2018 Infant Mortality Annual Report

Ohio Department of Health

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EXECUTIVE SUMMARY

Ohio has identified infant mortality as a priority in its 2017-2019 State Health Improvement Plan (SHIP)[1]. Infant mortality is the death of an infant before his or her first birthday. The Infant Mortality Rate is the number of infant deaths per 1,000 live births. The Infant Mortality Rate not only serves as a key indicator of maternal and infant health but is also an important measure of the health status of a community.

In 2018, the infant mortality rate fell to 6.9 from 7.2 in 2017 for all races. The rate among black infants fell to 13.9 in 2018 from 15.6 in 2017. However, the Ohio and national goal is 6.0 or fewer infant deaths per 1,000 live births in every racial and ethnic group. Additionally, racial and socio-economic inequities persist.

ODH continues to examine vital statistics and other data sources to monitor our progress and to better understand infant deaths so they may be prevented.

The following report presents results of analyses performed on infant deaths that occurred in 2018.

Key Findings

Section 1: General Findings

- In 2018, Ohio's infant mortality rate was 6.9 per 1,000 live births compared with 7.2 in 2017.
- From 2009 through 2018, Ohio's infant mortality rate decreased at an average of 1.1% per year.
- After a five-year increase, the black infant mortality rate went from 15.6 per 1,000 live births in 2017 to 13.9 in 2018.
- Black infants still die at a rate 2.5 to 3 times higher than white infants.

Section 2: A Deeper Look

- Prematurity-related conditions remain the leading cause of infant death in Ohio, comprising almost one-third of deaths.
- Infant deaths attributable to external injuries increased from 79 deaths (8%) in 2017 to 95 (10%) in 2018.
- Almost a third (32%) of all infants who died were born prior to 24 weeks gestation. A full-term pregnancy is at least 37 weeks.
- Preventable risk factors and opportunities for intervening were identified among infants who died.

Ohio Infant Mortality Rate by Race and Ethnicity (2016-2018)

In 2018, 938 Ohio infants died before their first birthday, 44 fewer than in 2017 (Table 1, Figure 1). In 2017, Ohio registered 982 deaths. Ohio's infant mortality rate for all races was 7.2 in 2017 and 6.9 in 2018 (Table 1). The black infant mortality rate was 15.6 in 2017 and 13.9 in 2018 (Table 1). Black infants were still more than 2.5 times more likely to die than white infants.

From 2009 through 2018, the infant mortality rate for all races decreased at an average of 1.1% per year while the white infant mortality rate decreased an average of 2.4% per year (Figure 2). The black infant mortality rate has not changed significantly since 2009.

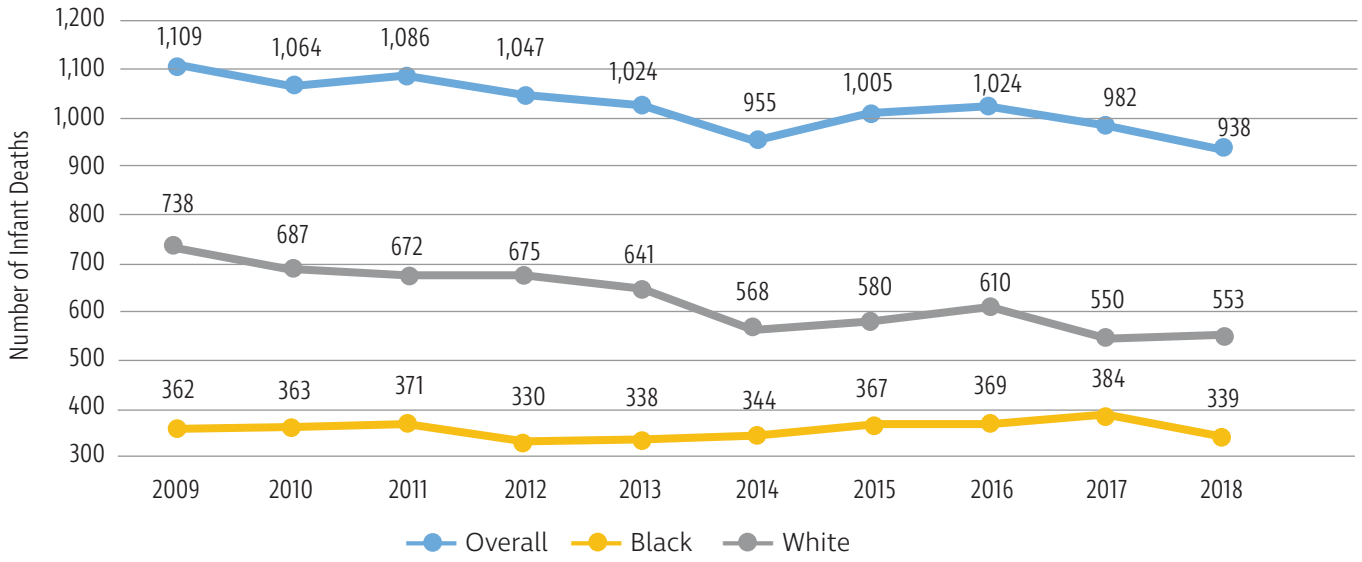
Table 1: Ohio Infant Mortality by Race and Ethnicity (2016-2018)

	2016		2017		2018	
	Infant Deaths	IMR*	Infant Deaths	IMR*	Infant Deaths	IMR*
All Races**	1,024	7.4	982	7.2	938	6.9
Race						
White	610	5.8	550	5.3	553	5.4
Black	369	15.2	384	15.6	339	13.9
American Indian	2	****	0	****	4	****
Asian/Pacific Islander	18	3.8^	20	4.2	15	3.2^
Ethnicity						
Hispanic	54	7.3	54	7.2	45	6.1
Non-Hispanic***	970	7.4	928	7.2	893	7.0

Data Source: Ohio Department of Health, Bureau of Vital Statistics
** Infant mortality rate per 1,000 live births.*
*** The total for all races includes 26 infant deaths of unknown race.*
**** Non-Hispanic deaths include those of unknown or missing ethnicity.*
***** Rates based on fewer than 10 deaths do not meet standards of reliability or precision and are suppressed.*
^ Rates based on fewer than 20 infant deaths should be interpreted with caution.

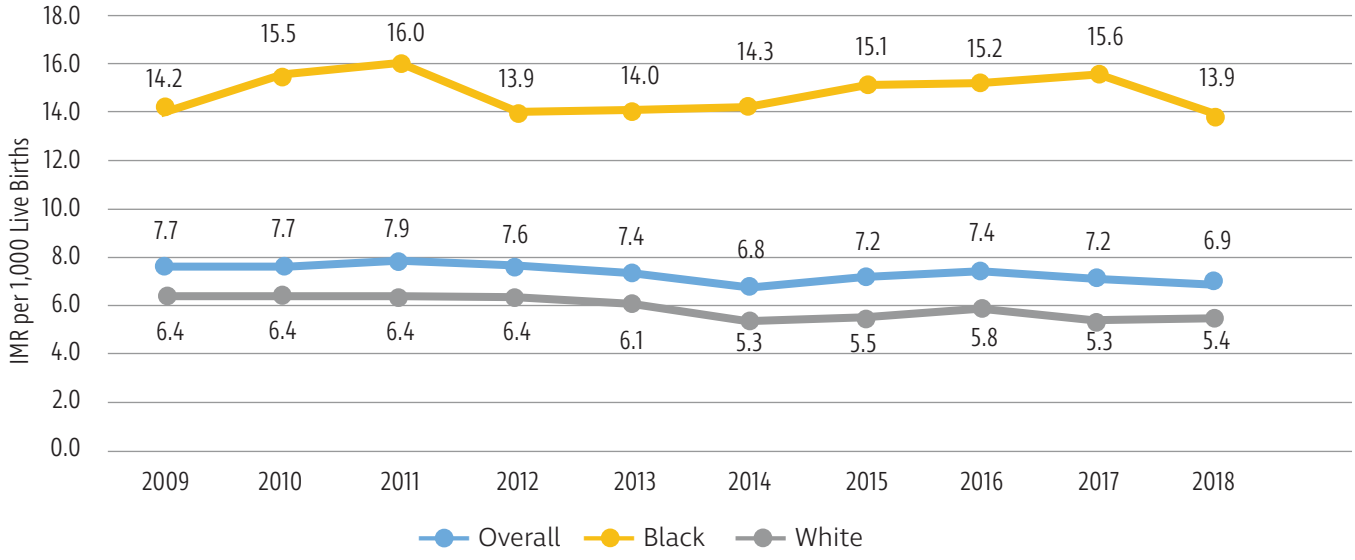
Trends in Ohio Infant Mortality (2009-2018)

Figure 1: Trends in the Number of Ohio Infant Deaths, by Race (2009 – 2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

Figure 2: Trends in Ohio Infant Mortality Rate (per 1,000 live births), by Race (2009 – 2018)

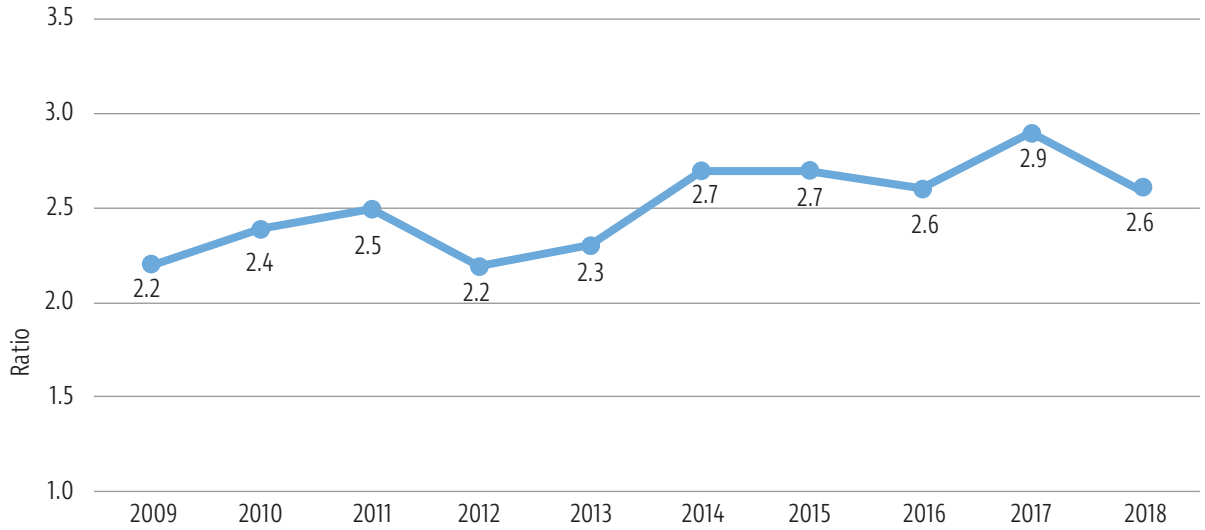


Data Source: Ohio Department of Health, Bureau of Vital Statistics

Racial Disparity in Infant Mortality

Despite seeing gains in the overall and white infant mortality rates, there has been no significant improvement in the black infant mortality rate in the past 10 years. After five years of steady increase, the black infant mortality rate went from 15.6 per 1,000 live births in 2017 to 13.9 in 2018. This is an encouraging sign. However, there is still much work that needs to be done as black infants continue to die at a rate 2.5 to 3 times that of white infants (Figure 3).

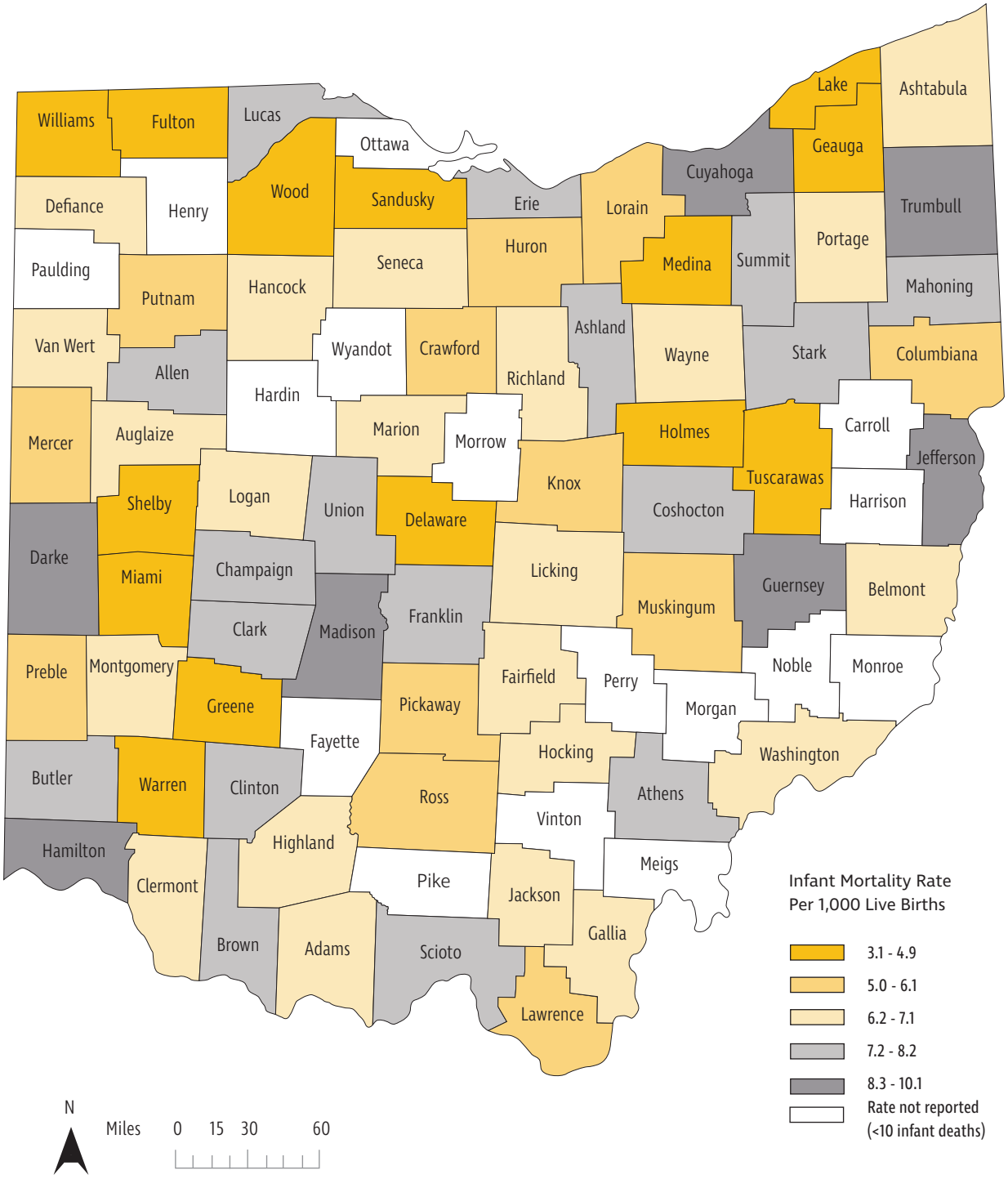
Figure 3: Black/White Infant Mortality Ratio*, Ohio (2009-2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics
**Black Infant Mortality Rate divided by the White Infant Mortality Rate*

Ohio Five-Year Average Infant Mortality Rates by County

Figure 4: Ohio Five-Year Infant Mortality Rate (per 1,000 live births), by County (2014-2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

Neonatal and Postneonatal Mortality Rates

Neonatal deaths occur during the first 27 days of life while postneonatal deaths occur at 28 through 364 days of life. Neonatal deaths are the largest contributor to the overall infant death rate, accounting for about two-thirds of all infant deaths (Table 2). The difference in the overall infant mortality rate from 2017 to 2018 can be largely attributed to fewer neonatal deaths in 2018 compared with 2017. This is especially true in the black population. This is likely due to a drop in premature births, especially those born prior to 23 weeks gestation. The neonatal mortality rate for all races was 5.0 in 2017 and 4.7 in 2018. The black neonatal mortality rate was 11.3 in 2017 and 8.5 in 2018.

Table 2: Ohio Neonatal, Postneonatal, and Overall Infant Mortality (per 1,000 live births), by Race and Ethnicity (2014-2018)

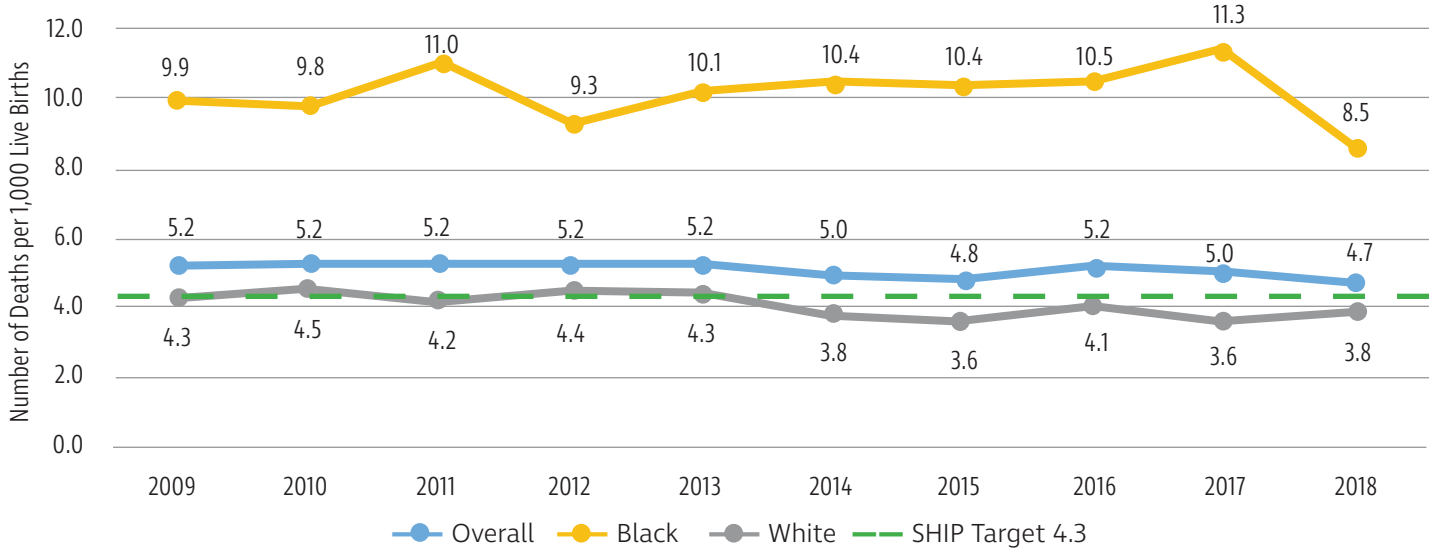
Race/Ethnicity	Year	Neonatal Deaths	Neonatal Mortality Rate	Postneonatal Deaths	Postneonatal Mortality Rate	Total Infant Deaths	Infant Mortality Rate	Births
White	2014	406	3.8	162	1.5	568	5.3	106,371
	2015	379	3.6	201	1.9	580	5.5	106,028
	2016	429	4.1	181	1.7	610	5.8	104,957
	2017	375	3.6	175	1.7	550	5.3	103,709
	2018	393	3.8	160	1.6	553	5.4	102,570
Black	2014	252	10.4	92	3.8	344	14.3	24,133
	2015	252	10.4	115	4.7	367	15.1	24,288
	2016	255	10.5	114	4.7	369	15.2	24,316
	2017	278	11.3	106	4.3	384	15.6	24,542
	2018	208	8.5	131	5.4	339	13.9	24,359
All Races	2014	692	5.0	263	1.9	955	6.8	139,514
	2015	667	4.8	338	2.4	1,005	7.2	139,312
	2016	713	5.2	311	2.3	1,024	7.4	138,198
	2017	684	5.0	298	2.2	982	7.2	136,895
	2018	632	4.7	306	2.3	938	6.9	135,226
Hispanic Ethnicity (Any Race)	2014	32	4.6	11	1.6*	43	6.2	6,885
	2015	30	4.3	12	1.7*	42	6.0	6,974
	2016	38	5.1	16	2.2*	54	7.3	7,425
	2017	42	5.6	12	1.6*	54	7.2	7,473
	2018	35	4.7	10	1.3*	45	6.1	7,434

Data Source: Ohio Department of Health, Bureau of Vital Statistics

** Rates based on fewer than 20 infant deaths should be interpreted with caution.*

Neonatal mortality is associated with prematurity (preterm birth before 37 weeks gestation), low birth weight, congenital anomalies, and health problems originating in the perinatal period, such as infections or birth trauma. Between 2009 and 2018, the overall neonatal mortality rate decreased by an average of about 1% per year. The white neonatal mortality rate decreased an average of about 2% per year during the same time period. The black neonatal mortality rate has not changed significantly over the past 10 years (Figure 5).

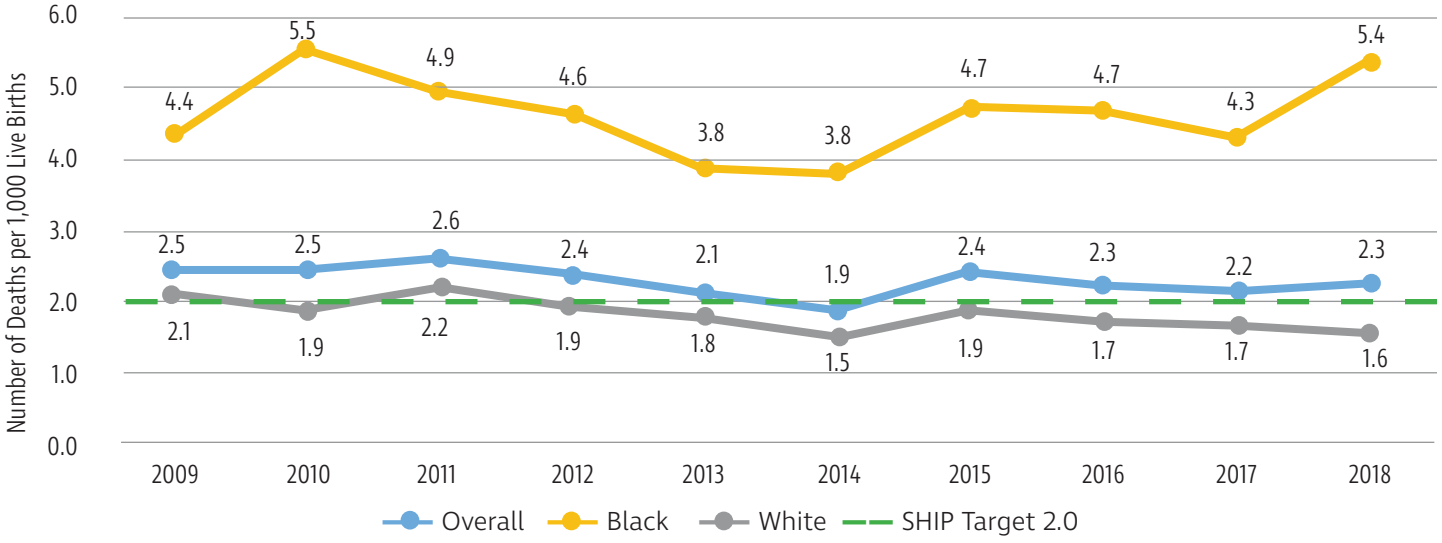
Figure 5: Trends in Ohio Neonatal Mortality (per 1,000 live births), by Race (2009-2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

Common causes of death in the postneonatal period include Sudden Infant Death Syndrome (SIDS), congenital anomalies, and unintentional injuries. Ohio's overall and black postneonatal mortality rate did not change significantly between 2009 and 2018. The white postneonatal mortality rate decreased an average of 3.2% per year (Figure 6).

Figure 6: Trends in Ohio Postneonatal Mortality (per 1,000 live births), by Race (2009-2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

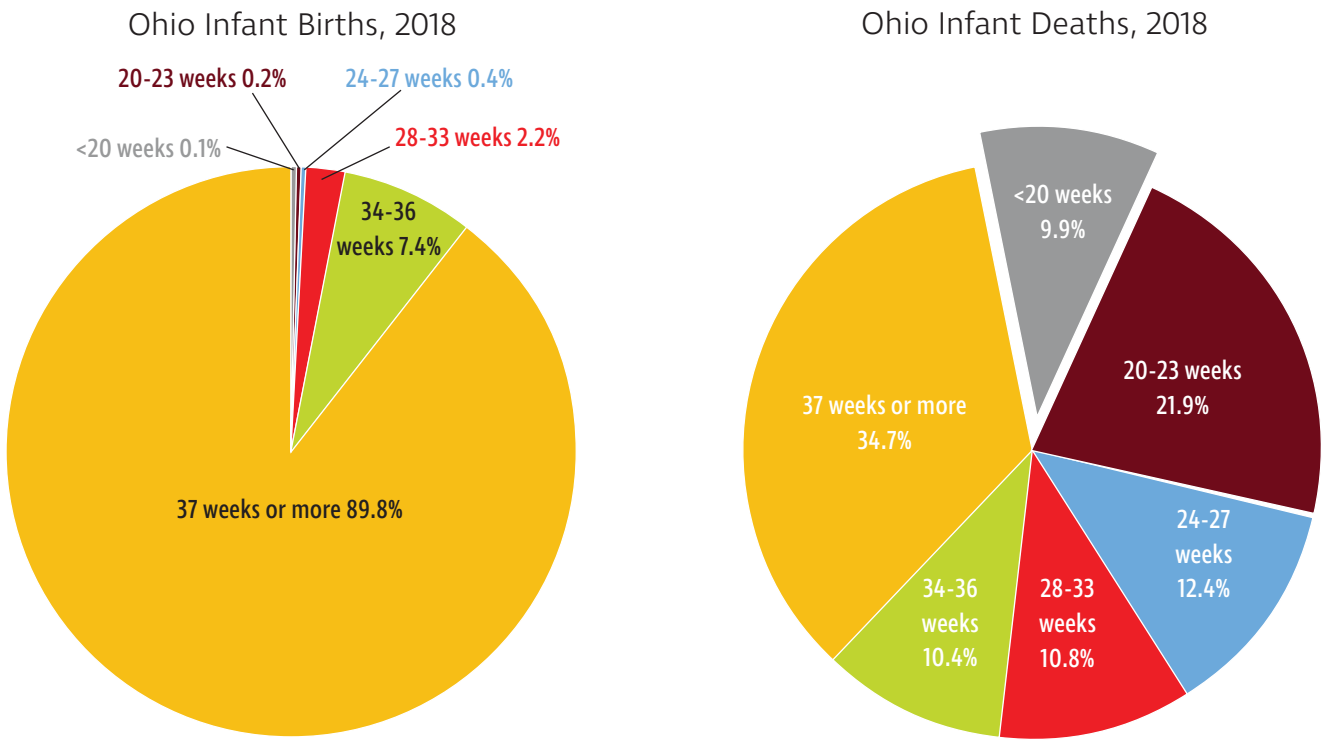
Infant Mortality by Duration of Gestation and Birthweight

Infant survival is highly associated with gestational age.

Although infants born less than 24 weeks accounted for 0.3% of total infants born, they accounted for about one-third of all infant deaths (Figure 7).

Despite the same proportion of babies born at full term (37 or more weeks gestation) in 2018 and 2017 (90%), the proportion of term babies dying was 35% in 2018 compared with 30% in 2017.

Figure 7. Proportion of Ohio Infant Births and Deaths by Gestational Age (2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

Forty percent of the infants who died did not survive their first day of life (Figure 8).

Among infants who died (Figure 8):

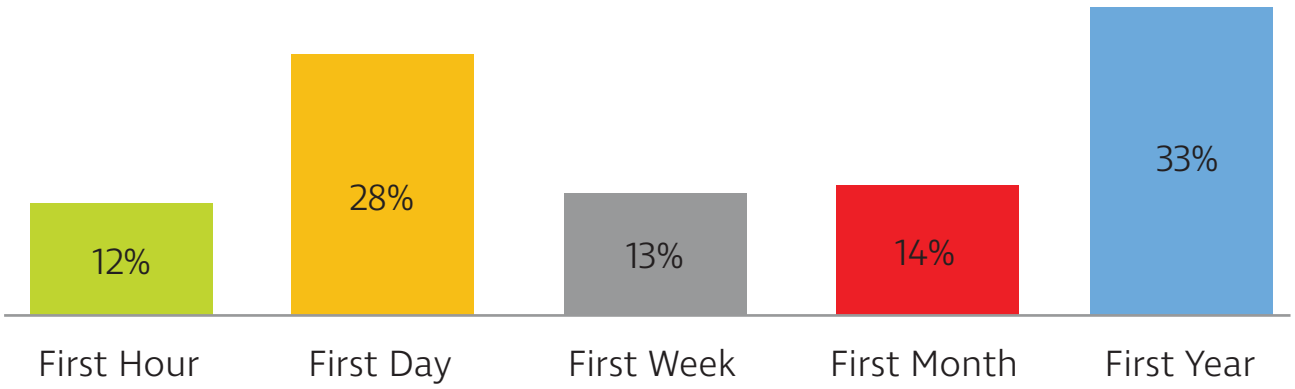
- Twelve percent occurred within the first hour of life.
- Twenty-eight percent more died by the end of the first day of life.
- Thirty-three percent died after the first month of life, but before the first birthday (called post-neonatal death).

Most of the infants who died were born early or small.

Among infants who died:

- Almost half (48%) were very low birth weight (<1,500g or 3 lbs 5 oz).
- Almost half (44%) were born before 28 weeks gestation (called very preterm).
- Over a quarter (28%) were small for their gestational age [among singletons born at greater than 21 weeks of gestation].

Figure 8. Age at Death Among Ohio Infants who Died (2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

Preventable Risk Factors for Infant Death were Common (Table 3).

Among infants who died:

- Two in five whose mothers had a prior birth were conceived earlier than recommended (less than 18 months after the prior birth).
- More than one-third were born to mothers who received no first trimester prenatal care.
- Twenty percent had a mother who smoked at the beginning of pregnancy.
- About one in 10 were born to a teenage mother.
- Almost forty percent (36%) of infant deaths were born to first-time mothers (first live birth), indicating the need for prevention efforts to target both first-time and non-first-time mothers.

Table 3. Common Risk Factors Among Ohio Infant Deaths (2018)

Risk Factor		%	#
Behavioral	Conceived <18 months after prior birth[1]	42	160
	Mother smoked during first trimester of pregnancy	20	188
Social	Low income (presumed Medicaid)	57	524
	Father not named on birth certificate	31	288
	Mother's education < high school	18	144
	Teen mother (<20 years of age)	9	72
Healthcare	No first trimester prenatal care[2]	40	325
	Born at inadequate level hospital[3]	9	77

[1]among infants whose mothers had a previous live birth

[2]12.4% unknown

[3]An infant born in a hospital without the appropriate level of care given the infant's gestational age and/or birth weight. Denominator includes infants born in a facility.

Data Source: Ohio Department of Health, Bureau of Vital Statistics

Many women whose infants died had health concerns prior to pregnancy.

Of the infants' mothers:

- One in three (38%) was obese.
- One in four (24%) smoked within three months of becoming pregnant.
- Pre-pregnancy hypertension (7%) and diabetes (2%) were relatively uncommon. However, these factors pose a high risk to pregnancy.

Infant deaths were not evenly distributed among the Ohio population.

Among infants who died:

- More than 33% had a non-Hispanic black mother.
- Almost two-thirds (60%) lived in an urban county targeted through the Ohio Equity Institute in Birth Outcomes (OEI): Cuyahoga, Franklin, Hamilton, Summit, Butler, Lucas, Montgomery, Stark, and Mahoning.
- Forty-one percent of white infant deaths and 88% of black infant deaths occurred in OEI counties.

Of the infants' mothers:

- One-third (33%) participated in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) during pregnancy, a program that reduces infant mortality by reducing the incidence of babies born at low birth weights and provides support services necessary for full-term pregnancies.
- About a third (30%) of mothers were not participating in WIC, but on Medicaid and therefore were likely eligible for WIC.
- Most (74%) mothers had a previous pregnancy (including live births and pregnancy losses) and some may have benefited from care between pregnancies.
- About 40% of the women did not receive first trimester prenatal care.

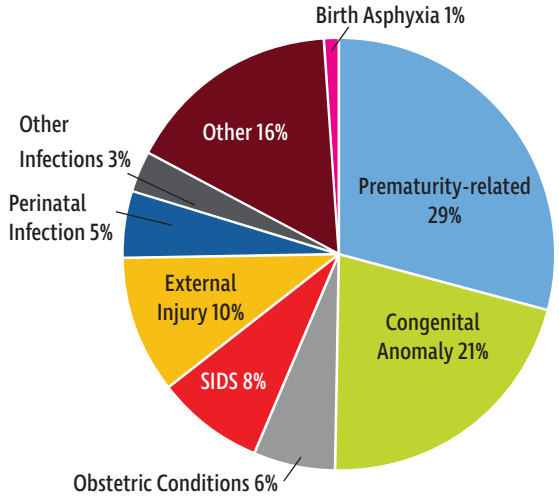
Preventable Preconception Risk Factors related to the leading causes of Ohio infant deaths

- **Prematurity-related conditions:** Almost one-third (32%) of deaths were among infants born before 24 weeks of gestation, and therefore highly unlikely to survive. Preventable risk factors for preterm birth were relatively common among the mothers of these infants and all infants who died of prematurity. Over 40% of the mothers were obese and one-third conceived after a shorter-than-recommended interpregnancy interval. Additionally, one in five infants who died due to prematurity were born to women who smoked before pregnancy.
- **External injury and SIDS:** Almost one half of infants who died of external injury and Sudden Infant Death Syndrome (SIDS) had mothers who smoked before pregnancy and over 30% continued smoking into the third trimester of pregnancy. External Injury includes deaths related to accidental suffocation in bed, which is associated with prenatal smoking.

Leading Causes of Infant Deaths

Prematurity and congenital anomaly together accounted for half of the infant deaths in 2018 (Figure 9).

Figure 9. Cause of Ohio Infant Deaths (2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

Prematurity-related conditions were the underlying cause of death for 269 (29%) infants.

Among these infants:

- Almost two-thirds (64%) lived in an OEI county.
- Most (55%) of their mothers were low income (presumed due to receiving Medicaid at delivery), but only half (28%) of those received WIC benefits during pregnancy.
- Over 34% of their mothers received no prenatal care in the first trimester.
- The mothers of 35% were black.
- Almost 16% were born in a facility without the appropriate level of care for their gestational age and/or birth weight.
- About 20% of their mothers had a previous preterm birth.

Leading Five Causes of Infant Deaths, Ohio 2017-2018

	2017	2018
1.	Prematurity-related 32%	Prematurity-related 29%
2.	Congenital Anomaly 18%	Congenital Anomaly 21%
3.	Obstetric Conditions 9%	External Injury 10%
4.	External Injury 8%	SIDS 8%
5.	SIDS 7%	Obstetric Conditions 6%

Congenital Anomaly was the underlying cause of death for 198 (21%) infants.

Among these infants:

- Over half (57%) lived in an OEI county.
- About 70% of mothers had a previous pregnancy, and 63% had a previous live birth, indicating potential opportunities for preconception care.
- Mothers of 69% of these infants were white.
- Thirty-seven percent of the mothers were obese before pregnancy, increasing the risks of congenital anomalies.

External Injury was the underlying cause of death for 95 (10%) infants.

Among these infants:

- More than half (53%) lived in an OEI county.
- About 53% of mothers did not receive prenatal care during the first trimester, which is 15% more than in 2017.
- Over half (52%) of the mothers smoked cigarettes before pregnancy, and over one-third smoked during each trimester of pregnancy.
- Most of the mothers (76%) were low income (presumed due to receiving Medicaid at delivery) and over half (55%) received WIC benefits during pregnancy.
- The mothers of 82% of these infants had a previous pregnancy and 72% had a previous live birth, presenting potential opportunities for intervention between pregnancies.

SIDS was the underlying cause of death for 79 (8%) infants.

Among these infants:

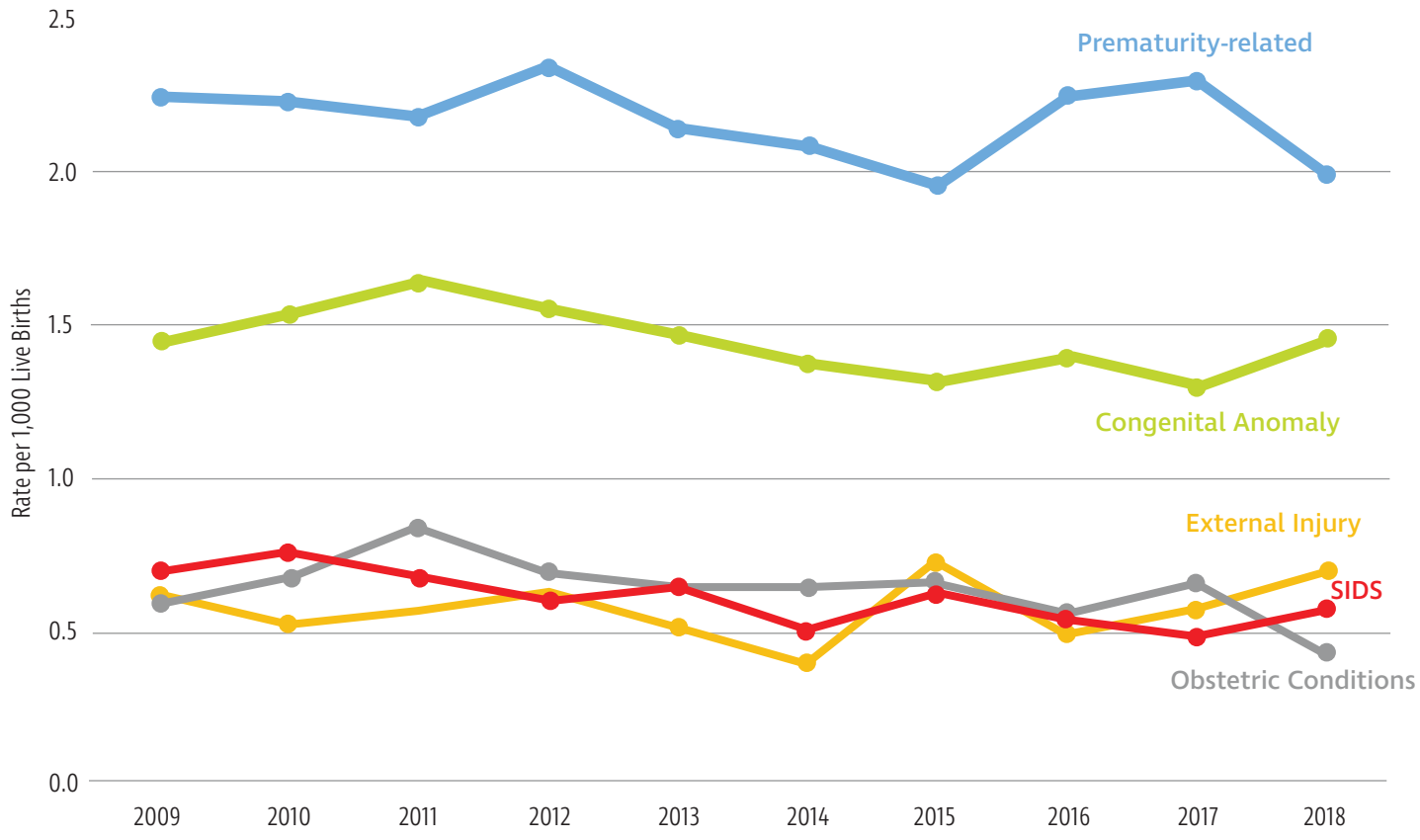
- Almost three-fourths (71%) lived in an OEI county.
- Most (86%) died after the first month of life but before their first birthday.
- More than 25% of the mothers have less than a high school education.
- Almost half (44%) of the mothers smoked in the three months before becoming pregnant.
- About one-third (29%) of the mothers smoked into the third trimester of pregnancy, compared with 39% in 2017.
- Most of the mothers (83%) received Medicaid insurance during pregnancy.

Obstetric Conditions were the underlying cause of death for 58 (6%) infants.

Among these infants:

- Almost two- thirds (63%) lived in an OEI county.
- More than half (59%) died before the end of the first day of life.
- A majority (76%) were born before 24 weeks gestation.
- Over 68% of mothers had a previous pregnancy, and 58% had a previous live birth.
- The mothers of 35% were obese before pregnancy, which is less than in 2017 (48%).

Figure 10. Cause-Specific Ohio Infant Mortality Rates for Leading Causes (2009-2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

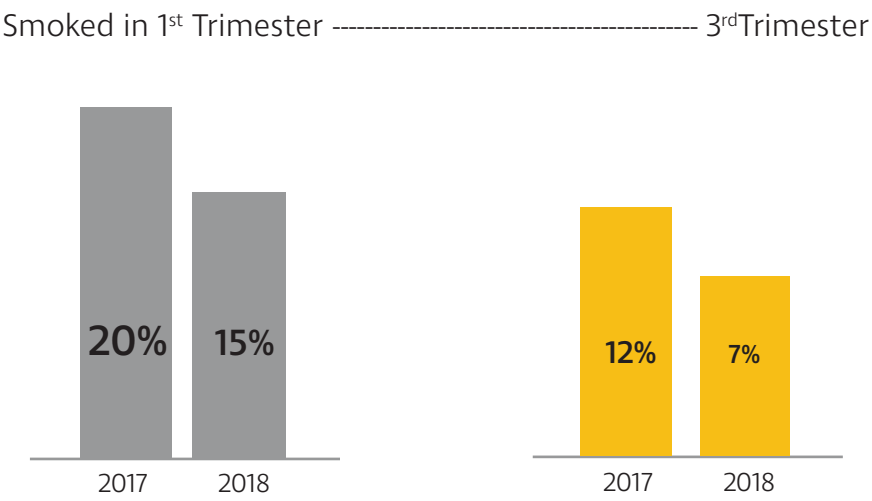
Prematurity-Related Infant Deaths

In 2018, there were fewer infant deaths due to prematurity-related conditions when compared with 2017. Prematurity-related infant deaths went from 314 in 2017 to 269 in 2018. The infant mortality rate for prematurity-related infant deaths went from 2.3 infant deaths per 1,000 live births in 2017 to 2.0 in 2018. However, prematurity-related conditions continued to lead as the top cause of infant death in 2018. (Figure 11).

Some notable changes among prematurity-related infant deaths from 2017 to 2018 include:

- In 2018, 15% of mothers smoked in the first trimester of pregnancy compared with 20% in 2017, and 7% of mothers smoked in the third trimester of pregnancy in 2018 compared with 12% in 2017 (Figure 11).
- More mothers received first trimester prenatal care in 2018. Thirty-four percent of mothers did not receive prenatal care during the first trimester, compared with 39% in 2017.

Figure 11. Percentage of Ohio Prematurity-Related Infant Deaths with Mothers who Smoked during Pregnancy (2017-2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

Opportunity to Intervene: A woman with a preterm birth is at risk for another preterm birth, but we found that fewer than 20% of infants who died due to prematurity had a mother with a previous preterm birth. However, over two-thirds had a prior pregnancy and that prior pregnancy could be a touchpoint with the medical system for optimizing the mother's health between pregnancies, thus improving the outcome of a subsequent pregnancy. First trimester prenatal care is an opportunity to identify and alleviate risks for a preterm birth, but about 30% of these mothers lacked first trimester prenatal care. This indicates a need to remove barriers both to early pregnancy identification and access to early prenatal care. Over one in four of these mothers were likely eligible for WIC but not receiving benefits. Connecting these women to the WIC program would present an opportunity to provide support services and improve pregnancy outcomes. Two-thirds lived in an OEI county, and a disproportionate number were black, supporting the focus of efforts to prevent prematurity within those nine counties and among black families

External Injury-Related Infant Deaths

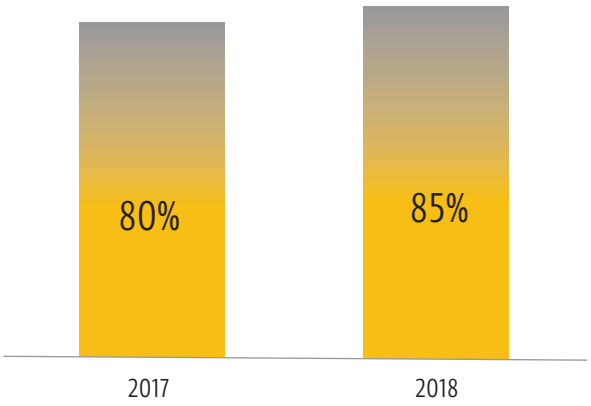
Mortality rates from external injuries significantly increased from 2016 to 2018.

Deaths caused by external injuries increased by 16 infants from 2017 to 2018. In 2018, external injury was the underlying cause of death for 95 infant deaths (10%) compared with 79 infant deaths (8%) in 2017. Ohio's infant mortality rate for external injuries significantly increased from 2016 to 2018, with 0.5 infant deaths per 1,000 live births in 2016, 0.6 in 2017, and 0.7 in 2018.

Some notable changes among external injury-related infant deaths from 2017 to 2018 include:

- More full-term babies died from external injuries in 2018. In 2018, infants born at full-term (37 or more weeks gestation) made up 85% of infant deaths caused by external injuries, compared with 80% in 2017 (Figure 12).
- A higher proportion of infants who died from external injuries were born to a mother who smoked during pregnancy in 2018; 46% of mothers smoked during the first trimester in 2018 compared with 32% in 2017. The percentage of mothers who smoked in the third trimester was 38% in 2018 and 29% in 2017.

Figure 12. Percentage of Ohio Infants who Died of External Injuries who had Been Born at Full Term (37 or more weeks gestation) (2017-2018)



Data Source: Ohio Department of Health, Bureau of Vital Statistics

Opportunity to Intervene: External Injury and SIDS deaths are often considered highly preventable; however, a combined 174 Ohio infants died from external injuries (95 infant deaths) and SIDS (79 infant deaths) in 2018. Additionally, external injury and SIDS were the third and fourth most common causes of infant deaths, respectively. More than one half of the mothers of infants who died of both causes participated in WIC while pregnant, indicating that WIC is an appropriate venue for advocating external injury and SIDS prevention including smoking cessation during pregnancy, keeping baby free of second-hand smoke, breastfeeding, and safe sleep. For more information on sleep-related infant deaths and the Ohio Child Fatality Review program, please see Appendix B.

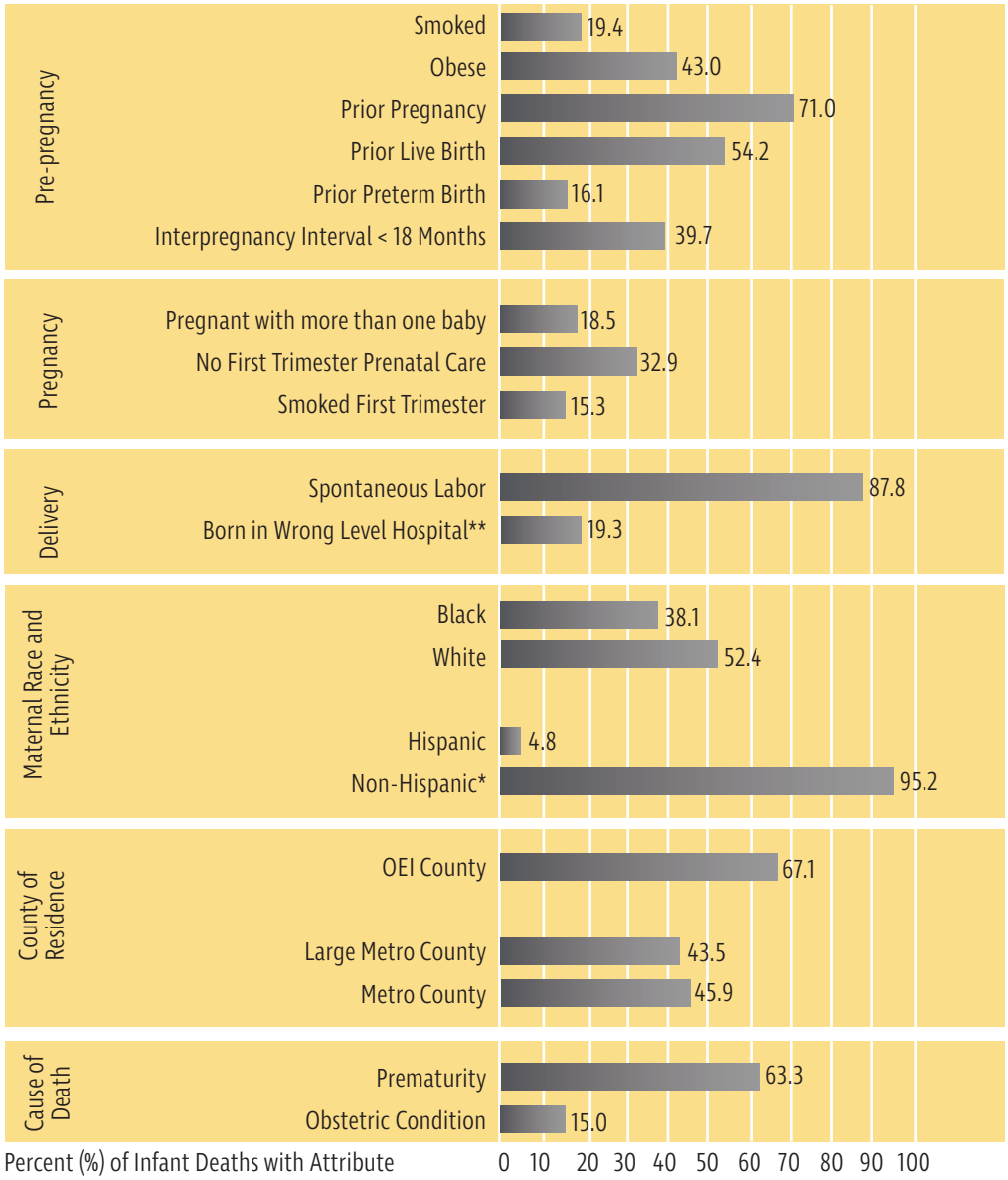
Deaths to Infants Born at Less Than 24 Weeks Gestation

Among infants who died and were born at less than 24 weeks gestation, only 16% of the mothers had a prior preterm birth, but 71% had previously been pregnant (Figure 13).

Among infants who died and were born before 24 weeks gestation:

- One-third of mothers did not receive prenatal care during the first trimester.
- Two-thirds lived in an OEI county.
- More than 40% of the infants who died had a mother who was obese prior to pregnancy.
- Almost 20% were not born in the appropriate level facility for their gestational age and birth weight.
- Over 60% died due to prematurity-related causes.

Figure 13. Maternal and Infant Attributes of Ohio Infants who Died and were Born Before 24 Weeks Gestation (2018)



**Non-Hispanic deaths include those of unknown or missing ethnicity.*
***An infant born in a hospital without the appropriate level of care given the infant's gestational age and/or birth weight. Denominator includes infants born in a facility.*
Data Source: Ohio Department of Health, Bureau of Vital Statistics

DATA SOURCES AND METHODS

This report contains data from the Birth Resident, Mortality, and Infant Mortality Period datasets, which are part of Ohio's Vital Statistics System. The data sets were downloaded from the Secure Ohio Public Health Information Warehouse, a self-service online tool where authorized users can obtain the most recent public health data available about Ohio. The numerator for rates (deaths) is calculated from the Mortality dataset while the denominator (live births) is calculated from the Birth Resident dataset. Therefore, for race and ethnic specific rates, the numerator is based on infant race as reported on the death certificate while the denominator is based on mother's race as reported on the birth certificate. Rates and percentages for subcategories with fewer than 10 infant deaths are suppressed due to insufficient reliability or confidentiality requirements. Causes of infant deaths were categorized using modified Dollfus criteria, which organizes infant deaths by etiology and their amenability to prevention efforts.[3]

For Section 2: A Deeper Look, race and ethnicity are defined as the mother's self-reported race and ethnicity on the birth certificate.

Trend analyses were conducted using Joinpoint software, which tests for significant trends over time and identifies time points where changes in trends occur. References to rates increasing, decreasing, or being different from one another indicate that differences or changes are statistically significant at the $p<0.05$ level. For measures where there appear to be observed differences between categories or over time, but these differences were not statistically significant, they are not mentioned in the text.

The Jenks natural breaks classification method was used to group counties by infant mortality rate for the map on page 8. This data clustering method creates classes or groups based on natural groupings. This is done by reducing the variance within classes and maximizing the variance between classes.

Access tables for data referenced in this report in Appendix C.

DEFINITIONS

- **Congenital anomaly:** This Dollfus category of infant cause of death includes deaths caused by congenital malformations, deformations, and chromosomal anomalies, and congenital disorders.
- **County type:** Based on the Centers for Medicaid and Medicare Services designations, this report divides counties into large metro, metro, micro or rural county types.
- **Eligible for WIC:** For purposes of these analyses, women were income eligible for WIC if they were presumed to be insured by Medicaid at delivery.
- **External injury:** This Dollfus category of infant cause of death includes deaths caused by accidents; accidental and intentional injuries; and accidental drowning, suffocation, aspiration, and asphyxiation.
- **Father not named on birth certificate:** The birth certificate contained no information about the father of the infant. Lack of information about the father is sometimes used as an indicator of a lack of paternal support for the pregnancy and infant.
- **Inadequate hospital level:** An infant born in a hospital without the appropriate level of care given the infant's gestational age and/or birth weight. For example, infants born before 32 weeks gestation should be delivered at facilities with specialized health care providers and equipment to care for infants who are born too early or critically ill. The 2016 maternity unit licensure levels of care were used and are prescribed through Ohio Revised Code. Based on recent recommendations from the American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine, identification and referral of women with high-risk pregnancies to hospitals better equipped and staffed to provide care have been important steps to improve birth outcomes.[4,5]
- **Infant death:** The death of a live-born infant before his or her first birthday.
- **Infant mortality rate:** The number of infant deaths in a specific year divided by the number of live births within that same year, multiplied by 1,000.
- **Neonatal death:** The death of a live-born infant during the first 27 days of life.
- **Neonatal mortality rate:** The number of neonate deaths in a specific year divided by the number of live births within that same year, multiplied by 1,000.
- **Mother:** A female Ohio resident who physically gives birth to the infant.
- **Obese:** Refers to a mother's body mass index (BMI) that was greater than 30 kg/m2 before becoming pregnant.
- **Obstetric conditions:** A Dollfus category of infant cause of death comprised primarily of the following: premature rupture of membranes, placenta previa, placental separation and hemorrhage, incompetent cervix, and multiple pregnancy.
- **OEI:** The Ohio Institute for Equity in Birth Outcomes is a partnership between ODH and nine urban communities to improve birth outcomes and reduce racial disparities in infant deaths.

DEFINITIONS

- **Postneonatal death:** The death of an infant aged 28 days through 364 days of life.
- **Postneonatal mortality rate:** The number of postneonatal deaths in a specific year divided by the number of live births within that same year, multiplied by 1,000.
- **Prematurity-related conditions:** Dollfus category of infant cause of death comprised of short gestation and low birth weight as well as several other causes that are specific to prematurity, such as neonatal hemorrhage, respiratory distress syndrome, and necrotizing enterocolitis.
- **SHIP:** Ohio's state health improvement plan that serves as a strategic menu of priorities, objectives, and evidence-based strategies to improve the health of Ohioans.
- **SIDS:** This acronym stands for Sudden Infant Death Syndrome and is a modified Dollfus category for infant cause of death.
- **Small for gestational age:** An infant who is smaller at birth than the usual size/weight for infants born at the same gestational age pregnancy.
- **Spontaneous preterm birth:** Initiation of labor was spontaneous rather than provider initiated such as through labor induction, or cesarean without labor, or membrane rupture.
- **WIC:** The Special Supplemental Nutrition Program for Women, Infants, and Children is a federal program administered by the state to income eligible women and their children up to age 5. The program improves pregnancy outcomes by providing or referring to support services.

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Appendix A: The Ohio Equity Institute (OEI)

In 2018, two-thirds of mothers who experienced an infant loss lived in one of nine Ohio counties and a disproportionate number were black. These counties include: Butler, Cuyahoga, Franklin, Hamilton, Lucas, Mahoning, Montgomery, Stark, and Summit. In 2013, a local team was formed in each of these nine counties to create the Ohio Equity Institute (OEI). During the first five years of the project, local teams were responsible for and completed the following activities: engaging their communities, coordinating resources and services, and identifying, promoting, and managing interventions aimed at improving local birth outcomes.

OEI 2.0 launched on October 1, 2018. This new, more targeted structure was developed to ensure that the program addresses key drivers of infant mortality and prioritizes the populations most vulnerable for poor birth outcomes. In 2018, about 30% of mothers who experienced an infant loss did not access first trimester prenatal care. We know removing barriers to both early pregnancy identification for prenatal care and access to prenatal care are opportunities to better address the needs of pregnant moms. We also learned in 2018 that more than one in four mothers who lost a baby was likely eligible for WIC but not receiving benefits. Streamlining access and referrals to resources and services for our moms and babies is paramount to ensuring each woman receives the totality of support she wants and deserves during her pregnancy.

Local OEI 2.0 teams are charged with implementing two strategies:

1. **Upstream strategy:** Facilitate the development, adoption, or improvement of policies and/or practices which impact the social determinants of health related to preterm birth and low birth weight in each county.

   Policy and practice changes adopted during year one of the grant will be implemented in year two. OEI teams used their local data to determine the most impactful areas to focus their policy and practice change efforts. Most OEI teams are focused on practice and policy changes in the areas of housing, transportation, and access to health care.

2. **Downstream strategy:** Local community Neighborhood Navigators identify and connect eligible pregnant women to clinical and social services.

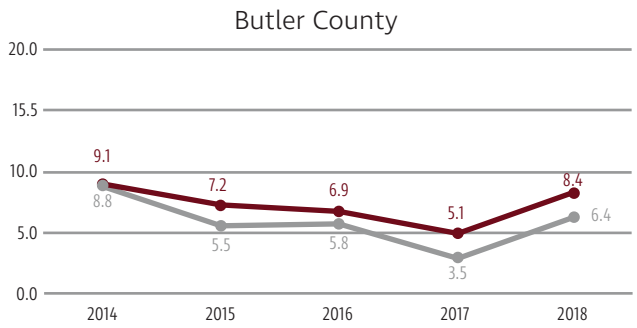
   Of women served from October 1, 2018 – August 13, 2019, nearly 70% were black. Of all women served during this same timeframe, 19.7% reported a history of unstable housing or homelessness, over 14% reported a need for safe sleep resources, 12% reported a need for prenatal support and 10% reported food insecurity.

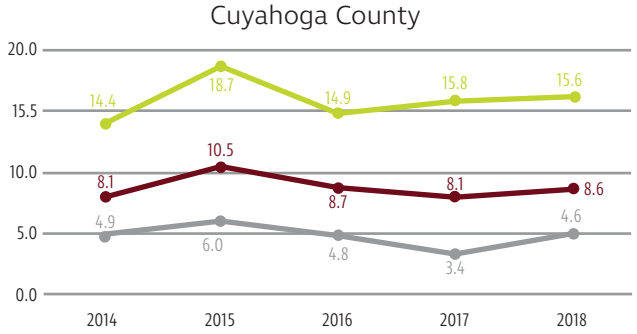
During year one of OEI 2.0, teams worked diligently to leverage the resources and services developed and coordinated in the first iteration of OEI to design and implement their new strategies. Local OEI teams collectively employed 27 Neighborhood Navigators. Each team designed unique community outreach strategies aimed at identifying unreached pregnant women in their neighborhoods, communities, and counties. Strategies included placing information near pregnancy tests in drug stores and dollar stores in high priority neighborhoods, hosting weekly roundtables at public libraries for local pregnant moms to connect with one another and service providers about their needs and concerns, building referral networks with local service providers (ex. WIC), and building relationships with local retail managers (ex. dollar stores) to allow Neighborhood Navigator presence during high-traffic times.

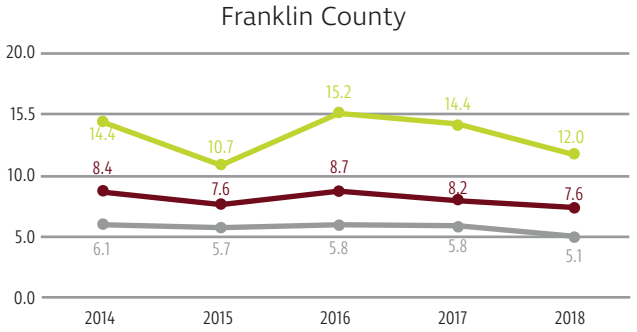
OEI teams receive technical assistance to support their local capacity in program design and implementation, epidemiology, monitoring and evaluation, and community engagement. Support is provided by the Ohio Department of Health as well as contracted vendors to ensure targeted, unique technical assistance for each individual team.

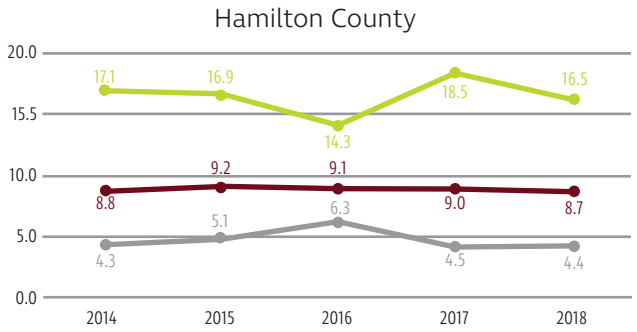
Figure A1: Trends in Infant Mortality Rate (per 1,000 live births), by OEI County and Race (2014-2018)

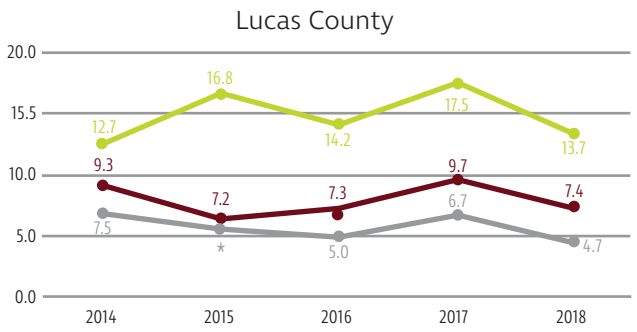
--White --Black --All Races

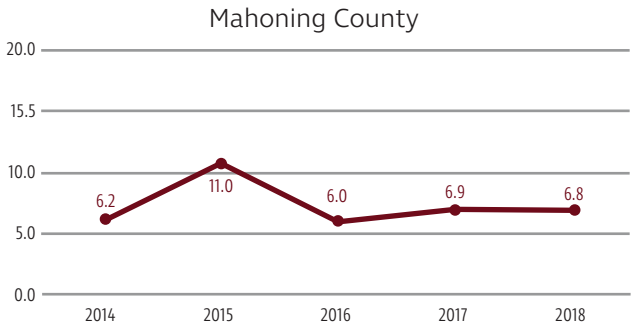


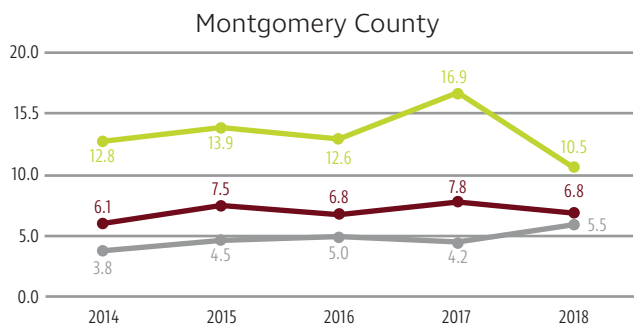


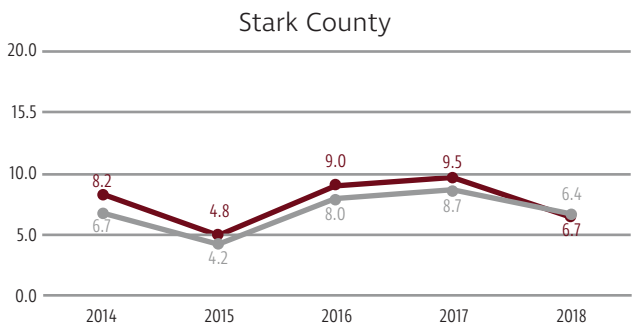


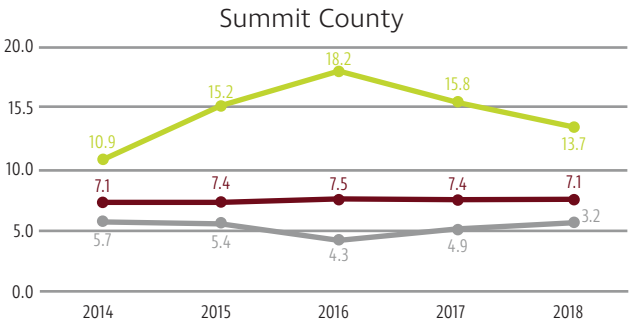












Data Source: Ohio Department of Health, Bureau of Vital Statistics
** Rates based on fewer than 10 deaths do not meet standards of reliability or precision and are suppressed.*

Note: The number of black infant deaths in Butler, Mahoning, and Stark counties was less than 10 in multiple years. For this reason, trends are not shown for black infant mortality in these counties. Additionally, the number of white infant deaths in Mahoning County was less than 10 in multiple years; therefore, trends are not shown for white infant mortality in Mahoning County.

Appendix B: Sleep-Related Deaths

The Ohio Child Fatality Review (CFR) program was established in 2000 by the Ohio General Assembly in response to the need to better understand why infants and children die. The law mandates CFR boards in each of Ohio's counties (or regions) to review the deaths of all children younger than 18 years of age. Ohio's CFR boards are composed of multidisciplinary groups of community leaders whose careful review process results in a thorough description of the factors related to infant and child deaths. The rich data collected through the CFR process allows communities and the state to identify factors contributing to deaths so initiatives aimed at reducing preventable deaths can be implemented. Child Fatality Review data have been used to better understand the complex issues related to infant mortality in Ohio, particularly in the area of sleep-related deaths. Examining sleep-related death data collected by CFR has provided the opportunity to address this critical contributor to infant mortality in a comprehensive way.

Despite their best efforts, CFR boards are not able to review every infant death, therefore, calculation of rates is not appropriate. Instead of rates, CFR statistics are reported as a proportion of the total reviews. Deaths that were not reviewed include cases still under investigation or involved in prosecution, out of state deaths reported too late for thorough review, and late-year deaths for which death certificates had not yet been processed. Due to these variables, it is usually impossible to find an exact number-for-number match between CFR data and data from other sources such as vital statistics. The unique role of CFR data is to provide a comprehensive depth of understanding to augment other, more one-dimensional surveillance data sources.

In 2018, 771 (82%) infant deaths were reviewed out of the 938 total infant deaths. This percentage of completed reviews will likely increase as some outstanding 2018 cases will have the opportunity for review in 2019 and beyond.

Out of the 771 CFR reviews, 140 were sleep-related deaths.

Of the 140 sleep-related infant death cases reviewed through CFR,

Black infants comprised half (54%) of the **sleep-related infant deaths**, despite only representing 18% of live births in 2018.

Black Infants 54%

- Half (49%) of all involved infants were between 1 month and 3 months old.
  - Sleep-related deaths become less common as infants age, but still occur up to 11 months of age.

Infant Safe Sleep

Baby sleeps safest alone, on their back, in a crib.

A number of unsafe sleep circumstances were commonly reported for sleep-related deaths:

Infants were put to sleep alone in only 36% (51) of reviews.

- **Bed-sharing was reported at the time of the death in 56% (78) of reviews.**
  - Among reviews indicating bed-sharing, infants most often shared a sleep surface with an adult only (72%), an adult and another child (13%), or another child only (9%). Six percent of reviews did not specify.
  - Of the 66 reviews that indicated bed-sharing with an adult, or adult and child, **15% indicated the person in charge was impaired at the time of the incident.**
- Eight percent (11) of reviews had missing or unknown data on sleeping alone.

Infants were put to sleep on their back in only 56% (78) of reviews.

- Twenty-two percent of infants were put to sleep on their side or stomach.
- Sleep position was unknown in 23% of reviews.

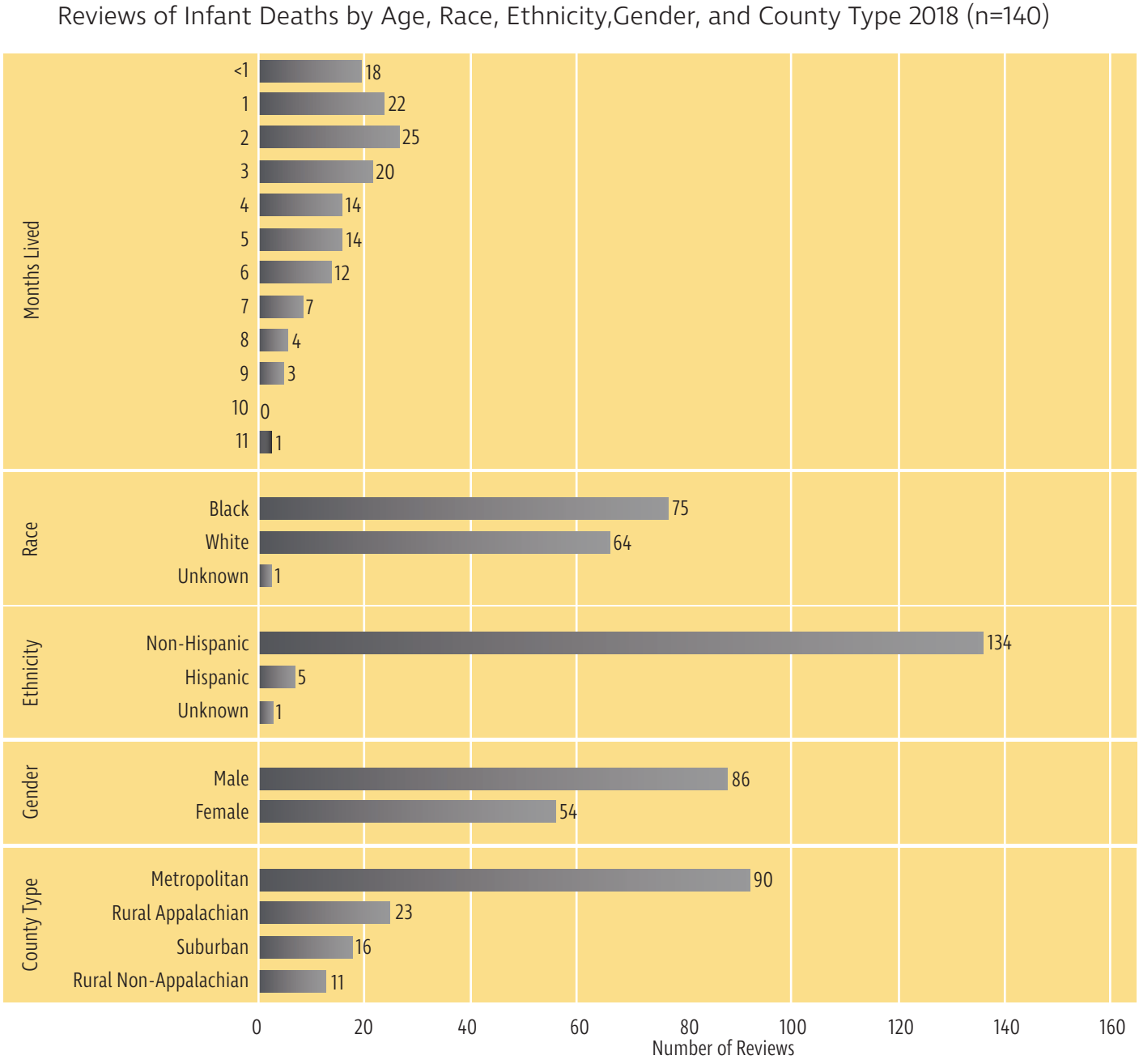
Infants were put to sleep in a crib or bassinet in only 21% (30) of reviews.

- Seventy-nine percent (110) of reviews occurred in an unsafe sleep environment (i.e. not a crib or bassinet). Of those,
  - **Fifty-four percent had a safe sleep space available in the home** (i.e. a crib or bassinet).
  - Thirteen percent did not have a safe sleep space available.
  - Thirty-four percent had unknown or missing data on safe sleep space availability.
- Eighty-seven percent (26) reported object(s) found in the sleep space.
  - Among the 26 reviews indicating objects in the crib or bassinet, the most commonly found objects were blankets (65%), comforters (23%), and pillows (15%). Forty-two percent reported multiple objects in the crib.

CFR identified additional unsafe sleep circumstances.

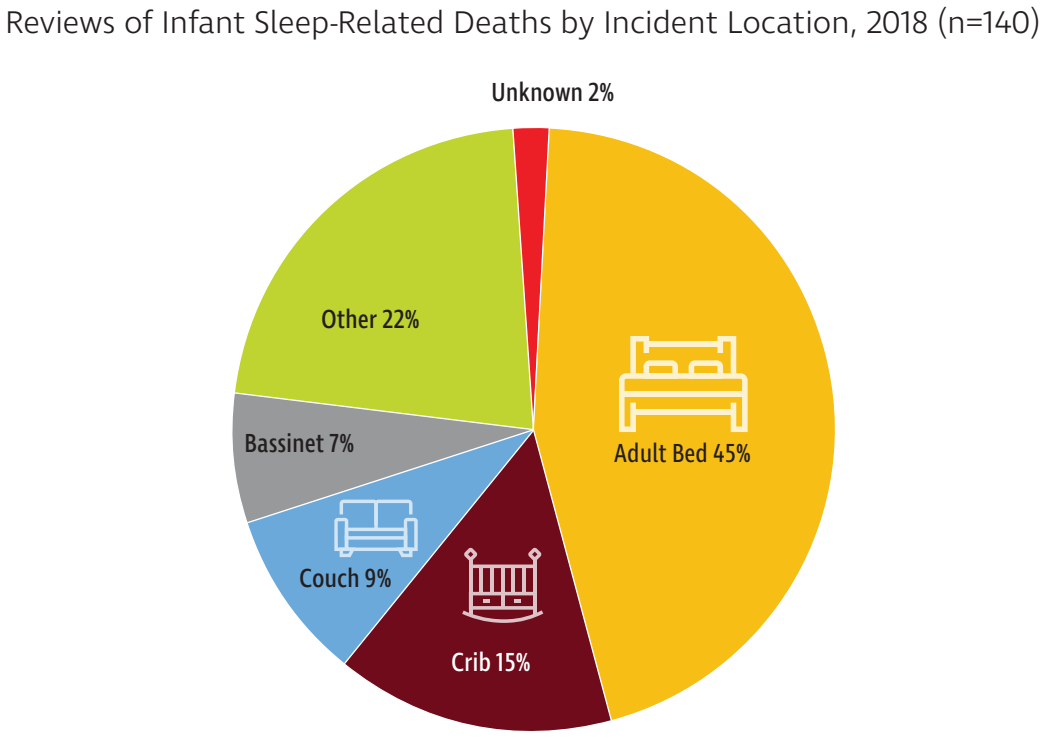
- **Second-hand smoke exposure was reported for 31%** (44) of the 2018 infant sleep-related deaths.
- Nine reviews indicated an adult fell asleep while feeding the infant, with three bottle-feeding, five breastfeeding, and one unknown.

Figure B1: Reviews of Ohio Infant Sleep-Related Deaths by Demographics (2018)



Data Source: Ohio Child Fatality Review

Figure B2: Reviews of Ohio Infant Sleep-Related Deaths by Incident Location (2018)



Data Source: Ohio Child Fatality Review
Note: Other incident locations are: Rock n' Play (4), floor (4), bouncy chair (3), car seat (3), swing (2), bed side sleeper (2), playpen/other play structure but not portable crib (2), baby box (1).

Appendix C: Supplementary Data Tables

Section 1: County-Level Infant Mortality Data

Table C1: Ohio Neonatal, Postneonatal, and Infant Mortality (per 1,000 live births), by County (2018)

Area	Neonatal Deaths***	Neonatal Mortality Rate	Postneonatal Deaths****	Postneonatal Mortality Rate	Total Infant Deaths	Infant Mortality Rate	Total Births
Ohio*****	632	4.7	306	2.3	938	6.9	135,226
Adams	0	*	0	*	0	*	364
Allen	9	*	1	*	10	8.1**	1,241
Ashland	5	*	1	*	6	*	623
Ashtabula	5	*	3	*	8	*	1,118
Athens	1	*	2	*	3	*	485
Auglaize	5	*	2	*	7	*	558
Belmont	2	*	2	*	4	*	642
Brown	2	*	1	*	3	*	504
Butler	27	6.0	11	2.4**	38	8.4	4,516
Carroll	1	*	0	*	1	*	269
Champaign	2	*	0	*	2	*	424
Clark	4	*	5	*	9	*	1,560
Clermont	14	6.0**	5	*	19	8.2**	2,323
Clinton	3	*	3	*	6	*	452
Columbiana	2	*	3	*	5	*	986
Coshocton	3	*	2	*	5	*	460
Crawford	1	*	0	*	1	*	454
Cuyahoga	82	5.9	38	2.7	120	8.6	13,873
Darke	3	*	4	*	7	*	633
Defiance	1	*	0	*	1	*	403
Delaware	8	*	0	*	8	*	2,127
Erie	4	*	2	*	6	*	811
Fairfield	7	*	6	*	13	7.6**	1,719
Fayette	2	*	1	*	3	*	365
Franklin	96	5.3	42	2.3	138	7.6	18,266
Fulton	1	*	0	*	1	*	472
Gallia	2	*	0	*	2	*	374
Geauga	1	*	1	*	2	*	967
Greene	8	*	2	*	10	5.8**	1,730
Guernsey	5	*	3	*	8	*	435
Hamilton	63	5.9	30	2.8	93	8.7	10,744
Hancock	3	*	4	*	7	*	859
Hardin	1	*	0	*	1	*	371
Harrison	1	*	1	*	2	*	143
Henry	1	*	0	*	1	*	321
Highland	2	*	0	*	2	*	569
Hocking	0	*	0	*	0	*	286

Table C1 continued

Area	Neonatal Deaths***	Neonatal Mortality Rate	Postneonatal Deaths****	Postneonatal Mortality Rate	Total Infant Deaths	Infant Mortality Rate	Total Births
Holmes	0	*	0	*	0	*	805
Huron	2	*	0	*	2	*	712
Jackson	3	*	2	*	5	*	425
Jefferson	1	*	2	*	3	*	680
Knox	1	*	3	*	4	*	778
Lake	9	*	1	*	10	4.5**	2,215
Lawrence	1	*	0	*	1	*	618
Licking	4	*	6	*	10	5.0**	2,009
Logan	4	*	1	*	5	*	566
Lorain	16	5.0**	6	*	22	6.9	3,207
Lucas	24	4.4	16	3.0**	40	7.4	5,417
Madison	2	*	0	*	2	*	431
Mahoning	9	*	7	*	16	6.8**	2,349
Marion	1	*	1	*	2	*	737
Medina	1	*	3	*	4	*	1,676
Meigs	0	*	0	*	0	*	213
Mercer	2	*	0	*	2	*	660
Miami	6	*	1	*	7	*	1,180
Monroe	1	*	1	*	2	*	129
Montgomery	30	4.6	14	2.2**	44	6.8	6,470
Morgan	0	*	0	*	0	*	133
Morrow	1	*	1	*	2	*	396
Muskingum	1	*	1	*	2	*	1,027
Noble	0	*	0	*	0	*	153
Ottawa	1	*	0	*	1	*	325
Paulding	0	*	0	*	0	*	221
Perry	2	*	0	*	2	*	408
Pickaway	3	*	1	*	4	*	637
Pike	1	*	1	*	2	*	342
Portage	8	*	2	*	10	7.2**	1,392
Preble	1	*	0	*	1	*	445
Putnam	4	*	0	*	4	*	424
Richland	4	*	4	*	8	*	1,362
Ross	2	*	3	*	5	*	849
Sandusky	1	*	1	*	2	*	639
Scioto	5	*	6	*	11	13.3**	829
Seneca	4	*	2	*	6	*	617
Shelby	2	*	1	*	3	*	609
Stark	18	4.4**	8	*	26	6.4	4,065
Summit	30	5.0	12	2.0**	42	7.1	5,953

Table C1 continued

Area	Neonatal Deaths***	Neonatal Mortality Rate	Postneonatal Deaths****	Postneonatal Mortality Rate	Total Infant Deaths	Infant Mortality Rate	Total Births
Trumbull	11	5.3**	4	*	15	7.3**	2,061
Tuscarawas	4	*	2	*	6	*	1,130
Union	2	*	2	*	4	*	706
Van Wert	0	*	2	*	2	*	330
Vinton	2	*	0	*	2	*	142
Warren	7	*	5	*	12	5.1**	2,361
Washington	7	*	3	*	10	17.5**	570
Wayne	8	*	3	*	11	7.5**	1,460
Williams	1	*	0	*	1	*	408
Wood	6	*	3	*	9	*	1,267
Wyandot	2	*	0	*	2	*	235

Data Source: Ohio Department of Health, Bureau of Vital Statistics

** Rates based on fewer than 10 deaths do not meet standards of reliability or precision and are suppressed.*

*** Rates based on fewer than 20 infant deaths should be interpreted with caution.*

**** Neonatal Death – Death of a live-born infant during the first 27 days of life.*

***** Postneonatal Death – Death of infant aged 28 days through 364 days of life.*

****** The total for Ohio includes 6 births with unknown county of residence.*

Table C2: Ohio 5-Year Infant Mortality Rate (per 1,000 live births), by County (2014-2018)

Area	Total Deaths	Total Births	Infant Mortality Rate
Ohio***	4,903	689,146	5.8
Adams	12	1,687	7.1**
Allen	50	6,289	8.0
Ashland	22	3,024	7.3
Ashtabula	37	5,579	6.6
Athens	21	2,578	8.1
Auglaize	18	2,827	6.4**
Belmont	21	3,251	6.5
Brown	20	2,453	8.2
Butler	164	22,526	7.3
Carroll	7	1,384	*
Champaign	16	2,030	7.9**
Clark	58	7,942	7.3
Clermont	78	11,600	6.7
Clinton	19	2,480	7.7**
Columbiana	27	5,251	5.1
Coshocton	18	2,323	7.7**
Crawford	13	2,401	5.4**
Cuyahoga	644	73,104	8.8
Darke	27	3,156	8.6
Defiance	15	2,140	7.0**
Delaware	43	10,814	4.0
Erie	31	3,967	7.8
Fairfield	59	8,566	6.9
Fayette	7	1,695	*
Franklin	761	93,965	8.1
Fulton	11	2,442	4.5**
Gallia	13	1,857	7.0**
Geauga	17	4,626	3.7**
Greene	42	8,979	4.7
Guernsey	23	2,285	10.1
Hamilton	485	54,211	8.9
Hancock	29	4,565	6.4
Hardin	4	1,876	*
Harrison	9	773	*
Henry	9	1,534	*
Highland	18	2,754	6.5**
Hocking	10	1,528	6.5**
Holmes	15	3,682	4.1**
Huron	19	3,705	5.1**

Table C2 continued

Area	Total Deaths	Total Births	Infant Mortality Rate
Jackson	14	2,091	6.7**
Jefferson	33	3,327	9.9
Knox	21	3,729	5.6
Lake	52	11,140	4.7
Lawrence	20	3,288	6.1
Licking	62	9,981	6.2
Logan	17	2,713	6.3**
Lorain	99	16,559	6.0
Lucas	222	27,781	8.0
Madison	18	2,127	8.5**
Mahoning	89	12,078	7.4
Marion	26	3,691	7.0
Medina	27	8,815	3.1
Meigs	7	1,185	*
Mercer	18	3,043	5.9**
Miami	29	5,981	4.8
Monroe	6	668	*
Montgomery	232	33,122	7.0
Morgan	2	746	*
Morrow	9	1,887	*
Muskingum	31	5,138	6.0
Noble	2	695	*
Ottawa	7	1,700	*
Paulding	5	1,087	*
Perry	8	2,113	*
Pickaway	17	3,066	5.5**
Pike	8	1,731	*
Portage	45	7,102	6.3
Preble	12	2,192	5.5**
Putnam	12	2,180	5.5**
Richland	47	6,840	6.9
Ross	24	4,290	5.6
Sandusky	16	3,258	4.9**
Scioto	32	4,333	7.4
Seneca	19	2,957	6.4**
Shelby	10	3,067	3.3**
Stark	157	20,770	7.6
Summit	220	30,135	7.3
Trumbull	93	10,432	8.9
Tuscarawas	28	5,822	4.8

Table C2 continued

Area	Total Deaths	Total Births	Infant Mortality Rate
Union	26	3,333	7.8
Van Wert	12	1,714	7.0**
Vinton	5	735	*
Warren	49	11,843	4.1
Washington	20	2,974	6.7
Wayne	53	7,669	6.9
Williams	10	2,095	4.8**
Wood	32	6,816	4.7
Wyandot	7	1,211	*

Data Source: Ohio Department of Health, Bureau of Vital Statistics.

** Rates based on fewer than 10 deaths do not meet standards of reliability or precision and are suppressed.*

*** Rates based on fewer than 20 infant deaths should be interpreted with caution.*

**** The total for Ohio includes 47 births and 1 death with unknown county of residence.*

Table C3: Infant Mortality Rate (per 1,000 live births), by OEI County and Race (2014-2018)

County	Race/Ethnicity	2014		2015		2016		2017		2018	
		Number of Deaths	Infant Mortality Rate	Number of Deaths	Infant Mortality Rate	Number of Deaths	Infant Mortality Rate	Number of Deaths	Infant Mortality Rate	Number of Deaths	Infant Mortality Rate
Butler	All Races	39	8.8	33	7.2	31	6.9	23	5.1	38	8.4
	White	32	9.1	20	5.5	20	5.8	12	3.5	22	6.4
	Black	3	*	11	23.1	8	16.1	6	*	13	23.7
Cuyahoga	All Races	122	8.1	156	10.5	128	8.7	118	8.1	120	8.6
	White	38	4.9	46	6.0	38	4.8	26	3.4	35	4.6
	Black	83	14.4	107	18.7	85	14.9	91	15.8	83	15.6
Franklin	All Races	158	8.4	145	7.6	165	8.7	155	8.2	138	7.6
	White	67	6.1	62	5.7	62	5.8	62	5.8	52	5.1
	Black	81	14.4	61	10.7	89	15.2	83	14.4	70	12.0
Hamilton	All Races	97	8.8	100	9.2	98	9.1	97	9.0	93	8.7
	White	28	4.3	33	5.1	40	6.3	29	4.5	28	4.4
	Black	63	17.1	61	16.9	50	14.3	66	18.5	59	16.5
Lucas	All Races	53	9.3	35	6.3	41	7.3	53	9.7	40	7.4
	White	29	7.5	6	*	19	5.0	25	6.7	17	4.7
	Black	20	12.7	27	16.8	22	14.2	27	17.5	21	13.7
Mahoning	All Races	15	6.2	26	11.0	15	6.0	17	6.9	16	6.8
	White	7	*	12	7.5	5	*	6	*-	5	*
	Black	8	*	13	20.3	10	15.1	10	14.9	9	*
Montgomery	All Races	40	6.1	50	7.5	45	6.8	53	7.8	44	6.8
	White	17	3.8	20	4.5	22	5.0	18	4.2	23	5.5
	Black	22	12.8	25	13.9	22	12.6	32	16.9	20	10.5
Stark	All Races	35	8.2	20	4.8	38	9.0	38	9.5	26	6.4
	White	24	6.7	15	4.2	29	8.0	30	8.7	23	6.7
	Black	10	20.2	5	*	9	*	8	*	3	*
Summit	All Races	44	7.1	45	7.4	45	7.5	44	7.4	42	7.1
	White	25	5.7	23	5.4	18	4.3	20	4.9	21	5.2
	Black	15	10.9	20	15.2	24	18.2	21	15.8	19	13.7

Data Source: Ohio Department of Health, Bureau of Vital Statistics

** Rates based on fewer than 10 deaths do not meet standards of reliability or precision and are suppressed.*

Table C4: Ohio Infant Deaths (2018)

Attribute	All Deaths		
	Percent	Numerator	Denominator
Behavioral			
Mother Smoked Pre-pregnancy	24.4	229	938
Mother Smoked First Trimester	20.0	188	938
Mother Smoked Third Trimester	15.0	141	938
Interpregnancy interval <18 months	41.5	160	386
Social			
Low Income (presumed Medicaid)	57.4	524	913
Education less than High School	17.8	144	810
Father not on birth certificate	30.7	288	938
Medical: Pre-pregnancy			
Obese	38.4	346	902
Hypertension	6.9	64	930
Diabetes	2.2	20	930
Medical Pregnancy			
Gestational Hypertension	10.2	95	930
Gestational Diabetes	5.8	54	930
Twin or higher order pregnancy	11.4	106	930
Healthcare and Services			
No First Trimester Prenatal Care	39.5	325	822
Born in Wrong Level Hospital***	8.7	77	884
WIC during Pregnancy	33.2	304	915
No WIC but probably eligible	29.7	269	906
Maternal Pregnancy History			
Prior Pregnancy	73.9	682	923
Prior Live Birth	62.9	579	920
Prior Preterm Birth	13.0	121	930
Demographic: Mother's Race			
Black	33.1	310	938
White	60.7	569	938
Demographic: Mother's Ethnicity			
Hispanic	3.6	34	938
Non-Hispanic**	96.4	904	938

Table C4 continued

Attribute	All Deaths		
	Percent	Numerator	Denominator
Demographic: Mother's Age (years)			
<18	2.3	19	821
18-19	6.5	53	821
20-24	22.1	181	821
25-29	32.8	269	821
30-34	24.5	201	821
35-39	9.4	77	821
40 or more	2.6	21	821
Demographic: County of Residence at Death****			
OEI County	59.8	556	930
Large Metro County	37.3	350	938
Metro County	51.4	482	938
Micro County	9.7	91	938
Rural County	*	*	*
Delivery: Gestational Age			
Before 20 weeks	9.8	91	929
20-23 weeks	21.9	203	929
24-27 weeks	12.4	115	929
28-33 weeks	11.0	102	929
34-36 weeks	10.3	96	929
37 weeks or more	34.7	322	929
Death: Birth Weight			
Less than 500 grams	21.0	181	863
500-999 grams	19.7	170	863
1000-1499 grams	7.1	61	863
1500-1999 grams	7.2	62	863
2000-2499 grams	10.7	92	863
2500 or more grams	34.4	297	863
Small for gestational age (SGA)	28.1	184	655
Death: Timing			
Within first hour of life	11.8	111	938
By end of first day	28.5	267	938
By end of first week	12.9	121	938
By end of first month	14.3	134	938
Before first birthday	32.5	305	938

Table C4 continued

Attribute	All Deaths		
	Percent	Numerator	Denominator
Death: Location			
Within hospital as inpatient	74.5	699	938
ER or outpatient setting	14.7	138	938
Dead on arrival	1.3	12	938
Home	7.6	71	938
Hospice/Nursing Home/Long Term Care Facility			
Other	1.7	16	938
Dollfus Cause of Death Category			
Prematurity	28.7	269	938
Congenital Anomaly	21.1	198	938
Obstetric Condition	6.2	58	938
SIDS	8.4	79	938
External Injuries	10.1	95	938
Perinatal Infections	5.3	50	938
Birth Asphyxia	1.2	11	938
Other Infections	3.4	32	938
Other	15.6	146	938

Source: Ohio Department of Health, Ohio Vital Statistics Linked Birth/Infant Death files
** Figure does not meet standards of reliability or precision, based on fewer than 10 deaths in the numerator*
***Non-Hispanic deaths include those of unknown or missing ethnicity.*
**** An infant born in a hospital without the appropriate level of care given the infant's gestational age and/or birth weight. Denominator includes infants born in a facility.*
*****County designations:* ***Large Metro=*** *(Cuyahoga, Franklin, Hamilton),* ***Metro=*** *(Allen, Ashland, Ashtabula, Athens, Belmont, Butler, Clark, Clermont, Columbiana, Delaware, Erie, Fairfield, Geauga, Greene, Hancock, Huron, Jefferson, Knox, Lake, Lawrence, Licking, Lorain, Lucas, Mahoning, Marion, Medina, Miami, Montgomery, Muskingum, Pickaway, Portage, Richland, Ross, Sandusky, Scioto, Seneca, Stark, Summit, Trumbull, Tuscarawas, Union, Warren, Wayne, Wood),* ***Micro=*** *(Auglaize, Brown, Carroll, Champaign, Clinton, Coshocton, Crawford, Darke, Defiance, Fayette, Fulton, Gallia, Guernsey, Hardin, Henry, Highland, Hocking, Holmes, Jackson, Logan, Madison, Meigs, Mercer, Morrow, Ottawa, Perry, Pike, Preble, Putnam, Shelby, Van Wert, Washington, Williams, Wyandot),* ***Rural=*** *(Adams, Harrison, Monroe, Morgan, Noble, Paulding, Vinton),* ***OEI=*** *(Butler, Cuyahoga, Franklin, Hamilton, Lucas, Mahoning, Montgomery, Stark, Summit)*

Table C5: Ohio Infant Deaths Among Those Born Less Than 24 weeks Gestation (2018)

Attribute	Among Infants Born at < 24 weeks Gestation		
	2018		
	Percent	Numerator	Denominator
Behavioral			
Mother Smoked pre-pregnancy	19.4	57	294
Mother Smoked first trimester	15.3	45	294
Interpregnancy interval <18 months	39.7	25	63
Social			
Low Income (presumed Medicaid)	53.6	151	282
Education less than High School	16.7	46	276
Father not on birth certificate	37.1	109	294
Medical: Pre-pregnancy			
Obese	43.0	120	279
Hypertension	5.9	17	286
Diabetes	*	*	*
Medical: Pregnancy			
Gestational Hypertension	5.2	15	286
Gestational Diabetes	*	*	*
Twin or higher order pregnancy	18.5	53	286
Health Care and Services			
No First Trimester Prenatal Care	32.9	83	252
Born in Wrong Level Hospital***	19.3	53	275
WIC during Pregnancy	23.3	65	279
No WIC but probably eligible	45.3	96	212
Maternal Pregnancy History			
Prior Pregnancy	71.0	203	286
Prior Live Birth	54.2	154	284
Prior Preterm Birth	16.1	46	286
Demographic: Mother's Race			
Black	38.1	112	294
White	52.4	154	294
Demographic: Mother's Ethnicity			
Hispanic	4.8	14	286
Non-Hispanic**	95.2	280	286
Demographic: Mother's Age (years)			
<18	*	*	*
18-19	5.6	16	285
20-24	20.0	57	285
25-29	31.2	89	285
30-34	29.8	85	285
35-39	10.2	29	285
40 or more	*	*	*

Table C5: Continued

Attribute	Among Infants Born at < 24 weeks Gestation		
	2018		
	Percent	Numerator	Denominator
Demographic: County of Residence at Death**			
OEI County	67.1	192	286
Large Metro County	43.5	128	294
Metro County	45.9	135	294
Micro County	7.5	22	294
Rural County	*	*	*
Delivery: Spontaneous vs. Provider Initiated			
Spontaneous Labor	87.8	251	286
Provider-initiated labor/delivery	12.2	35	286
Delivery: Gestational Age			
Before 20 weeks	31.0	91	294
20-23 weeks	69.1	203	294
Delivery: Birth Weight			
Less than 500 grams	69.2	162	234
500-999 grams	29.9	70	234
1000-1499 grams	*	*	*
1500-1999 grams	*	*	*
2000-2499 grams	*	*	*
2500 or more grams	*	*	*
Small for gestational age (SGA)	*	*	*
Death Timing			
Within first hour of life	26.5	78	294
By end of first day	57.5	169	294
By end of first week	5.4	16	294
By end of first month	5.1	15	294
Before first birthday	5.4	16	294
Death Location			
Within hospital as inpatient	97.3	78	294
ER or outpatient setting	*	*	*
Dead on arrival	*	*	*
Home	*	*	*
Hospice/Nursing Home/Long Term Care Facility	*	*	*
Other	*	*	*

Table C5: Continued

Attribute	Among Infants Born at < 24 weeks Gestation		
	2018		
	Percent	Numerator	Denominator
Dollfus Cause of Death Category			
Prematurity	63.3	186	294
Congenital Anomaly	*	*	*
Obstetric Condition	15.0	44	294
SIDS	*	*	*
External Injuries	*	*	*
Perinatal Infections	6.8	20	294
Birth Asphyxia	*	*	*
Other Infections	*	*	*
Other	7.8	23	294

Source: Ohio Department of Health, Ohio Vital Statistics Linked Birth/Infant Death files
** Figure does not meet standards of reliability or precision, based on fewer than 10 deaths in the numerator*
***Non-Hispanic deaths include those of unknown or missing ethnicity.*
**** An infant born in a hospital without the appropriate level of care given the infant's gestational age and/or birth weight. Denominator includes infants born in a facility.*
*****County designations:* ***Large Metro=*** *(Cuyahoga, Franklin, Hamilton),* ***Metro=*** *(Allen, Ashland, Ashtabula, Athens, Belmont, Butler, Clark, Clermont, Columbiana, Delaware, Erie, Fairfield, Geauga, Greene, Hancock, Huron, Jefferson, Knox, Lake, Lawrence, Licking, Lorain, Lucas, Mahoning, Marion, Medina, Miami, Montgomery, Muskingum, Pickaway, Portage, Richland, Ross, Sandusky, Scioto, Seneca, Stark, Summit, Trumbull, Tuscarawas, Union, Warren, Wayne, Wood),* ***Micro=*** *(Auglaize, Brown, Carroll, Champaign, Clinton, Coshocton, Crawford, Darke, Defiance, Fayette, Fulton, Gallia, Guernsey, Hardin, Henry, Highland, Hocking, Holmes, Jackson, Logan, Madison, Meigs, Mercer, Morrow, Ottawa, Perry, Pike, Preble, Putnam, Shelby, Van Wert, Washington, Williams, Wyandot),* ***Rural=*** *(Adams, Harrison, Monroe, Morgan, Noble, Paulding, Vinton),* ***OEI=*** *(Butler, Cuyahoga, Franklin, Hamilton, Lucas, Mahoning, Montgomery, Stark, Summit)*

Table C6: Ohio Infant Deaths by Cause (2018)

Attribute	Due to Prematurity			Due to Congenital Anomaly			Due to Obstetric Conditions			Due to External Injury			Due to Sudden Infant Death Syndrome		
	Percent	Numerator	Denominator	Percent	Numerator	Denominator	Percent	Numerator	Denominator	Percent	Numerator	Denominator	Percent	Numerator	Denominator
Behavioral															
Mother Smoked Pre-pregnancy	19.3	52	269	13.6	27	198	*	*	*	51.6	49	95	44.3	35	79
Mother Smoked First Trimester	14.5	39	269	10.1	20	198	*	*	*	46.3	44	95	36.7	29	79
Mother Smoked Third Trimester	7.4	20	269	8.6	17	198	*	*	*	37.9	36	95	29.1	23	79
Interpregnancy interval <18 months	42.2	27	64	35.6	36	101	*	*	*	51.8	29	56	45.3	24	53
Social															
Low Income (presumed Medicaid)	55.0	143	260	43.6	85	195	54.4	31	57	76.3	71	93	83.1	64	77
Education less than high school	14.7	37	252	12.0	21	175	19.6	11	56	25.8	17	66	27.9	17	61
Father not on birth certificate	37.9	102	269	21.2	42	198	36.2	21	58	29.5	28	95	32.9	26	79
Medical: Pre-pregnancy															
Obese	44.0	114	259	37.0	71	192	34.6	19	55	30.1	28	93	38.7	29	75
Hypertension	6.4	17	267	7.6	15	197	*	*	*	*	*	*	*	*	
Diabetes	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Medical: Pregnancy															
Gestational Hypertension	8.6	23	267	10.2	20	197	*	*	*	*	*	*	14.3	11	77
Gestational Diabetes	*	*	*	12.7	25	197	*	*	*	*	*	*	*	*	*
Twin or higher order pregnancy	21.4	57	267	*	*	*	*	*	*	*	*	*	*	*	*
Health Care and Services															
No First Trimester Prenatal Care	33.9	78	230	44.0	77	175	28.6	14	49	53.0	44	83	43.8	32	73
Born in Wrong Level Hospital****	15.5	39	252	*	*	*	18.5	10	54	*	*	*	*	*	*
WIC during Pregnancy	27.3	70	256	25.5	50	196	17.5	10	57	55.3	52	94	58.4	45	77
No WIC but probably eligible	46.0	85	185	30.6	44	144	36.8	21	57	65.9	27	41	75.0	24	32
Maternal Pregnancy History															
Prior Pregnancy	72.4	191	264	69.5	137	197	68.4	39	57	81.9	77	94	84.4	65	77
Prior Live Birth	55.3	145	262	63.5	125	197	57.9	33	57	72.3	68	94	79.2	61	77
Prior Preterm Birth	19.5	52	267	9.6	19	197	*	*	*	*	*	*	13.0	10	77
Demographic: Mother's Race															
Black	34.9	94	269	24.8	49	198	37.9	22	58	39.0	37	95	53.2	42	79
White	56.9	153	269	69.2	137	198	53.5	31	58	56.8	54	95	43.0	34	79
Demographic: Mother's Ethnicity															
Hispanic	*	*	*	*	*	*	*	*	*	*	*	*		*	*
Non-Hispanic***	96.7	260	269	96.5	191	198	87.9	51	58	97.9	93	95	97.5	77	79
Demographic: Mother's Age (years)															
<18	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
18-19	6.9	18	261	6.8	12	176	*	*	*	*	*	*	*	*	*
20-24	21.1	55	261	19.9	35	176	21.1	12	57	25.8	17	66	27.9	17	61
25-29	29.1	76	261	36.4	64	176	29.8	17	57	33.3	22	66	31.2	19	61
30-34	28.7	75	261	19.9	35	176	31.6	18	57	18.2	12	66	18.0	11	61
35-39	10.7	28	261	10.8	19	176	*	*	*	*	*	*	*	*	*
40 or more	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Demographic: County of Residence at Death***															
OEI County	63.7	170	267	56.9	112	197	63.2	36	57	53.2	50	94	71.4	55	77
Large Metro County	40.2	108	269	36.4	72	198	43.1	25	58	28.4	27	95	48.1	38	79
Metro County	52.4	141	269	51.5	102	198	46.6	27	58	62.1	59	95	41.8	33	79
Micro County	5.6	15	269	11.6	23	198	*	*	*	*	*	*	*	*	*
Rural County	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Table C6: Continued

Attribute	Due to Prematurity			Due to Congenital Anomaly			Due to Obstetric Conditions			Due to External Injury			Due to Sudden Infant Death Syndrome		
	Percent	Numerator	Denominator	Percent	Numerator	Denominator	Percent	Numerator	Denominator	Percent	Numerator	Denominator	Percent	Numerator	Denominator
Delivery: Spontaneous vs. Provider Initiated															
Spontaneous Labor	72.7	194	267	42.6	84	197	82.5	47	57	52.1	49	94	49.4	38	77
Provider-initiated labor/delivery	27.3	73	267	57.4	113	197	17.5	10	57	47.9	45	94	50.7	39	77
Delivery: Gestational Age															
Before 20 weeks	22.6	60	265	*	*	*	25.9	15	58	*	*	*	*	*	*
20-23 weeks	47.6	126	265	*	*	*	50.0	29	58	*	*	*	*	*	*
24-27 weeks	20.8	55	265	*	*	*	*	*	*	*	*	*	*	*	*
28-33 weeks	4.9	13	265	21.7	43	198	*	*	*	*	*	*	*	*	*
34-36 weeks	*	*	*	22.2	44	198	*	*	*	*	*	*	*	*	*
37 weeks or more	*	*	*	47.0	93	198	*	*	*	85.3	81	95	81.0	64	79
Delivery: Birth Weight															
Less than 500 grams	50.0	112	224	*	*	*	60.4	29	48	*	*	*	*	*	*
500-999 grams	40.2	90	224	*	*	*	*	*	*	*	*	*	*	*	*
1000-1499 grams	*	*	*	14.4	28	194	*	*	*	*	*	*	*	*	*
1500-1999 grams	*	*	*	17.5	34	194	*	*	*	*	*	*	*	*	*
2000-2499 grams	*	*	*	22.7	44	194	*	*	*	12.8	12	94	13.0	10	77
2500 or more grams	*	*	*	37.1	72	194	*	*	*	78.7	74	94	80.5	62	77
Small for gestational age (SGA)	10.7	11	103	44.6	83	186	*	*	*	22.0	20	91	23.6	17	72
Death: Timing															
Within first hour of life	20.1	54	269	12.1	24	198	32.8	19	58	*	*	*	*	*	*
By end of first day	48.0	129	269	29.8	59	198	58.6	34	58	*	*	*	*	*	*
By end of first week	14.9	40	269	16.7	33	198	*	*	*	*	*	*	*	*	*
By end of first month	12.3	33	269	14.7	29	198	*	*	*	10.5	10	95	13.9	11	79
Before first birthday	4.8	13	269	26.8	53	198	*	*	*	88.4	84	95	86.1	68	79
Death: Location															
Within hospital as inpatient	97.4	262	269	86.4	171	198	100.0	58	58	17.9	17	95	12.7	10	79
ER or outpatient setting	*	*	*	*	*	*	*	*	*	48.4	46	95	51.9	41	79
Dollfus Cause of Death Category															
Dead on arrival	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Home	*	*	*	9.1	18	198	*	*	*	22.1	21	95	24.1	19	79
Hospice/Nursing Home/Long Term Care Facility	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Other	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Source: Ohio Department of Health, Ohio Vital Statistics Linked Birth/Infant Death files

** Figure does not meet standards of reliability or precision, based on fewer than 10 deaths in the numerator*

***Measure valid only for premature births*

****Non-Hispanic deaths include those of unknown or missing ethnicity.*

*****An infant born in a hospital without the appropriate level of care given the infant's gestational age and/or birth weight. Denominator includes infants born in a facility.*

******County designations:* ***Large Metro=*** *(Cuyahoga, Franklin, Hamilton),* ***Metro=*** *(Allen, Ashland, Ashtabula, Athens, Belmont, Butler, Clark, Clermont, Columbiana, Delaware, Erie, Fairfield, Geauga, Greene, Hancock, Huron, Jefferson, Knox, Lake, Lawrence, Licking, Lorain, Lucas, Mahoning, Marion, Medina, Miami, Montgomery, Muskingum, Pickaway, Portage, Richland, Ross, Sandusky, Scioto, Seneca, Stark, Summit, Trumbull, Tuscarawas, Union, Warren, Wayne, Wood),* ***Micro=*** *(Auglaize, Brown, Carroll, Champaign, Clinton, Coshocton, Crawford, Darke, Defiance, Fayette, Fulton, Gallia, Guernsey, Hardin, Henry, Highland, Hocking, Holmes, Jackson, Logan, Madison, Meigs, Mercer, Morrow, Ottawa, Perry, Pike, Preble, Putnam, Shelby, Van Wert, Washington, Williams, Wyandot),* ***Rural=*** *(Adams, Harrison, Monroe, Morgan, Noble, Paulding, Vinton),* ***OEI=*** *(Butler, Cuyahoga, Franklin, Hamilton, Lucas, Mahoning, Montgomery, Stark, Summit)*

Table C7: Ohio Infant Mortality Rate by Cause, Ohio (2009-2018)

Year/ Cause of Death	Prematurity	Congenital Anomaly	Obstetric Conditions	External Injury	Sudden Infant Death Syndrome
2009	2.2	1.5	0.6	0.6	0.7
2010	2.2	1.5	0.7	0.5	0.8
2011	2.2	1.6	0.8	0.6	0.7
2012	2.3	1.6	0.7	0.6	0.6
2013	2.1	1.5	0.6	0.5	0.6
2014	2.1	1.4	0.6	0.4	0.5
2015	2.0	1.3	0.7	0.7	0.6
2016	2.3	1.4	0.6	0.5	0.5
2017	2.3	1.3	0.7	0.6	0.5
2018	2.0	1.5	0.4	0.7	0.6

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