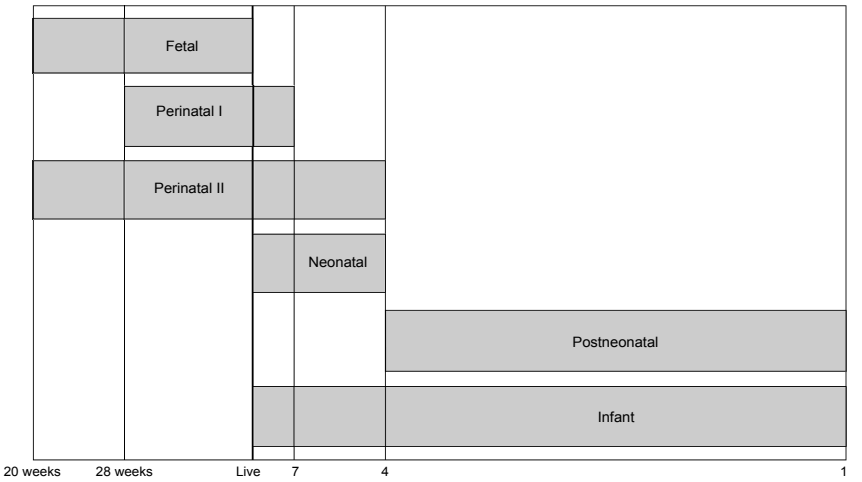
Fetal and infant mortality

Introduction

This report presents fetal and infant mortality data. Infant deaths occur within one year of birth. Fetal deaths included in this report are for fetuses weighing at least 350 grams at delivery, or at least 20 weeks' gestation if delivery weight is unknown. This definition applies to data after 1998. Although fetal and infant death records are useful for statistical descriptions of deaths within a given period, their fundamental purpose is to help discover and evaluate preventive strategies to improve infant health. As an aid to understanding and monitoring health trends, this report divides fetal and infant deaths into five overlapping categories: fetal deaths, perinatal deaths, infant deaths, neonatal deaths and postneonatal deaths. These categories are consistent with the definitions established by the National Center for Health Statistics (see Figure 7-1).

The five categories of fetal and infant death were analyzed using three databases: fetal deaths, infant deaths and births. National publications covering the subject of fetal and infant death may use one or any combination of these databases. As a result, death rates often vary slightly depending on whether birth or death cohorts were used as the data source for statistical analysis. The next section discusses the definitions for birth and death cohorts.

Figure 7-1.
Fetal*, perinatal and infant death: definitions



*Fetal deaths reported include those with birthweights of at least 350 grams or, if birthweight is unknown, at least 20 weeks gestation.

Throughout this report, some tables display rates and ratios based on small numbers of events. Rates and ratios based on fewer than five events are unreliable. It is important to avoid inferring causal relationships based solely on the data contained in these tables.

Definitions and methodology

The following are definitions of fetal and infant death data components.

- **Fetal deaths** are those that occur among fetuses weighing at least 350 grams at delivery, or that have completed at least 20 weeks' gestation if delivery weight is unknown. To classify an event as a fetal death, the developing fetus must have died either in utero or during delivery. Fetal deaths are classified as "early" (20–27 weeks' gestation) or "late" (28 or more weeks' gestation). Oregon public health and safety laws require fetal death reporting.*
- **Infant deaths** are those that occur during a child's first year (measured from birth through 364 days). Infant deaths include both neonatal and postneonatal deaths.
  - » **Neonatal deaths** are those that occur during the first 27 days of life. Neonatal deaths may be "early" (under seven days) or "late" (seven to 27 days).
  - » **Postneonatal deaths** are those that occur from day 28 through day 364 after birth.
- **Perinatal deaths definition I** includes fetal deaths at 28 weeks of gestation or more, and infant deaths at less than seven days after birth.
- **Perinatal deaths definition II** includes fetal deaths at 20 weeks or more of gestation, and infant deaths at less than 28 days after birth.

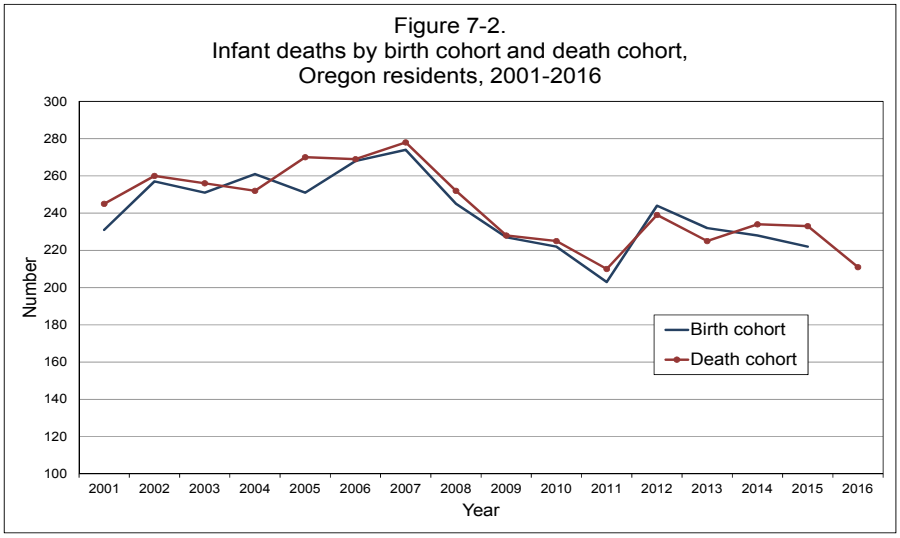
*** Prior to Nov. 10, 1998, fetal deaths occurring at 20 weeks of gestation or more were reported. Effective that date, the Oregon Legislature amended Oregon Revised Statute 432.333 to read: "Each fetal death of 350 grams or more, or, if weight is unknown, of 20 completed weeks' gestation or more, calculated from the date last normal menstrual period began to the date of delivery, that occurs in this state shall be reported within five days after delivery to the county registrar of the county in which the fetal death occurred or to the Center for Health Statistics or as otherwise directed by the Center for Health Statistics." Currently, hospitals and reporting facilities send all fetal death reports directly to the Oregon Center for Health Statistics rather than to county registrars.**

- The **death cohort** for infant death includes all infant deaths occurring in any given calendar year. In this report, the death cohort consists of infants that died in 2016 and could have been born in either 2015 or 2016. Data from the death cohort are usually available sooner than birth cohort data, as described below. The focus and analysis of the death cohort is on death record information, including age, residence of the infant and cause of death. Table 7-1 and Table 7-2 are based on a death cohort.
- The **birth cohort** for matched infant deaths (each death record matched to its corresponding birth record) is based on analysis of infants born in the same calendar year that die within one year of their birth. In this report, the birth cohort consists of infants born in 2015 that died in either 2015 or 2016. Analysis based on a birth cohort is typically not as timely; however, it allows the analysis of characteristics from the birth record, such as mother's race, age and factors affecting the birth outcomes (e.g., birthweight, prenatal care, mother's use of tobacco). Rates using the birth or death cohorts may differ slightly, but the difference is usually small. Tables 7-8 through 7-18 are based on an infant birth cohort. See Figure 7-2 for a comparison of deaths by birth cohort and death cohort.

Use of the 2016 death cohort

This chapter uses data from the 2016 death cohort in the first two tables. Much of the discussion is on the cause

Figure 7-2.
Infant deaths by birth cohort and death cohort,
Oregon residents, 2001-2016



of death. Infant characteristics at the time of death are derived from death records, with the primary focus on age at death, county of residence at death and underlying cause of death. Total age-specific and cause-specific mortality ratios are computed by dividing the number of infant deaths in a calendar year by the number of births in the same calendar year.

Demographics

During 2016, 211 Oregon resident infants under 1 year of age died — a decrease from 233 in 2015. The infant mortality rate also decreased, from 5.1 deaths per 1,000 births to 4.6 (see Table 7-1). Oregon's infant death rate was 22.0% lower than the U.S. rate of 5.9 per 1,000 births during 2015 (the most recent year for which data are available). (1) As in previous years, most infants (70.1%) that died during 2016 were less than 28 days old. More than half (55.9%) of infant deaths occurred within the first week of life (see Figure 7-3).

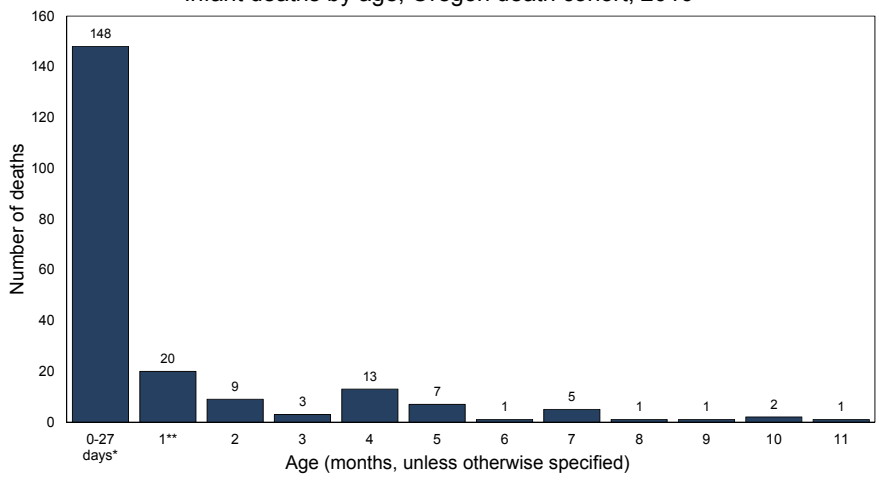
During 2016, 211 infants died within the first year of life.

Between 2012 and 2016, the infant mortality rates for Oregon counties (excluding counties with fewer than five infant deaths) ranged from 5.0 to 17.7. Two Oregon counties had infant mortality rates significantly higher than the state rate (5.0): Tillamook (10.3) and Josephine (8.2). No county had an infant mortality rate significantly lower than the state rate.

Sudden infant death syndrome

Sudden infant death syndrome (SIDS) is the sudden and unexpected death of an apparently healthy infant under 1 year of age, usually during the postneonatal period. Historically,

Figure 7-3.
Infant deaths by age, Oregon death cohort, 2016



*Neonatal period is <28 days. Inset shows details of neonatal period.
**1 month age group includes infants more than 27 days and less than 2 months of age.

Oregon's SIDS rate has been higher than the national rate, and SIDS has been a leading cause of death among Oregon infants (see Figure 7-4). However, since 2001, Oregon's and the nation's rates have been similar. Oregon's rate dropped quickly after the implementation of "Back to Sleep," a national educational campaign begun in 1994 to encourage non-prone sleeping positions for infants.

The number of SIDS deaths decreased slightly from 23 in 2015 to 21 in 2016, and the SIDS death rate among infants was unchanged at 0.5 per 1,000 live births. This decrease in the number of SIDS deaths was not statistically significant. In 2016, SIDS accounted for 10.0% of all infant deaths in Oregon and 30.2% of all postneonatal deaths (see Table 7-2).

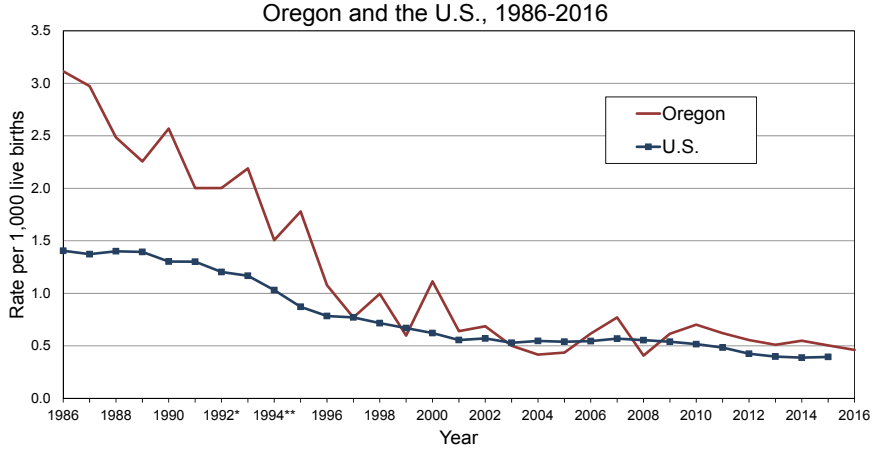
SIDS accounted for 10% of all infant deaths in 2016.

Neonatal death

Oregon's neonatal and postneonatal death rates have been declining since 1936, when the neonatal death rate was 29.0 per 1,000 births and the postneonatal death rate was 15.3 per 1,000 births. In 2016, the neonatal death rate was 3.3 per 1,000 births, unchanged from the previous year. The postneonatal death rate was 1.4 per 1,000 births, a decrease from 1.8 in 2015 (see Figure 7-5 and Table 7-1).

In 2016, 148 infants died during the neonatal period, a slight decrease from 150 in 2015. Oregon's neonatal death rate has consistently been below that of the United States (see Figure 7-6). The 2016 Oregon rate (3.3) is 15.4% lower than the 2015 national rate of 3.9. (1) Congenital anomalies were responsible for more neonatal deaths than any other cause (30.4%), followed by short gestation and fetal growth

Figure 7-4.
Sudden infant death syndrome (SIDS) death rates,
Oregon and the U.S., 1986-2016



*The first American Academy of Pediatrics statement was released in 1992.
**The kickoff of the "Back to Sleep" campaign was in 1994.
Death cohort 1986-2016. Changes in cause of death coding affected SIDS death rates beginning in 1999.

Table A - Neonatal deaths due to respiratory distress syndrome, 2000-2016

Year	Number	Percent*	Rate**
2000	6	3.6	13.1
2001	5	3.2	11
2002	4	2.3	8.9
2003	3	1.7	6.5
2004	6	3.4	13.1
2005	10	5.6	21.8
2006	5	2.7	10.3
2007	9	4.7	18.2
2008	3	1.9	6.1
2009	2	1.3	4.2
2010	3	2.0	6.6
2011	4	2.8	8.9
2012	4	2.5	8.9
2013	4	2.6	8.9
2014	2	1.3	4.4
2015	2	1.3	4.4
2016	2	1.4	4.4

* Percent of neonatal deaths due to RDS.
**Per 100,000 live births.

(19.6%) and maternal factors (18.2%) (see Table 7-2). Only two neonates died from respiratory distress syndrome (RDS) in 2016 (see Table A).

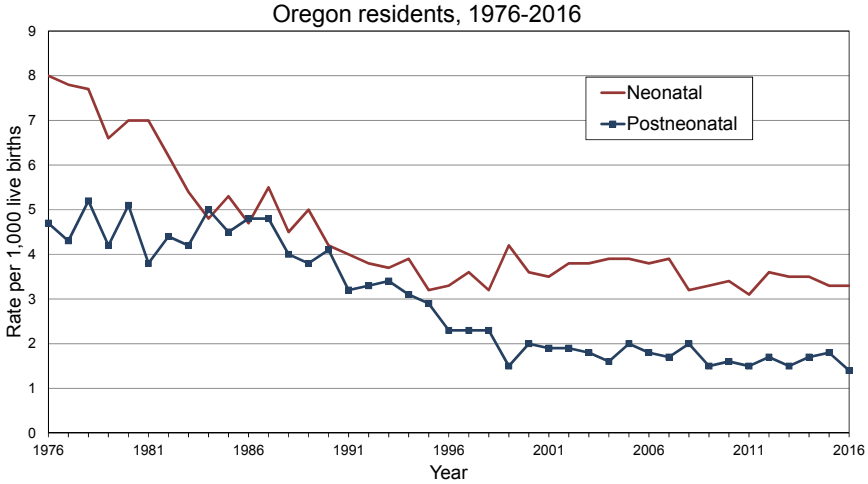
Postneonatal death

In 2016, 63 Oregon infants died during the postneonatal period, representing 29.9% of all infant deaths. The postneonatal death rate of 1.4 per 1,000 births represents a slight decrease from 2015 (1.8 per 1,000 births); the difference is not statistically significant (see Figure 7-5). Sudden infant death syndrome (SIDS) was the most common cause of postneonatal death (30.2%). Unintentional injuries were the second most common cause and accounted for 17.5% of postneonatal deaths. Congenital anomalies were the third most common cause (15.9%) (see Table 7-2). Before 1996, Oregon's postneonatal death rate was higher than the U.S. rate; since then, the state rate has been lower than the national rate (1.4 per 1,000 births for Oregon in 2016 versus 2.0 per 1,000 births for the latest U.S. data available in 2015). (1)

Fetal death

Fetal deaths were first reported to the Public Health Division in 1928, when the ratio of fetal deaths to live births was 29.0 for every 1,000 Oregon births. Since then, this ratio has generally decreased, and has remained under 5.0 since 1998 (see Figure 7-7 and Table 5-2). In 2016, there were 184 Oregon resident fetal deaths, or 4.0 fetal deaths per 1,000 live births (see Table 7-3). This is not a statistically significant

Figure 7-5.
Neonatal and postneonatal death rates,
Oregon residents, 1976-2016



Death cohort 1976-2016.

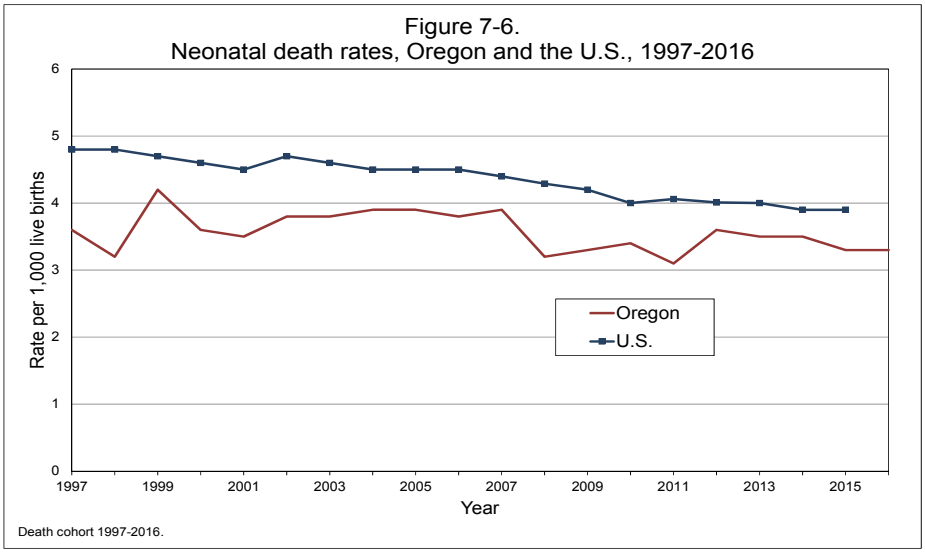


Table B - Fetal death ratios per 1,000 live births, by mother's age, 2012-2016					
Age	Year				
	2012	2013	2014	2015	2016
Total	4.6	4.2	4.2	4.1	4.0
15-44	4.6	4.1	4.1	4.0	4.0
15-19	7.4	3.5	5.4	4.8	6.0
20-24	3.9	4.2	3.1	4.6	3.6
25-29	3.4	4.3	4.2	2.9	3.9
30-34	5.0	3.2	3.6	3.9	3.6
35-39	5.2	5.7	4.9	5.0	4.8
40-44	7.8	4.7	7.5	6.7	5.4

decrease from 2015 when 186 fetal deaths were reported; at that time the ratio was 4.1 fetal deaths per 1,000 live births (see Table B).

Fetal cause of death

Table 7-4 shows the causes of Oregon's 184 fetal deaths in 2016. "Unspecified" was the most frequently reported cause of fetal death in 2016 (a total of 72 deaths). Complications of the placenta, cord and membranes were the second most common cause of fetal death with 53 deaths. Congenital anomalies were third most common, with 23 deaths. These three causes of death represented 80.4% of all Oregon fetal deaths during 2016. In 1999, the first year in which Oregon used ICD-10 codes, fetal death of unspecified cause represented 18.4% of all fetal deaths. In 2016, this same cause made up 39.1% of fetal deaths, a 112.5% increase.

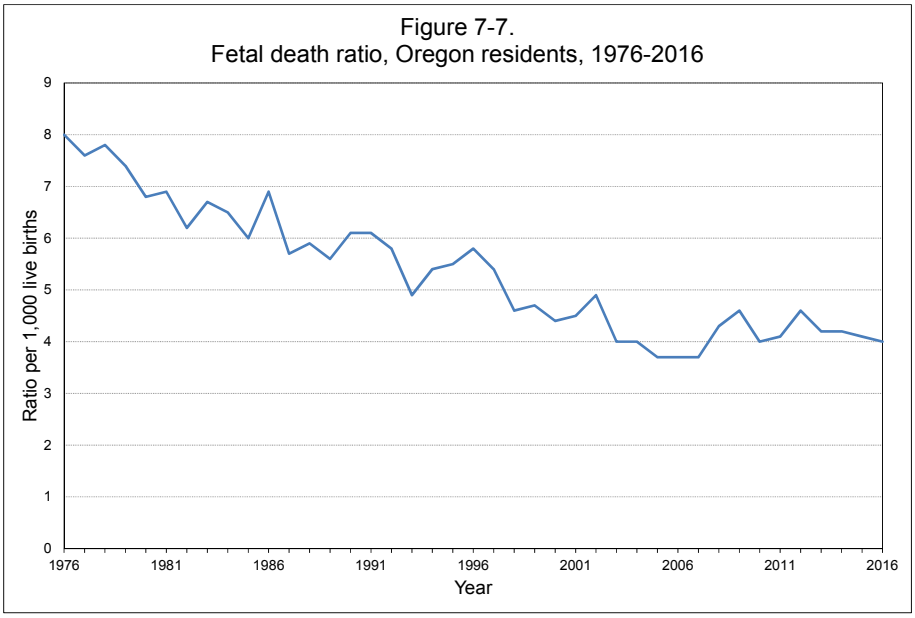


Table C - Percentage of fetal deaths by weeks of gestation, 2007-2016			
Year	Weeks of gestation		
	<28	28-36	37+
2007	45.3	31.5	22.7
2008	41.5	31.6	26.4
2009	33.3	40.3	26.4
2010	39.2	35.4	24.9
2011	36.6	36.6	26.9
2012	36.4	33.5	29.6
2013	39.2	29.1	31.7
2014	34.0	39.3	26.7
2015	40.9	34.9	23.1
2016	42.4	34.2	23.4

2015 birth cohort for infant deaths

Infant mortality analyses can also be performed using birth cohort data. The numerators for all rates and ratios are based on the number of infants born in a given year that die prior to their first birthday. Perinatal analyses also include all fetal deaths occurring in the same year. Because infants can be born in one year and die the following year, use of the birth cohort requires that the 2016 death data be included in the report on the 2015 birth cohort. For illustration, 222 of the infants born in 2015 died within the first year of life; of these 222 deaths, 206 died in calendar year 2015, and 16 died in 2016. Those that died in 2016 also appear in this year's report as part of the 2016 death cohort.

The Center for Health Statistics has produced tables containing infant and perinatal death data from the birth, fetal death and matched infant death files. These birth cohort tables display data for infant and perinatal deaths according to several maternal risk factors and low birthweight. Additionally, this report presents neonatal and postneonatal deaths that were matched to their corresponding birth. Thus, a birth occurring at the end of December 2015 may have a matched postneonatal death that occurred up to one year later, at the end of December 2016.

Use of a birth cohort from a matched birth and death file allows analysis of characteristics of an infant's mother during pregnancy and delivery. These are the characteristics of interest: mother's marital status, age, ethnicity, race, education, start of prenatal care and tobacco use. The characteristics of the infant derived from the birth record and fetal death record include birthweight, gestational age and county of residence at time of birth.

Small numbers

Due to the small number of events in some risk factor categories, this report uses three-year groupings of the risk characteristics to improve statistical reliability. Single-year tables displaying risk factors are also included for comparison with statistics of prior years, but the analyses of risk factors and maternal characteristics are done using only the three-year tables.

Perinatal deaths

Perinatal death, reported in tables 7-13 through 7-16, combines fetal deaths of specific gestation and neonatal deaths in Oregon (see Figure 7-1). These tables present a comprehensive picture of late-gestation fetal deaths and neonatal deaths. As shown in Figure 7-8, the perinatal death rate (the combined rates of fetal and neonatal death) has been lower in recent years relative to the rates seen in the 1990s. The 2015 birth cohort's neonatal death rate was 3.4, unchanged from that of the previous cohort. Both the fetal and neonatal death rates fluctuate from year to year due to the small number of cases. The fetal death rate hit a low of 3.7 during 2005 to 2007, but has increased slightly since that time.

Neonatal deaths: 2013–2015 birth cohorts

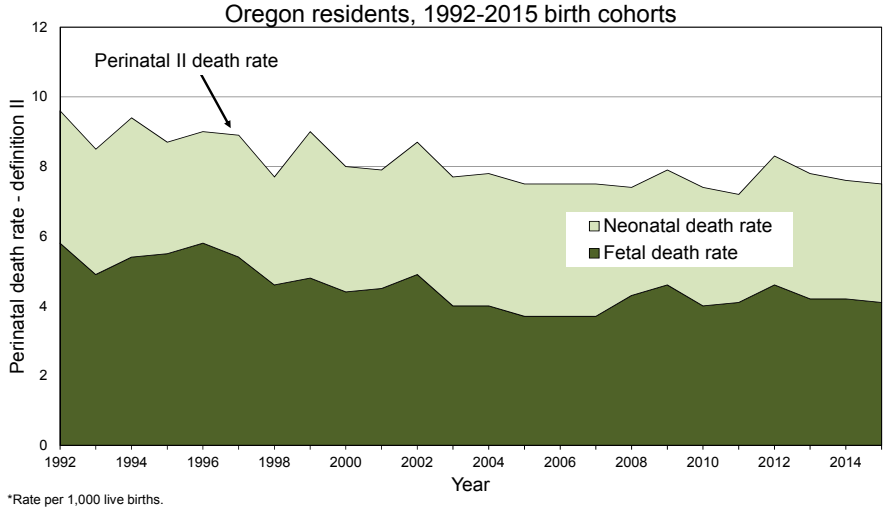
Some maternal characteristics may influence pregnancy outcomes of infants that died during the neonatal period. This section discusses marital status, age, ethnicity and race, education, prenatal care, and tobacco use (see Table 7-18).

Birthweight has long been a predictor of survival.

Birthweight

The birthweight of an infant has long been recognized as a predictor of subsequent survival. An increase in birthweight correlates with a decrease in the risk of neonatal death. For 2013–2015, Oregon's neonatal death rate decreased, on average, by roughly 60% for each 250- to 500-gram increase in birth weight for infants weighing

Figure 7-8.
Fetal, neonatal and perinatal II death rates*
Oregon residents, 1992-2015 birth cohorts



*Rate per 1,000 live births.

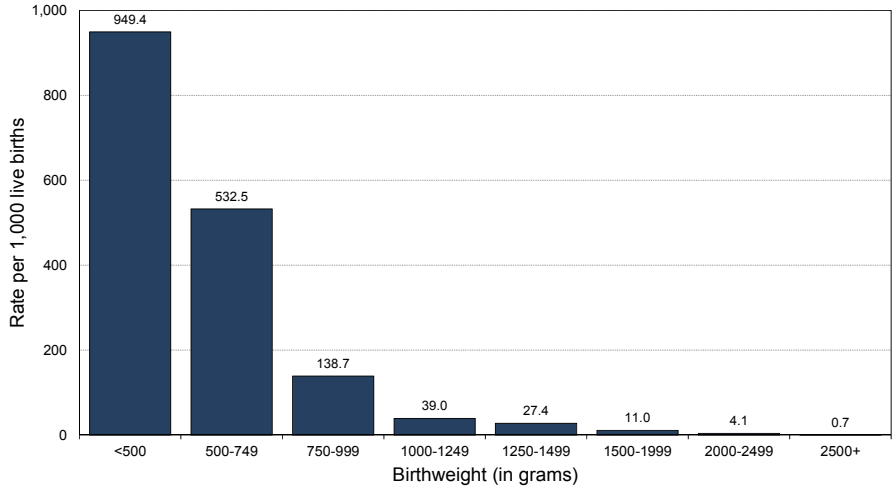
less than 3,000 grams at birth (see Table 7-12). The death rate for infants weighing less than 350 grams was 1,000.0 per 1,000 live births (i.e., a 100% mortality rate), decreasing to 0.7 per 1,000 live births for infants weighing more than 2,500 grams (see Table 7-12 and Figure 7-9).

Many behavioral, social and medical conditions are associated with higher rates of infant death. These conditions may also have confounding or mitigating effects on each other. This report does not try to account for or hold all these variables constant in relation to each other. Instead, it presents a simple descriptive analysis.

Maternal characteristics

Oregon's death rate among neonates born to women reported as married at the time of giving birth was lower than among those born to unmarried women during 2013–2015 (3.1 versus 3.9 per 1,000). The difference was significantly different. Infants of women with more than a high school education had a lower neonatal death rate (3.0 per 1,000) than those of women in other education categories, and a significantly lower rate than those born to mothers with only a high school education. The highest neonatal infant death rates were seen among infants born to non-Hispanic Black mothers (8.3 per 1,000) and to mothers of other and unknown race (19.1 per 1,000). Both groups had rates significantly higher than mothers who were Asian (2.7), multiple race (3.0), Hispanic (3.2) and non-Hispanic White (3.4). None of the other differences in rates between race and ethnic groups was significant. Infants born to

Figure 7-9.
Neonatal death rates by birthweight,
Oregon birth cohort, 2013-2015



mothers aged 40–44 years had a significantly higher rate of neonatal infant death than those with mothers of age groups 20–24, 25–29, 30–34 and 35–39 years (8.6 versus 2.9, 3.1, 2.9, and 4.2, respectively). Infants born as part of multiple-birth events had significantly higher rates of neonatal deaths than single births (19.8 versus 2.9, see Table 7-18).

Prenatal care

Infants born to Oregon women who had received prenatal care, regardless of when it began, had significantly lower neonatal mortality rates than those born to women who had received no prenatal care (3.0 versus 29.2 per 1,000 births) (see Table 7-18).

Tobacco use

The infants of Oregon women who did not use tobacco had lower rates of neonatal deaths (3.2 per 1,000) than infants of women who smoked before or during pregnancy (3.4 and 4.5 per 1,000, respectively). None of the differences was statistically significant. Tobacco use may be underreported, thereby eliminating some high-risk mothers from the analysis and potentially lowering the neonatal death rates for this category (see Table 7-18)).

Postneonatal deaths: 2013–2015 birth cohort

Postneonatal death refers to a death of an infant between its 28th and 364th day of life. This section discusses the influences of marital status, age, ethnicity and race, education, prenatal care, and tobacco on birth outcomes (see Table 7-18).

Maternal characteristics

Infants born to single mothers had a significantly higher rate of postneonatal death than did infants of married mothers (2.4 versus 1.1). Oregon's postneonatal death rate was also significantly higher for infants of mothers who gave birth to multiple infants (5.3 versus 1.4 for singleton births). Infants of women with more than a high school education had a significantly lower postneonatal death rate (1.1) than infants of mothers with some high school (2.5) or high school graduates (2.3). Infants born to non-Hispanic American Indian mothers had the highest postneonatal

mortality rate (4.1), but differences between this rate and the rates for other races or Hispanics were not statistically significant. Infants of younger mothers generally had higher death rates than infants of older mothers. Infants born to mothers aged 30–34 had the lowest postneonatal death rate (0.9), followed by mothers aged 35–39 (1.2). Infants in both of these age groups had significantly lower death rates than infants born to mothers aged 20–24 (2.4). Infants of mothers aged 30–34 also had a significantly lower postneonatal death rate than those born to mothers aged 15–19 years (2.3) (see Table 7-18).

Prenatal care

Infants of Oregon women receiving prenatal care in the first trimester of pregnancy had lower rates of postneonatal death (1.2) than infants of mothers starting prenatal care in the second trimester (2.2). Similarly, infants of women who received prenatal care during the first or second trimester had lower rates than those who received no prenatal care (7.3). These differences were statistically significant.

Tobacco use

The postneonatal death rate of infants born to mothers who used tobacco before or during pregnancy was significantly higher than of those born to mothers who did not smoke (3.1 and 4.5, versus 1.2) (see Table 7-18).

Fetal and early neonatal deaths: birth attendant and place of delivery

In 2011, the Oregon Legislature passed House Bill 2380, which required the Oregon Public Health Division to add two questions to the Oregon birth record to determine mothers' planned place of birth and birth attendant. Every mother who delivered in a hospital was asked whether she had planned to deliver at a private home or a freestanding birthing center, and the planned primary attendant type at the time she went into labor. Overall, two early neonatal deaths and no fetal deaths with a gestation of 37 weeks or more were associated with planned out-of-hospital births in 2016.

Three types of midwives practice in Oregon: certified nurse midwives (CNM), licensed direct entry midwives (LDM) and direct entry midwives (DEM). CNMs have completed an accredited, university-affiliated nurse midwifery

program and have an active nurse practitioner license. They may attend deliveries in hospitals, freestanding birth centers and homes. LDMs are direct entry midwives who have volunteered for state licensure through the Oregon Health Licensing Agency. They must meet qualifications and adhere to regulations set by the Oregon Legislature and Board of Direct Entry Midwifery. Lay midwives are unlicensed but are registered with the Center for Health Statistics to certify births.

In 2016, there were 45 full-term (at least 37 weeks' gestation) fetal deaths. None of the mothers in these full-term deaths intended an out-of-hospital birth; no deaths occurred after intrapartum transfer to a hospital; no deaths occurred in a non-hospital setting (see Table 7-19).

There were 21 full-term early neonatal deaths in 2016. These are deaths where the infant lived less than seven days after birth, and the gestational period was at least 37 weeks. The mothers in most (19) of these deaths intended to deliver in a hospital and did so. The remaining two deaths were planned non-hospital deliveries. For one, the planned attendant was an unlicensed direct-entry midwife, but the delivery resulted in an intrapartum transfer to the hospital. The other did not specify a planned attendant type and occurred in a non-hospital setting with an attendant who was not medically trained (see Table 7-20).

Endnote

1. Final 2015 U.S. data obtained from the CDC WONDER detailed mortality table website: http://wonder.cdc.gov/ucd-icd10.html.