Perinatal Periods of Risk:

Analyzing Disparities to Reduce Feto-Infant Mortality
Clark County, 2015-2019

Clark County
Combined
Health District

Statement of Purpose

This report was prepared to present the results of Phase I & II of the Perinatal Periods of Risk (PPOR) analysis completed for Clark County, OH August 2022 for the time period between 2015-2019. PPOR is an approach used to aid communities to reduce fetal and infant mortality through the use of birth and death data. The data collected and analyzed were provided by the Ohio Department of Health, Bureau of Vital Statistics, Resident Birth and Death files.

Information provided in this report is intended for the use by Clark County Department of Epidemiology to help guide decisions for evidence-based interventions.

Note: All analyses, interpretations, and conclusions were performed by Daisy Okpa, MPH. The Ohio Department of Health does not claim responsibility for any findings within this report. Contact information is provided below.

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Table of Contents

Perinatal Periods of Risk (PPOR) Background

The Perinatal Periods of Risk approach provides urban communities with a framework and tools to use in investigating and preventing feto-infant mortality[1]. There are two phases of PPOR. Phase I of PPOR identifies and categorizes the populations of interest into four periods of risk based on gestational age and birth weight:

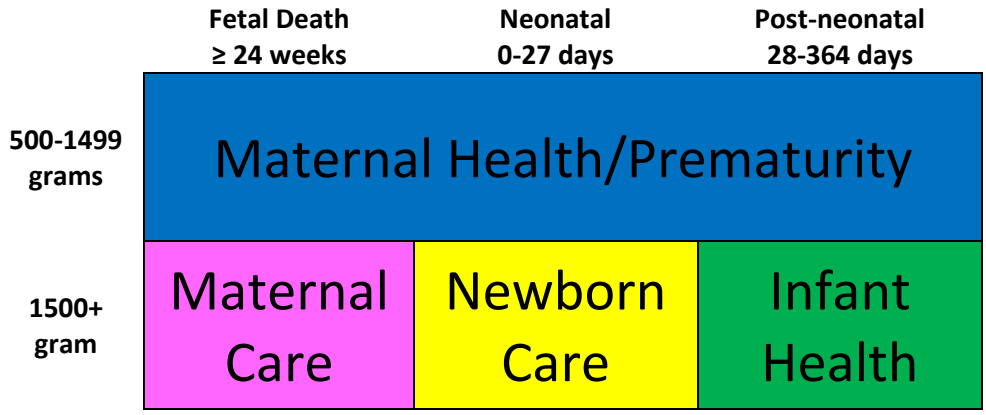


Figure 1 PPOR Map

Each period has a set of primary causes and possible action steps for intervention. The period with the largest number of deaths should be prioritized by the community. There are some ways for community stakeholders to take action in addressing the areas found to be contributing the most preventable deaths. This can be done by[2]:

- Assessing relevant community assets
- Finding existing evidence-based programs
- Adapting existing programs and/or designing new programs
- Determining appropriate policy and/or practice change

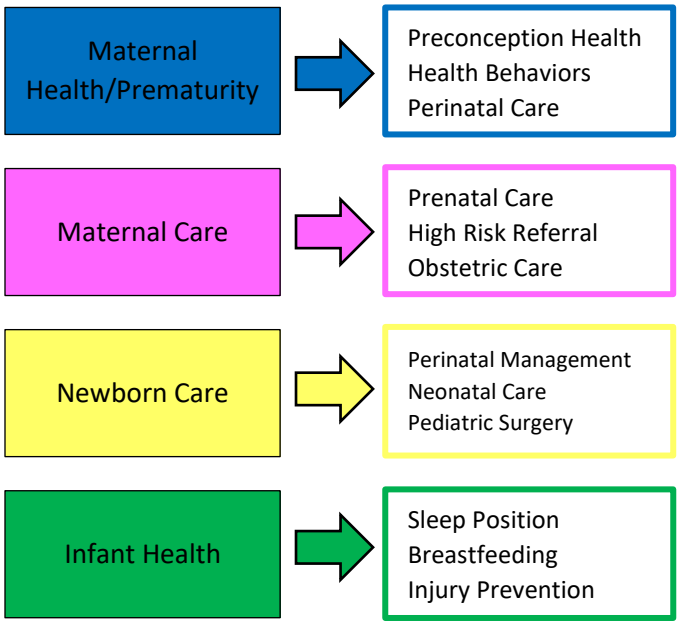


Figure 2 Period of Risk Focus Areas for Intervention

The study population includes PPOR eligible fetal and infant deaths in Clark County, OH and the reference population are eligible deaths in the entire state of Ohio from mothers who are non-Hispanic white, at least 20 years of age, and with at least some

[1] Sappenfield, W. M., Peck, M. G., Gilbert, C. S., Haynatzka, V. R., & Bryant, T., 3rd (2010). Perinatal periods of risk: analytic preparation and phase 1 analytic methods for investigating feto-infant mortality. Maternal and child health journal, 14(6), 838–850. https://doi.org/10.1007/s10995-010-0625-4

[2] Montgomery County Perinatal Periods of Risk Analysis 2014-2017 Report

college education (≥13 years of education). The study population is compared to the reference population to identify the excess deaths and death rates within each period. It is necessary for the study population to have at least 60 feto-infant deaths. For Clark County to meet to minimum requirement, 5 years between 2015-2019 were combined for analysis. There are a total of 62 fetal and infant deaths in the study population.

Phase II dives deeper into the periods with most preventable deaths to identify the specific causes, contributing risk factors, and potential impact of addressing contributing risk factors.

Data Collection

Live births, fetal deaths, and birth-death linked are the three vital record file types that are necessary to complete the PPOR analysis. The study group includes Clark County resident births and deaths occurring between 2015 and 2019. The external reference group of best outcomes includes Ohio resident births and deaths. The following chart shows the criteria for each group.

Study Group Criteria

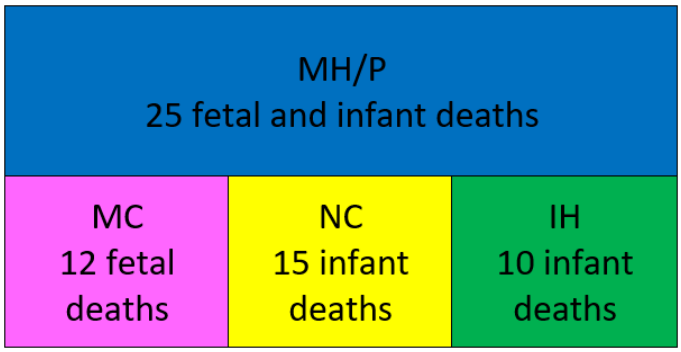
- Fetal deaths (≥500g & ≥24 weeks gestation)
- Infant deaths
- Live births (≥500g & ≥22 weeks gestation)
- Clark County resident
- Occurring between 2015 and 2019

Reference Group Criteria

- Ohio resident
- White, non-Hispanic
- At least 20 years of age
- At least 13 years of education (some college)

Step 1. Mapping Study Group and Reference Group Fetal and Infant Deaths and Calculating Feto-Infant Mortality Rates (FIMRs) for Each Period of Risk

The fetal and infant deaths are mapped into the four periods of risk by gestational age and birth weight for both the study and reference group.

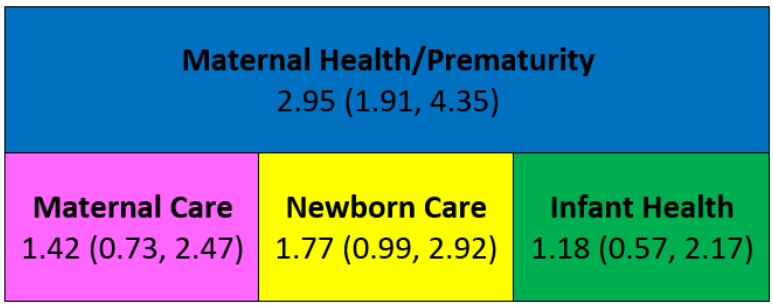


There were 62 Clark County feto-infant deaths. Most deaths occurred within the Maternal Health/Prematurity period. This period includes the babies less than 1500 grams (3.3lbs)

Figure 3 Feto-Infant Death Map, Clark County, 2015-2019

The FIMR is calculated for each period by dividing the number of period deaths by the total number of live births plus fetal deaths. This is completed for the study population and the reference group.

Period FIMR = (Period Deaths / [Live Births + Fetal Deaths]) * 1,000



The overall FIMR is 7.31 deaths per 1,000 live births plus fetal deaths. Among all women in Clark County, the **MH/P** has the highest FIMR at 2.95, followed by the **NC** period at 1.99.

Figure 4 Feto-Infant Mortality Rate by Period of Risk with 95% Confidence Intervals, Clark County, 2015-2019

Step 2. Calculating Excess (Preventable) Death Rates for Study Group and Death Counts for Each Period of Risk

Excess death rates are found by subtracting the reference group FIMR from the study group FIMR.

Preventable FIMR = FIMR Reference – FIMR Study Group

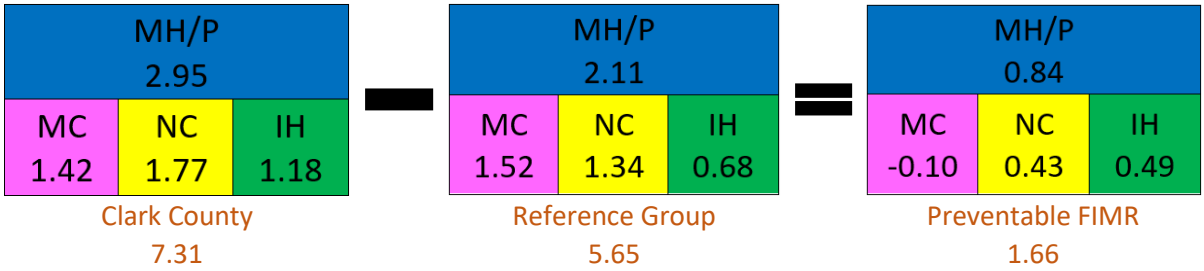
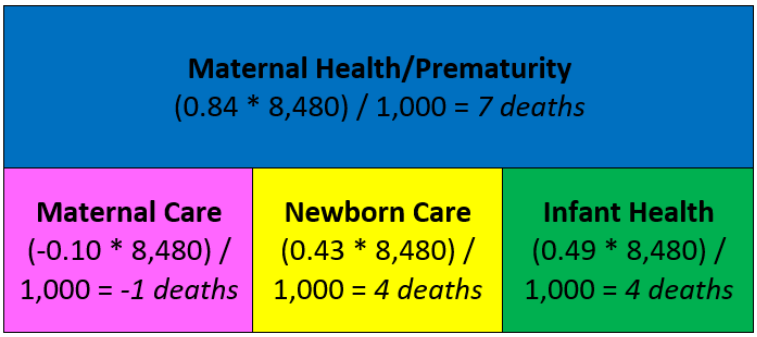


Figure 5 Preventable Feto-Infant Mortality Rates by Period Risk

Note: A negative number or rate means that the study group has a better outcome compared to the reference group

Excess death counts are calculated for each period using the period FIMR.

Preventable Deaths = (Period Preventable FIMR * [Live Births + Fetal Deaths]) / 1000



From 2015 to 2019, an estimated 14 feto-infant deaths could have been prevented in Clark County. The MH/P period accounted for the largest number of preventable deaths (7).

Figure 6 Preventable Feto-Infant Mortality Deaths by Period of Risk

Phase I Discussion

There were 8,480 fetal deaths and live births that fit within the PPOR analysis criteria in Clark County between 2015 and 2019. Of those, there were 25 fetal deaths and 37 infant deaths (62 total deaths). For the reference population, there were 324,100 PPOR eligible live births and fetal deaths. Within this population, there were 787 fetal deaths and 1,045 infant deaths (1,832 total deaths).

The overall FIMR for Clark County was 7.31 compared to the overall FIMR for the reference population of 5.65. Figure 3 shows the FIMR for each period with a 95% confidence interval. The overall rate for Clark County is 1.3x higher than the overall rate for the reference population.

Maternal Health/Prematurity (MH/P) has the highest fetal-infant mortality rate of 2.95, followed by Newborn Care (NC) at 1.77. Clark County Combined Health District and community stakeholders should prioritize decreasing the MH/P period of risk rate. There has been a decrease of 0.08 in the rate from when the PPOR analysis was completed for 2012-2016. However, that time period did not meet the minimum 60 deaths requirement, so accurate comparisons cannot be made.

When looking at preventable, or excess, deaths (Figure 6), Maternal Care (MC) is the only period where the Clark County has a better outcome compared to the reference population. For the other periods Clark County has 7 (MH/P), 4 (NC), and 4 (IH) preventable deaths compared to the reference.

Limitations

A limitation, specific to Clark County, is the inability to make comparisons between identities (i.e., racial background) due to death counts being less than 60 within each racial identity.

Conclusions

Clark County's FIMR (7.31 deaths per 1,000 live birth + fetal deaths) increased form the previous PPOR analysis period (7.05 from 2012-2016). The most preventable fetal and infant deaths occurred within the MH/P period.

Completing Phase I of the PPOR analysis is the first step in the PPOR process. The next section will focus on the Phase II analysis and identifying specific disparities (protective or risk factors) within the MH/P period.

Phase II Background

Phase II investigates the preventative and risk factors that can contribute to opportunity gaps, excess feto-infant mortality identified in Phase I and perinatal risk period(s)[3]. The same vital records used in Phase I are used in Phase II; however, more data elements will be analyzed. Phase II is comprised of the three following steps:

1. Identify pathways or mechanisms for the excess feto-mortality
2. Estimate the prevalence of risk and preventative factors by type of mechanism
3. Estimate the impact of those risk and preventative factors

Investigations conducted within Phase II rarely identify clear contributors, it typically rules out risk and preventative factors that do not contribute. The analyses will not identify new causes, they will identify known causes that are relevant to the community being investigated. Phase II is more exploratory than Phase I. The same initial three datasets are used; however, additional data sources can be utilized. These can include the Pregnancy Risk Assessment Monitoring System (PRAMS), disease reporting systems, hospital discharge records, public health surveillance system data, and more.

Phase II requires more feto-infant deaths than the 60 deaths required in Phase I. Depending on the risk factor prevalence and study parameters, the number of deaths required could be at least 88 in Phase II. While Phase II can still be conducted with less than 88 deaths, the results may be misleading or not lead to definitive conclusions. If possible, increasing the sample size is recommended by combining births and deaths across years, subpopulations, and/or geographic areas.

More in-depth information regarding the Phase II steps and calculations can be found in the *Perinatal Periods of Risk: Phase 2 Analytic Methods for Further Investigating Feto-Infant Mortality* article published by Sappenfield in 2010.

[3] Sappenfield, W. M., Peck, M. G., Gilbert, C. S., Haynatzka, V. R., & Bryant, T., 3rd (2010). Perinatal periods of risk: phase 2 analytic methods for further investigating feto-infant mortality. *Maternal and child health journal*, *14*(6), 851–863. https://doi.org/10.1007/s10995-010-0624-5

Phase II Discussion

The Phase I analysis conducted showed the largest difference within the Maternal Health/Prematurity period when comparing Clark County to the reference group. For this period, all feto-infant deaths and live births are sorted by gestational age and birth weight for the study group and the reference group. A Kitagawa Analysis was conducted to determine whether the cause within the MH/P period is due to birth weight distribution or birth weight specific mortality. Birth weight distribution means there is a higher rate of death due to an increase in the number of very low birth weight births (<1,500g). Birth weight specific mortality means there is a higher rate of death due to a low survival rate of VLBW babies. The Kitagawa Analysis shows that the primary cause within Clark County is the birth weight distribution. Figure 7 shows the percentage breakdown for the two pathways.

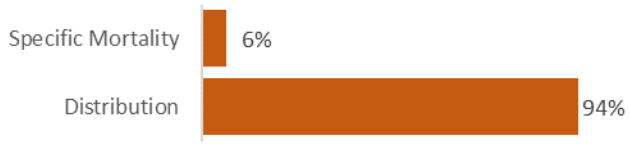


Figure 7 Causal Pathways for Preventable MH/P Deaths, Clark County, 2015-2019

Identifying Factors

Using the vital statistics birth files, behavioral, social, health and/or economic disparities were collected for the live births ≥500g and <1500g. The following factors were analyzed:

Demographic & Clinical

- Teen Mom (≤19 years)
- Older Mom (≥35 years)
- Medicaid Recipient
- WIC Recipient
- Prior Preterm Birth
- Married
- Living within City Limits

Health Behavior

- Overweight/Obese
- Hypertension (Pre-pregnancy/Gestational)
- Diabetes (Pre-pregnancy/Gestational)
- Smoking (During Pregnancy)
- Breastfed
- Sexually Transmitted Diseases
- Inadequate Prenatal Care
- Inadequate Weight Gain

Characteristics of Clark County VLBW births are compared to Clark County births ≥1500g to determine differences in the presence of risk factors. A Population Attributable Risk (PAR) analysis is conducted to estimate the impact of factors on VLBW births. PAR identifies the percentage of a population that can be explained by a certain risk factor. If that risk factor is removed, it is assumed that the VLBW births explained by that risk factor will also be removed.

$$PAR\% = 100 \times P\,(RR - 1) / [1 + P\,(RR - 1)]$$

PAR% = The population attributable risk percentage
P = Proportion of the population with a particular risk factor
RR = Risk ratio

Table 1 provides more information about how each factor is affecting Clark County births. The PAR% values with a negative value or the RR value less than 1 means the risk factor is a protective factor. The PAR% values with a positive value or the RR value greater than 1 means it is a risk factor.

Table 1 Disparities Impacting VLBW Births (<1,500g), Clark County, 2015-2019 (n = 96)

Disparities	PAR%	RR	95% CI	# VLBW Births
Demographic				
Teen Mom (≤19 years)	2.6%	1.6	(0.3, 18.3)	7
Older Mom (≥35 years)	8.6%	1.6	(2.7, 24.2)	21
Medicaid Recipient	2.2%	1.1	(0, 92.9)	32
WIC Recipient	-10.3%	0.6	(-4.1, -28.4)	15
Prior Preterm Birth	14.6%	3.8	(8, 25.2)	19
Married	-23.8%	0.7	(-8.1, -98.3)	54
Living within City Limits	2.3%	1.0	(0, 100)	65
Health Behavior				
Overweight/Obese	6.4%	1.1	(1.3, 75.3)	50
Hypertension (pre-pregnancy)	1.4%	1.5	(0.1, 21.4)	4
Hypertension (gestational)	15.2%	3.0	(8.1, 26.8)	22
Diabetes (pre-pregnancy)	-	-	-	0
Diabetes (gestational)	3.7%	1.6	(0.7, 17.8)	9
Smoking During Pregnancy	7.3%	1.5	(1.9, 24.5)	19
Breastfed	-161.5%	0.2	(-120.4, -231.2)	47
STDs/Hepatitis	7.1%	2.1	(2.5, 18.8)	13
Inadequate Prenatal Care[1]	3.8%	1.4	(0.3, 31.4)	11
Inadequate Weight Gain	32.9%	1.7	(10.0, 68.4)	57

[1]Beginning prenatal care after the fourth month of pregnancy

Interpreting the risk factors most impacting VLBW births:

- VLBW births may have been reduced by an estimated **32.9% (or 57 births)** if all women adequately gained weight during pregnancy.
- VLBW births may have been reduced by an estimated **15.2% (or 22 births)** if all women had a healthy, normal blood pressure during pregnancy.
- VLBW births may have been reduced by an estimated **14.6% (or 19 births)** if all women did not have a previous preterm birth.

Being a WIC recipient, being married, and breastfeeding were found to be protective factors of VLBW births. These protective factors mean that for these births from 2015-2019, these characteristics were found to be associated with reducing a risk factors impact. These protective factors can change over time.

Within Clark County, mothers with a previous preterm birth are 3.8 times likely to have a baby born under 1,500 grams. However, as this is expected, we need to focus on reducing the likelihood of the following risk factors such as gestational hypertension (3.0), STD present and/or treated during pregnancy (2.1), and inadequate weight gain (1.7). Figure 8 shows the risk and protective factors within Clark County. STDs included in this analysis were gonorrhea, syphilis, herpes, chlamydia, hepatitis B, and hepatitis C.

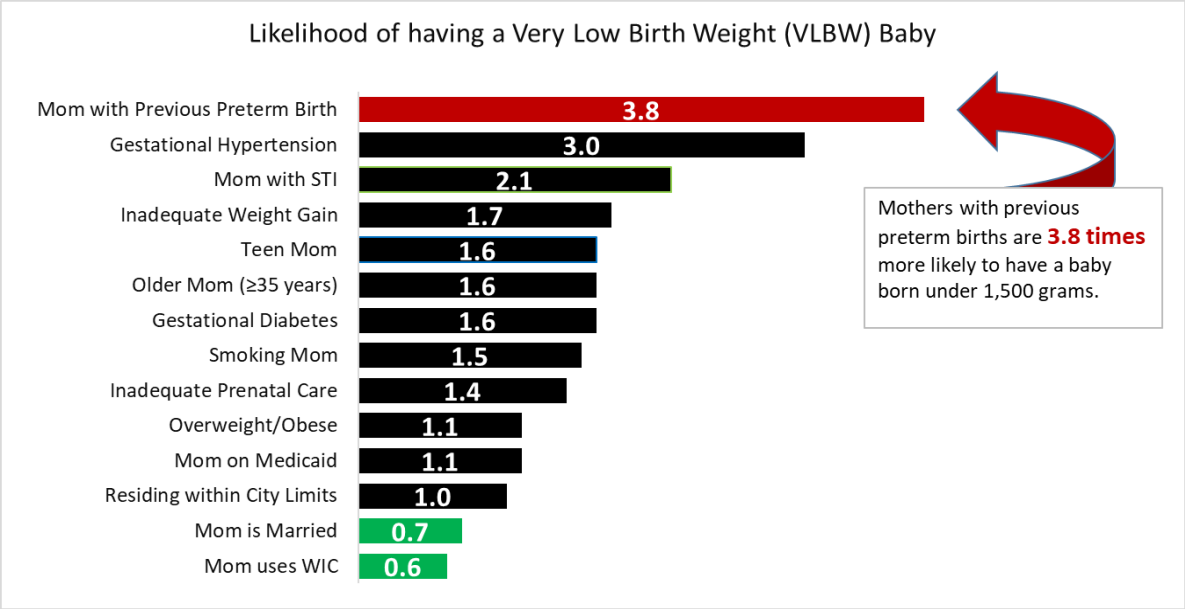


Figure 8 VLBW Likelihood, Clark County, 2015-2019

Prevention and/or Reduction Recommendations

While gestational hypertension is not completely preventable, there are ways to control it based on a physician's recommendations. Some ways to reduce gestational hypertension include drinking at least 8 glasses of water a day, regular exercise, receive adequate rest[4]. Lowering STI/STD infection before and during pregnancy involve getting regularly tested and using condoms during sexual activity. It is normal to gain between 25- and 35-pounds during pregnancy; however, mothers should adhere to their physician's recommendations about the appropriate amount of weight to be gained as this is dependent on their pre-pregnancy BMI.

Reducing deaths within the MH/P period should focus on enhancing outreach to women before or between pregnancies (preconception/inter-conception care).

1. Implement preconception health screening tools and curricula
2. Target healthy behaviors (smoking/drug/alcohol cessation, nutrition, fitness, healthy sexual behaviors
3. Implement specialized perinatal care

[4] https://americanpregnancy.org/healthy-pregnancy/pregnancy-complications/gestational-hypertension/

Limitations

One of the limitations of the PPOR analysis is that it does not include fetal and infant deaths with a gestational age less than 24 weeks and a birth weight less than 500g. The exclusion of these deaths is for quality purposes for the sake of analysis but may result in an under-estimation of mortality rates and/or rates of contributing risk and protective factors. The second limitation is due to missing or insufficient data on birth and death records, there may be disparities that are not analyzed.

Birth Weight	Live Births	Infant Deaths	Fetal Deaths (24+wks)
500-749g	21	6	5
750-999g	32	2	2
1,00-1,249g	16	3	5
1,250-1,499g	25	1	1
1,500-1,999g	132	6	5
2,000-2,499g	440	3	2
2,500g+	7,789	16	5
Total PPOR Valid	**8,455**	**37**	**25**

Table 2 Feto-Infant Deaths and Live Births by Birth Weight, Clark County, 2015-2019

PPOR Conclusion

Most of the preventable fetal and infant deaths within Clark County occurred within the MH/P period. These deaths are attributed to an increase in the number of VLBW babies, based on the Kitagawa analysis. Among all women, some contributing factors were gestational hypertension, STI infection, and inadequate weight gain. The full list of factors can be viewed in Table 1 or Figure 8.

While completing this analysis is the first step, it is important to develop strategic actions for prevention once results are determined and presented. These findings can be used to strengthen infant mortality reduction initiatives or launch new prevention programs.

Definitions

Cessation: A reduction in usage or complete stoppage

Fetal Death: A fetus born without signs of life

Fetal Mortality Rate (FMR): The number of fetal deaths per 1,000 live births plus fetal deaths

Gestational Diabetes: Diabetes diagnosed for the first time during pregnancy

Gestational Hypertension: A form of high blood pressure in pregnancy, can develop into preeclampsia

Infant Mortality (IM): The death of a live-born baby before their first birthday

Infant Mortality Rate (IMR): The number of infant deaths per 1,000 live births

Protective Factor: A characteristic at the biological, psychological, cultural level that is associated with a lower likelihood of problem outcomes

Risk Factor: A characteristic at the biological, psychological, cultural level that is associated with a higher likelihood of problem outcomes

Very Low Birth Weight (VLBW): A baby born under 1,500 grams