

Infant Mortality

Definition: Death of a child younger than one year old. These deaths are often divided into two groups: neonatal mortality (death of an infant within the first 27 days of life) and postneonatal mortality (death of an infant 28–364 days old). This chapter uses period rates, the number of deaths in a given period per 1,000 live births in the same period, unless otherwise noted.

Summary

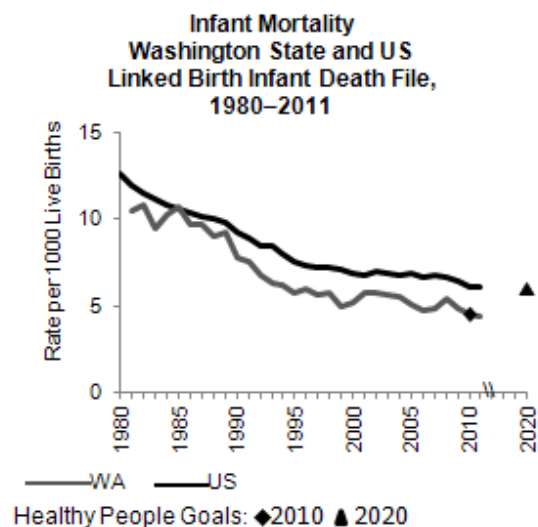
Infant mortality is associated with poor maternal health, poor quality of and access to medical care and preventive services, and low socioeconomic position.¹ In 2011, 387 Washington State children died in their first year of life. The state infant mortality rate for that year was 4.5 per 1,000 live births, compared to a preliminary 2011 national rate of 6.0 per 1,000. Washington's infant mortality rate has been among the lowest in the country for several years. Still, disparities persist. American Indian and Alaska Native infants experience about twice the infant mortality of Asians and whites, and their infant mortality rate has been increasing. Black infants also have elevated infant mortality compared to Asians and whites, but their rate has been decreasing. Infant mortality rates for babies whose mothers receive Medicaid are higher than among mothers not receiving Medicaid.

No single intervention reduces all infant mortality. Prenatal care; participation in the Women, Infants and Children nutrition program (WIC); and receipt of high-risk neonatal care help to reduce deaths. Other proven strategies to reduce infant death include folic acid supplementation to prevent some types of birth defects, smoking cessation, use of infant car seats, and placing infants to sleep on their backs. Reducing births before 39 weeks in women without medical conditions requiring early delivery also lowers risk of infant death.

Time Trends

Washington's infant mortality rate has steadily declined since 1980, as has the national rate. The majority of this decrease occurred during 1980–1995, when the rate dropped from 11.8 to

5.8 deaths per 1,000 live births. Since then the rate of decrease has slowed. Washington's infant mortality rate was 4.5 in 2011. While the decreasing trend occurs in both neonatal and postneonatal deaths, the patterns are somewhat different. The decrease in neonatal deaths, which made up 63% of infant deaths in 2011, mirrors the overall decrease in infant mortality. The decrease in postneonatal deaths occurred almost entirely from 1988 through 1996.



The leading causes of infant death in Washington for 2009–2011 combined were birth defects, sudden infant death syndrome (SIDS) and preterm birth. Studies suggest that the national decrease in infant mortality from 1980–2000 was due to technological advances in neonatal medicine, use of regionalized care systems for high-risk infants, advances in prenatal diagnosis of severe birth defects resulting in selected termination of affected pregnancies, and improved treatment of some birth defects.^{1,2,3} More recently, increases in preterm birth and preterm birth-related infant mortality have slowed further declines in infant mortality.⁴

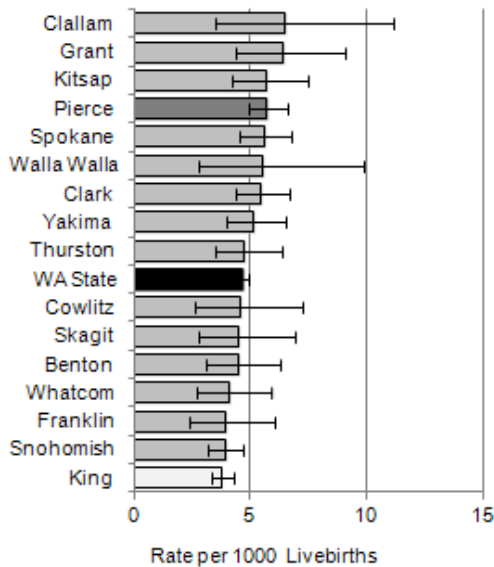
2010 and 2020 Goals

The national *Healthy People 2020* objective is to reduce infant mortality to no more than 6.0 deaths per 1,000 live births. This goal was set at 10% lower than the 2006 U.S. infant mortality rate. It is higher than the *Healthy People 2010* goal of no more than 4.5 deaths per 1,000 live births. By 2010, Washington met both national objectives.

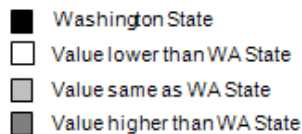
Geographic Variation

In 23 Washington counties, 10 or fewer infants died during 2009–2011. Infant mortality rates for these counties fluctuate considerably even when combining three years, and so they are not reported here. Among the 16 counties with more stable infant mortality rates, Pierce County had a higher rate than the state overall and King County had a lower rate.

**Infant Mortality
Washington Counties***
Linked Birth Infant Death File, 2009–2011



* Counties with 10 or fewer infant deaths excluded

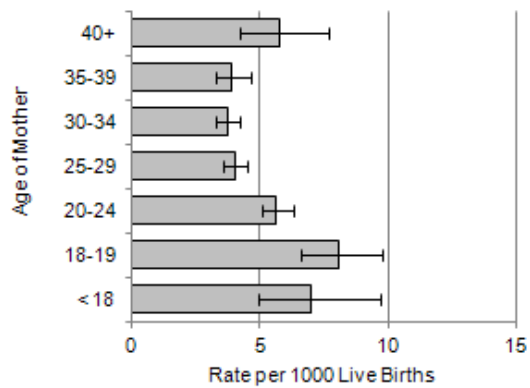


These rates are not adjusted for county differences in maternal age, race, Hispanic origin or socioeconomic status, all of which may affect infant mortality rates.

Age of Mother

In Washington from 2009–2011, babies born to mothers younger than 25 years had higher infant mortality than babies born to mothers ages 25–39. Babies born to mothers ages 40 and older had higher infant mortality rates than babies born to mothers ages 25–34. Nationally, babies born to teenage mothers and mothers ages 40 and older have the highest infant mortality rates.⁵ Because of the small numbers of deaths in specific age and race categories in Washington, it is not possible to determine whether this relationship holds for all racial groups and for infants of Hispanic origin. Nationally, infants of non-Hispanic white teen mothers had higher mortality than for mothers 40 years and older. However, for non-Hispanic blacks and Mexicans the mortality rate of infants born to teen mothers was less than that of infants born to mothers 40 and older.

**Infant Mortality
Age of Mother**
Linked Birth Infant Death File, 2009–2011



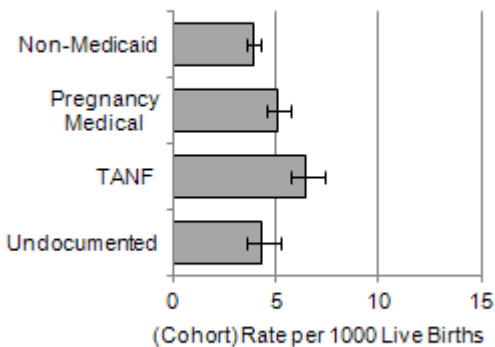
Economic Factors

Research continues to associate lower maternal income with higher infant mortality rates. Medicaid coverage of prenatal care and delivery and receipt of cash assistance (Temporary Assistance for Needy Families—TANF) can be used as indicators of low income. Infant death rates based on Medicaid data are [cohort](#) rates. (See [Technical Notes](#).)

For 2008–2010, the most recent data available, the [cohort](#) infant mortality rate for infants of low-income mothers receiving Medicaid and TANF was 6.5 deaths per 1,000 live births. Mothers of those infants generally had family incomes less than 50% of the [federal poverty level](#). Among mothers who received Medicaid but not TANF (Pregnancy Medical), the infant mortality rate was 5.1 per 1,000. These

women have family incomes less than 185% of the federal poverty level. The infant mortality rate among mothers who did not receive Medicaid was 3.9 deaths per 1,000.

**Cohort Infant Mortality
By Medicaid Program
First Steps Database, 2008–2010**



S-Program: Medicaid but not TANF
TANF: Temporary Assistance for Needy Families

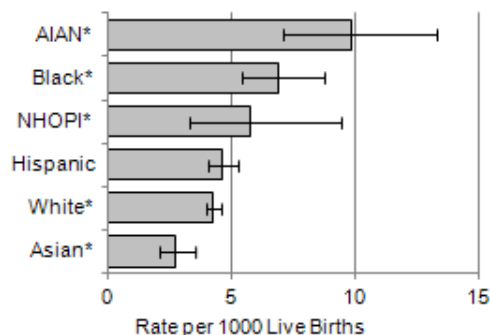
Low income is not a risk factor for infant mortality for all groups, however. Infants of undocumented low-income women receiving medical assistance had an infant mortality rate similar to infants of mothers who did not receive Medicaid. Undocumented mothers are predominantly of Hispanic origin and often have family incomes less than those of women receiving TANF.⁶ Lower infant mortality rates among infants of Hispanic women who were not born in the United States have often been reported. The lower rates have been attributed to strong social support networks and the very low prevalence of risk behaviors such as smoking during pregnancy.⁷

Race and Hispanic Origin

Race in this section refers to mothers who reported one race only and reported they were not of Hispanic ethnicity. (See [Technical Notes](#).) Babies born to American Indian and Alaska Native mothers experienced an infant mortality rate (9.8 per 1,000) over three times that of babies born to Asian mothers (2.7 per 1,000) and twice that of those born to white mothers (4.3 per 1,000) in 2009–2011 combined. In addition, the infant mortality rate of babies born to American Indian and Alaska Native mothers in Washington has been increasing since 1994, in contrast to decreases or no change among other racial and ethnic groups. The infant mortality rate for infants born to black mothers

(6.9 per 1,000) has declined substantially since at least 1990, but remains higher than the white rate (4.3 per 1,000). About 37% of births to black mothers in Washington are among foreign born women. Infants born to these women have lower infant mortality than infants of U.S. born black women.

**Infant Mortality
Race and Hispanic Origin
Linked Birth Infant Death File, 2009–2011**



* Non-Hispanic
AIAN: American Indian/Alaska Native
NHOPI: Native Hawaiian/Other Pacific Islander

Other Measures of Impact and Burden

Causes of death. The three leading causes of infant death in Washington from 2009–2011 listed on death certificates were birth defects (24%), SIDS (14%) and preterm birth (11%). Deaths due to birth defects impact infants of all ages, but are more common among neonates. SIDS deaths impact older infants during the postneonatal period. Preterm birth-related deaths mostly occur during the neonatal period. The next most frequent causes of death included maternal complications and complications of placenta, cord and membranes, which together accounted for 12% of infant deaths. These deaths occur mostly in the neonatal period. Injuries and violence such as homicide, motor vehicle crashes, and choking or suffocation accounted for 5% of all infant deaths from 2009–2011. These deaths occur mostly during the postneonatal period.

Birth defects. In Washington, infant mortality caused by birth defects has dropped by about half, from a rate of 2.2 per 1,000 in the early 1980s to 1.1 per 1,000 in 2009–2011. This decrease is likely explained by a combination of improved prenatal diagnosis and pregnancy management as well as improvements in neonatal technology and surgical repair of malformations.⁸ Folic acid has been found to prevent neural tube defects, which are conditions with very high mortality rates. To be effective in

preventing neural tube defects, folic acid must be taken prior to pregnancy. Washington [Pregnancy Risk Assessment Monitoring System](#) (PRAMS) data for 2008–2010 show that during the month before becoming pregnant, about 31% ($\pm 2\%$) of women took a multivitamin daily. The rate ranged from 40% ($\pm 4\%$) of Asian mothers to 16% ($\pm 4\%$) of American Indian and Alaska Native mothers.

Sudden Infant Death Syndrome. SIDS continues to be a leading cause of infant mortality. After the Back to Sleep Campaign in the late 1980s, SIDS deaths in Washington declined from 2.6 deaths per 1,000 live births in 1980 to 0.5 per 1,000 in 2005. SIDS rates have fluctuated in recent years, but remain low. Sudden unexpected infant deaths (SUID) is a new broader category of death that includes SIDS deaths as well as deaths due to accidental suffocation in bed and other infant deaths of unknown cause. The shift to this grouping is partly due to more systematic death scene investigations of unexpected infant deaths and recognition of sleep-related factors that may contribute to death.⁹

Very low birth weight and prematurity. Very low birth weight (VLBW) infants weigh less than 1,500 grams (three pounds, five ounces) and are usually very premature (less than 34 weeks gestation). From 2009–2011, they accounted for about 1% of all births but made up 42% of infant deaths in Washington. The deaths of VLBW infants are classified on the death certificate as due to preterm birth as well as several other causes of death, including deaths due to birth defects; maternal complications of pregnancy; complications related to the umbilical cord, placenta or membranes; respiratory distress; cardiovascular disorders; and bacterial sepsis.

Black infants in Washington have twice the prevalence of VLBW as white infants. This difference has long been recognized in the United States as a whole, but the reasons for it are unclear.¹⁰ (See [Singleton Low Birth Weight](#) for a discussion about the contribution of medical, behavioral and environmental risk factors to low birth weight.)

Prematurity as well as infant birth weight greatly impacts infant mortality. Late preterm births (34–36 weeks gestation) have higher rates of neonatal and postneonatal mortality compared to term infants.¹¹ A study of all U.S. births in 2001 found that one in five late preterm infants

had no medical reason for the early delivery recorded on the birth certificate. These infants are often induced and have higher mortality rates compared with infants of similar gestational age born after spontaneous labor.¹² Such findings, along with research showing that early term infants (37–38 weeks) have higher morbidity and mortality than infants born at 39–41 weeks, have raised questions about the definition of full-term gestation. Infant mortality decreases the longer the baby is in the womb up to 40 weeks.¹³

Multiple births. Twins, triplets and other multiple births have over four times the risk of infant death as singletons. From 2009–2011, multiple births accounted for 11% of infant deaths, while they comprised about 3% of births. These deaths are two times more common among neonates than among older infants.

Risk and Protective Factors

In general, risk factors for infant mortality cluster together. Rates are highest for babies born to mothers who are black or American Indian and Alaska Native. Rates are also higher among babies born to mothers who are low income, smoke, have poor nutritional status, or are younger than 20 or older than 40. Two important categories of risk—maternal and infant medical conditions and social and behavioral factors—are discussed below.

Maternal and infant medical risks. Risk factors that contribute to the many causes of infant mortality include medical conditions that precede the pregnancy and complications that occur during pregnancy and birth. Maternal medical risks include a history of preterm birth, uterine malformations, chronic diseases (such as hypertension, kidney disease, obesity and diabetes), genetic factors and perinatal infections (such as HIV, Hepatitis B and sexually transmitted diseases).¹⁴ Additional risk factors include multiple gestation pregnancy (twins or more) and inadequate pregnancy weight gain.¹⁴

In addition to low birth weight and prematurity, infant medical risks include birth defects, hemolytic disease (a condition in which the mother's antibodies attack the fetus' red blood cells) and infections such as Group B Strep.¹⁴ Despite substantial progress in preventing Group B Strep, the disease remains a leading infectious cause of morbidity and mortality among newborns in the United States.¹⁵

Maternal stress during pregnancy has been associated with preterm delivery and is suggested

as a cause of racial and ethnic disparities in preterm delivery.¹⁶ On Washington PRAMS from 2008–2010, 10% ($\pm 3\%$) of black and 14% ($\pm 4\%$) of American Indian and Alaska Native mothers reported high stress in the 12 months prior to delivery compared to 1% ($\pm 2\%$) of Asian, 5% ($\pm 2\%$) of white, and 6% ($\pm 2\%$) of Hispanic mothers. High stress was defined as experiencing at least six of 13 specific stressful life events, including separation or divorce, moving to a new address, homelessness and losing a job.

Social and behavioral factors. Smoking during pregnancy is associated with miscarriage, premature birth, fetal growth restriction, low birth weight, infant death and SIDS.¹⁷ Among infant deaths in the United States, 5%–7% of preterm-related deaths and 23%–34% of SIDS deaths could be avoided by eliminating smoking during pregnancy.¹⁸ From 2009–2011, the death rate in Washington for infants whose mothers smoked just before pregnancy was 7.6 per 1,000 compared to 4.2 for nonsmokers. The SIDS death rate for infants born to mothers who smoked just before pregnancy was 1.5 per 1,000 compared to a SIDS rate of 0.5 per 1,000 for infants born to nonsmokers.

Pregnancies occurring too close together or too far apart have been associated with perinatal death. Interpregnancy intervals shorter than 18 months and longer than 59 months increase the risk of adverse perinatal outcomes including low birth weight and preterm birth.¹⁹ The reasons for these associations are unclear, but may be related to maternal nutritional status or changes in reproductive capacity with age.¹⁹

Recent research shows maternal obesity is associated with increased risk of infant death, mainly neonatal death. This may be due in part to the increased incidence of maternal diseases such as hypertension and diabetes in obese women.^{20,21} Maternal obesity is also associated with increased risk of infants born with neural tube defects. This may be related to the need for increased levels of folate beyond the current recommendation of 400 micrograms per day.²²

Illicit drug use increases the incidence of fetal growth restriction, preterm birth and adverse pregnancy outcome, all of which contribute to infant mortality. But other behaviors associated with drug use, including smoking, alcohol use and domestic violence, also contribute to risk.²³ From 2008–2010, the mortality rate for babies

born to Medicaid-identified substance users (alcohol, illicit drugs or both) was 13.0 per 1,000. This rate was significantly higher than the rate among Medicaid non-substance users, 5.4 per 1,000.²⁴

Breastfed infants are less likely to die from any cause in the post-neonatal period.^{25,26} In Washington, the percent of women who breastfeed varies by race and ethnicity. According to 2008–2010 Washington PRAMS data, 82% ($\pm 3\%$) of Asian women, 73% ($\pm 3\%$) of white women, 71% ($\pm 3\%$) of Hispanic women, 71% ($\pm 4\%$) of black women, 60% ($\pm 5\%$) of American Indian and Alaska Native women and 60% ($\pm 11\%$) of Native Hawaiian and other Pacific Islander women reported breastfeeding at two months postpartum.

Risks for SIDS. Babies born to mothers who are young, poorly educated, have absent or late prenatal care, smoke or are at risk for preterm birth for any reason are more likely to die in the first year of life, especially from SIDS.^{27,28} Other risk factors for SIDS include sleeping on the stomach or side, sleeping on a soft surface, overheating, preterm birth, low birth weight, male gender and not breastfeeding.^{29,30} Recent evidence shows that breastfeeding is protective against SIDS and this effect is stronger when infants are only fed breastmilk.^{26,30} Pacifier use also protects against SIDS.³⁰ A recent review of scientific literature suggests that immunizations might have a protective effect against SIDS.^{30,31} Some deaths previously classified as SIDS may be due to accidental suffocation and strangulation in bed.^{9, 32}

Intervention Strategies

No single intervention reduces all infant mortality. The best overall strategy to reduce infant death rates is to reduce modifiable risk factors for specific causes of death. For example, folic acid reduces infant mortality caused by neural tube defects.

Prenatal care. Prenatal care can reduce maternal, fetal and infant morbidities and mortality by identifying and treating maternal conditions and behaviors that affect birth outcomes.¹⁴ Routine prenatal care includes screening and counseling for infections, interpersonal violence, chronic medical conditions, substance abuse and genetic risk factors.¹⁴

But even early prenatal care can occur too late to address preexisting medical and behavioral factors that influence infant mortality. Recently, maternal fetal experts have recommended that preconception or interconception services be provided at every

healthcare encounter for women of childbearing age.^{14,33} Preconception care can increase opportunities to optimize pregnancy spacing, prevent unintended pregnancies and identify modifiable risk factors associated with infant death. Data are limited on the effectiveness of this strategy. Two recent studies found that women who received preconception counseling changed important behaviors, such as reducing substance use, and increasing folic acid supplementation, healthy eating and physical activity.^{34,35}

Folic acid. Infants with neural tube defects, including spina bifida and anencephaly, have high morbidity and mortality rates. Preconception and early prenatal folic acid supplementation can prevent neural tube defects.³⁶ Research conducted after mandatory folic acid fortification of food suggests that fortification is the major factor in reducing neural tube defects related to insufficient intake of folic acid by women of childbearing age.³⁷

WIC. Some research indicates that infants born to women who participate in nutrition programs such as the Supplemental Nutrition Program for Women, Infants, and Children (WIC) have fewer low birth weight and preterm infants and enter prenatal care earlier than low-income women who do not participate in WIC.^{38,39} This was especially true for women at high risk for these conditions.³⁸ WIC provides nutrition education, referrals to health and social services, and checks to buy WIC-approved groceries.

High-risk neonatal care. Technical advances in high-risk obstetric and neonatal care in the past 20 years have contributed to the dramatic reduction in mortality rates among infants with low birth weights.⁴⁰ High-risk newborns, especially very low birth weight newborns, are more likely to survive when delivered at perinatal regional centers or facilities providing specialized (Level III) perinatal services.^{40,41}

Smoking cessation. Pregnant women can be especially motivated to quit smoking.⁴² A brief counseling session by an appropriately trained healthcare provider has been shown to be effective in helping women to quit smoking, as has providing a financial incentive for confirmed quitting.⁴³ In the first year after pregnancy, many women who quit during pregnancy start smoking again. Evidence for strategies to help women remain tobacco-free has been weak,⁴⁴ but two interventions reported recently show promise.

These studies used motivational interviewing and counseling, or counseling with diaper vouchers provided monthly following confirmation of quit status.^{45,46} States with Medicaid coverage for prenatal smoking interventions have higher quit rates during pregnancy and more women remain tobacco-free after delivery than states without Medicaid coverage.⁴⁷

In Washington, First Steps maternity support services recommend that providers ask clients about tobacco use and secondhand smoke exposure throughout pregnancy and after delivery. The Washington State Department of Health funds the toll-free Washington Tobacco Quitline which provides services for all pregnant women regardless of health insurance. Pregnant women are eligible for an intensive 10-call program, which includes two contacts after delivery for women who have quit.

Elective delivery before 39 weeks. Given the increased mortality risk for late-preterm and early term births, efforts to reduce deliveries before 39 weeks unless medically needed will lower the risk for infant death.¹² Physician education and hospital enforced policies can reduce elective deliveries before 39 weeks.^{48,49,50} The Washington State Perinatal Collaborative is working with the Washington State Hospital Association and hospitals throughout the state to reduce delivery before 39 weeks unless medically needed.

SIDS risk reduction. Recently, the American Academy of Pediatrics updated recommendations for reducing the risk of SIDS, including putting babies to sleep on their backs, promoting pacifier use, and promoting infants sleeping nearby but not in the same bed as caregivers. Other recommendations include promoting breastfeeding and immunizations, and reducing tobacco and substance use.³⁰ Expectant and new parents in Washington receive education and written materials about providing a safe infant sleep environment from WIC, CHILD Profile and WithinReach. Women in Maternity Support Services also receive this guidance.

Injury prevention. Strategies to prevent suffocation deaths in infants include putting infants to sleep in a safe environment, supervising infants while eating and ensuring children play with age-appropriate toys. Use of infant car seats decreases injury and mortality from motor vehicle crashes.^{51,52}

Death review. The American Academy of Pediatrics recommends establishing local or regional child death review teams to study health problems, analyze services and develop policy

recommendations directed at preventing infant mortality.⁵³ Approximately 10 of Washington's 35 local health jurisdictions review unexpected deaths of children from birth through age 17. Lack of funding threatens the existence of these reviews.

See Related Chapters: [Access to Prenatal and Preconception Care](#), [Singleton Low Birth Weight](#), [Unintended Pregnancy](#), [Teen Pregnancy and Childbearing](#), [Nutrition](#), and [Obesity and Overweight](#)

Data Sources

Washington State Department of Health, Center for Health Statistics, Vital Registration System Annual Statistical Files, Linked Birth Infant Deaths 1980–2010, released September 2011; analysis prepared by Office of Healthy Communities.

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For More Information

Washington Department of Health, Division of Prevention and Community Health, Office of Healthy Communities, (360) 236-3584.

Technical Notes

Period or cohort rates. Infant death rates based on vital statistics data are period rates that use infant deaths in a given year or years as the numerator and infant births in the same year(s) as the denominator. Infant death rates based on Medicaid data are cohort rates that describe the experience of a birth cohort. The denominator includes all births in a specified time period (cohort) and the deaths before 365 days of age among those infants in the numerator. The deaths may occur in the same years as the cohort, or in the subsequent year.

Birth defects. An abnormality in structure that is present at birth, such as cleft lip or palate.

Sudden infant death syndrome (SIDS): Sudden, unexplained death of an infant from an unknown cause.

Race- and Hispanic origin-specific rates: Race- and Hispanic-origin specific rates of infant mortality are

calculated using the mother's race and Hispanic origin. When Hispanic origin was missing, but a race was provided, infants were considered Non-Hispanic. Unless otherwise noted, the race groups include non-Hispanics and people who report one race only. About 4% of infant deaths were among mothers who reported multiple races.

Federal Poverty Level: The federal poverty level is published each year by the Department of Health and Human Services. It is the estimated minimum income a family needs in order to provide for basic needs. It is used as the basis for eligibility for federal and state assistance programs. In 2010, the federal poverty level was \$17,374 for a family of 3.

Medicaid Program: Medicaid women received maternity care paid for by Medicaid. Medicaid recipients were divided into three major subgroups (from highest to lowest socioeconomic status) based on program eligibility. **Pregnancy Medical** were women eligible for the pregnancy medical assistance "S" program. These women were U.S. citizens or legal U.S. residents, and were eligible to receive Medicaid because they were pregnant and had incomes at or below 185% the federal poverty level; **TANF** were women enrolled in the Temporary Assistance for Needy Families (TANF) program. These women were very low income (generally less than 50% the federal poverty level) and received cash assistance (TANF) in addition to Medicaid; and **Undocumented** were women who were not legally admitted for permanent residence, lack temporary residence status, or were not lawfully present in the United States. They were eligible to receive Medicaid because they were pregnant and had incomes at or below 185% the federal poverty level. Undocumented women were not eligible for TANF although their incomes were often lower than women on TANF. All three Medicaid groups had incomes below most non-Medicaid women. Note that Medicaid eligibility status for pregnant legal residents who were not U.S. Citizens changed in spring 2009. Prior to spring 2009, legal residents who were not U.S. Citizens were grouped with Undocumented women (and called Non-Citizens).

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Endnotes

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