have used Medicaid coverage as a proxy for socioeconomic status. Doing so could confound the outcomes observed because it would be difficult to assess if Medicaid coverage or the low socioecomic status of the patients explained the outcomes found. In sum, it is possible that the characteristics of the Medicaid population may explain the ambiguous relationship between Medicaid and the IMR. This may occur because the population is at greater risk of an infant death or because the population served may receive lower quality care for reasons unrelated to Medicaid coverage.

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[103] 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.

[104] Researchers have also found evidence, in examinations of cardiac events, that could indicate that Medicaid patients receive lower quality of care. For example, researchers have found that Medicaid patients were less likely to receive costly interventions for heart attacks, and were, in turn, more likely to die from a heart attack. See Edward F. Philbin, Peter A. McCullough, and Thomas G. DiSalvo, et al., "Underuse of Invasive Procedures Among Medicaid Patients with Acute Myocardial Infarction," *American Journal of Public Health*, vol. 91, no. 7 (July 2001), pp. 1082-1088 and John G. Canto, William J. Rogers, and William J. French, et al., "Payer Status and the Utilization of Hospital Resources in Acute Myocardial Infarction," *Archives of Internal Medicine*, vol. 160 (March 27, 2000), pp. 817-823.

[105] Bruce E. Landon, Eric C. Schneider, and Sharon-Lise T. Normand, et al., "Quality of Care in Medicaid Managed Care and Commercial Health Plans," *Journal of the American Medical Association*, vol. 298, no. 14 (October 10, 2007), pp. 1674-1681.

[106] Edward F. Philbin, Peter A. McCullough, and Thomas G. DiSalvo, et al., "Underuse of Invasive Procedures Among Medicaid Patients with Acute Myocardial Infarction," *American Journal of Public Health*, vol. 91, no. 7 (July 2001), pp. 1082-1088.

[107] Bruce E. Landon, Eric C. Schneider, and Sharon-Lise T. Normand, et al., "Quality of Care in Medicaid Managed Care and Commercial Health Plans," *Journal of the American Medical Association*, vol. 298, no. 14 (October 10, 2007), pp. 1674-1681.

Selected State Studies

A few states have examined Medicaid payment for births. Below is a discussion of four such states, three with rates below the U.S. average of 6.69—Hawaii (5.64), Minnesota (5.18) and Washington (4.68)—and one with an IMR higher than the U.S. average —Alabama (9.03).[108] These states compare Medicaid coverage to being uninsured and find different outcomes for Medicaid covered births.

Hawaii[109]

The Hawaii State Department of Health examined the relationship between Medicaid status and birth outcomes using hospital discharge data from 2004 to 2006. They found that rates of IMR and low birthweight were significantly higher among those with Medicaid when compared to births covered by private or military insurance. The IMR for Medicaid-covered births was lower than the IMR found for births to the uninsured. They also found that the Medicaid population was more likely to have had a short birth interval—a recent birth within the past 15 months—which is linked to low birthweight and short gestational age births. They did not examine racial, ethnic or education differences between the Medicaid and non-Medicaid populations.

Minnesota[110]

The Minnesota Department of Health examined the relationship between IMR and Medicaid using 1997 to 2001 Medicaid data linked to birth certificates. They found that the IMR was higher for Medicaid covered births (7.4) than for births covered by other sources (5.2). Medicaid was more likely to cover teen births and infants born to non-white women, and women with Medicaid received less prenatal care than those covered by other sources. They also found that the types of infant death observed differed for Medicaid and non-Medicaid covered births. SIDS and unintentional injuries were more common causes of death for the Medicaid population. The Minnesota researchers found lower infant mortality for some minority groups with Medicaid coverage, which they conclude suggests that Medicaid coverage may reduce the risk of an infant death for some groups.

Washington[111]

The Washington State Department of Health examined infant mortality in 2003 and found higher infant mortality for births covered by Medicaid than for those covered by other sources. Specifically, the IMR for Medicaid covered births (9.0) was double the rate for non-Medicaid covered births (4.5). They found

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[108] Births: Final Data 2006.

[109] 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.

[110] Maternal and Child Health, Minnesota Department of Health, *The Birth Certificate and Medicaid Data Match Project: Initial Findings in Infant Mortality*, St. Paul, MD, September 2005, www.health.state.mn.us/divs/fh/mch/infamort.html.

[111] Washington State Department of Health, *Infant Mortality*, MCH Data Report 2006: Infant Mortality , Spokane, WA, January 2006.

that IMR were higher for teen mothers, women who were African American, American Indians/Alaska Native or a Native Hawaiian/Pacific Islander.

Alabama[112]

The Alabama Department of Public Health examined 2005 birth data by method of payment for delivery. They compared Medicaid, private insurance, self pay—who they consider to be uninsured— and other. They found the best outcomes for births covered by private insurance and that births covered by Medicaid had worse outcomes when compared to births covered by private insurance, but better outcomes than births to women who were uninsured. When compared to the uninsured, women whose births were covered by Medicaid were more likely to have received prenatal care and less likely to have an infant born at a low birthweight or to have a infant die within the first year. When compared to private insurance, Medicaid mothers received less prenatal care and had higher IMR—11.6 compared to 6.6. They also observed that mothers whose births were paid for by Medicaid were less educated, more likely to be teenagers, and less likely to be married. Based on the contrasts between Medicaid and the uninsured, the authors conclude that Medicaid improves health outcomes.

Summary

The U.S. infant mortality rate is higher than those observed in a number of developed countries. The IMR is correlated with a number of demographic characteristics that may directly influence IMR or may increase the risk of conditions associated with IMR such as low birthweight and short gestational age birth. Additionally, the IMR may be affected by health system characteristics such as existence or type of insurance coverage and the quality of prenatal care received. The relationship between Medicaid and the IMR is unclear and may be confounded by the composition of the population receiving Medicaid because Medicaid program eligibility is determined by income.

[112] Louie Albert Woodbright, *Method of Payment for Delivery* , Alabama Department of Public Health, Montgomery , AL, July 2007, www.adph.org.