

Perinatal Periods of Risk (PPOR) Analysis Denver, 2005-2010

Phase I

I. Introduction

The death of an infant or loss of a developing fetus is always devastating. Unfortunately, African American/Black women are significantly more likely to experience this type of loss. In 2011, the Centers for Disease Control reported that in the United States, the infant mortality rate, defined as any death from birth to 1 year of age, among black babies was 2.2 times higher than that of white babies (11.4 infant deaths per 1,000 live births vs. 5.1, respectively). A similar rate ratio is apparent in Denver with approximately two black infant deaths for every one white infant death recorded over the past 10 years. Although infant mortality rates have been steadily declining in Colorado over the past 15 years, the rate of decline is markedly slower in the county of Denver and racial disparities still persist.

This report summarizes a unique methodology used to investigate disparities in fetal-infant mortality (Perinatal Periods of Risk analysis), presents published results to date, and presents and discusses analytic results using the most recent Denver data. The report concludes with a summary of these analyses, recommendations and a series of next steps.

Introduction to Perinatal Periods of Risk (PPOR)

Infant mortality rates tell only part of the story. These rates do not include fetal deaths and they do not stratify based on infant weight at birth or gestational age at death. The Perinatal Periods of Risk (PPOR) uses this critical information to help us understand factors associated with both infants deaths (after a live birth) and fetal losses (miscarriages).

PPOR results can be helpful as the community works to create meaningful, effective prevention efforts to close the disparity in fetal-infant mortality, a priority of Denver Public Health's Maternal Child Health (MCH) Program.

PPOR is a unique analytic approach for several reasons:

- All fetal deaths (≥ 500 grams) with a gestational age of 24 weeks or greater are included.*
- Based on weight and gestational or infant age at death, each event is categorized according to the opportunity for prevention (Figure 1);
- The approach is grounded in the principles of social justice and posits: if one population group can experience low fetal-infant mortality rates, all population groups should be able to achieve that same rate. Accordingly, the referent group against which all others are compared is chosen at the discretion of the analytic team but should be one that experiences very low fetal-infant mortality rates.

** The earliest and smallest fetal losses are not included because intervention is generally not possible and reporting is not uniform.*

"What is PPOR?"

"The Perinatal Periods of Risk (PPOR) is a comprehensive approach for addressing high infant mortality rates and disparities in those rates. Adapted by CityMatCH and the CDC from the periods of risk approach used in developing nations, PPOR is detailed in a suite of articles in the Maternal and Child Health Journal.

PPOR brings community stakeholders together to build consensus, support, and partnership around vital records data, which are collected for (nearly) every birth, infant death and fetal death in the US. Designed as a "data to action" tool for use in US cities, PPOR has also been used successfully by Healthy Start sites, suburban counties, groups of rural counties, and tribal organizations. It has even become a common part of state infant mortality surveillance. All six stages of the PPOR process (readiness, data analysis, planning, implementation, evaluation and re-investment) contribute to making data a powerful agent for systems change, but at the core of PPOR are its analytic methods."

CityLights, Celebrating the 15th Anniversary of PPOR's Conception, Vol 20, No. 3, Fall 2012

Figure 1: Categories of Risk and Corresponding Opportunities for Prevention Used in Perinatal Periods of Risk (PPOR) Analysis

Maternal Health/Prematurity (Blue) Fetal (>24 weeks) & infant deaths (0-364 days) between 500-1499 grams Prevention focus: maternal chronic disease prevention and management, maternal health behaviors and perinatal care of the infant		
Maternal Care (Pink) Fetal death (>24 weeks), ≥ 1500 grams Prevention focus: Prenatal care, high-risk referral and obstetric care	Newborn Care (Yellow) Neonatal death (0-27 days), ≥ 1500 grams Prevention focus: Perinatal and neonatal care and pediatric surgery	Infant Health (Green) Perinatal death (28-364 days), ≥ 1500 grams Prevention focus: Sleep-related death, injury and infection

As deaths and fetal losses are categorized according to PPOR methodology, excess risk in each category can be linked to associated factors and appropriate prevention measures (Figure 1). For example, excess death in **Maternal Health/Prematurity (blue box)** can be attributed to a mother’s pre-conception health and/or perinatal care suggesting efforts to promote healthy eating and active living before pregnancy or educating pregnant women about perinatal care. Similarly, excess death in **Infant Health (green box)** is associated with the care of the infant and may be mitigated by education efforts about safe sleeping practices or facilitating access to regular well-child health care.

PPOR Results to Date

Denver: PPOR Rates over Time

In Denver, the overall fetal-infant mortality rate from 2005 to 2010 has improved, compared to the rate reported from 1997 to 2002 (Table 1). Overall, rates have fallen by approximately 9% with the biggest improvements (29%) among infants aged 29 to 364 days.

Table 1: Fetal-Infant Mortality Rate* (PPOR Analysis), Denver

	1997-2002**	2005-2010***	% Change
Maternal Health/Prematurity (Blue)	3.3	3.2	-3%
Maternal Care (Pink)	2.4	2.1	-13%
Newborn Care (Yellow)	1.2	1.4	+17%
Infant Health (Green)	1.7	1.2	-29%
Total	8.6	7.8	-9%

*per 1,000 live births and fetal deaths

** Source: Infant Mortality in Colorado, Trends, 1990-2002

*** Source: Vital Statistics, Colorado Department of Public Health and Environment

Denver Compared to Neighboring Counties and Colorado

When comparing Denver PPOR rates to the state as a whole (Table 2), it is clear that the fetal-infant mortality rate due to **Maternal Health/Prematurity (blue box)** is higher in Denver. When comparing Denver County to Douglas County, Denver fares worse overall (7.8 vs. 5.2 deaths per 1,000 live births/fetal deaths) and in all categories, particularly **Maternal Health/Prematurity (blue box)**. Denver and Adams Counties are more similar, although Denver's mortality rate due to **Maternal Health/Prematurity (blue box)** appears to be higher.

Table 2: Fetal-Infant Mortality Rate* (PPOR Analysis), Colorado: 2005 to 2010

	Colorado	Denver	Douglas	Adams
Maternal Health/Prematurity (Blue)	2.7	3.2	2.0	2.9
Maternal Care (Pink)	1.9	2.1	1.4	2.1
Newborn Care (Yellow)	1.3	1.4	1.0	1.6
Infant Health (Green)	1.4	1.2	0.8	1.4
Total	7.0	7.8	5.2	8.1

*per 1,000 live births and fetal deaths

Source: Vital Statistics, Colorado Department of Public Health and Environment

Denver and Colorado Compared to the United States

Excess rates generated through perinatal periods of risk analyses are not currently used for systematic surveillance on a national level. However, a report prepared for the March of Dimes Perinatal Data Center using vital statistics data from 2000 to 2002 allows for some comparisons (Table 3). Overall, the US fared worse than Colorado (9.1 vs. 8.0 deaths per 1,000 live births/fetal deaths), but Denver rates were slightly worse than the state (8.4 vs. 8 deaths per 1,000 live births/fetal deaths). Regardless of geographic stratification, rates due to **Maternal Health/Prematurity (blue box)** factors were highest, followed by rates of death due to factors associated with **Maternal Care (pink box)**.

Table 3: Fetal-Infant Mortality Rate* (PPOR Analysis), United States, Colorado and Denver: 2000 to 2002

	US	Colorado	Denver
Maternal Health/Prematurity (Blue)	3.7	3.2	3.9
Maternal Care (Pink)	2.2	2.1	2.0
Newborn Care (Yellow)	1.3	1.2	1.1
Infant Health (Green)	1.8	1.5	1.4
Total	9.1	8.0	8.4

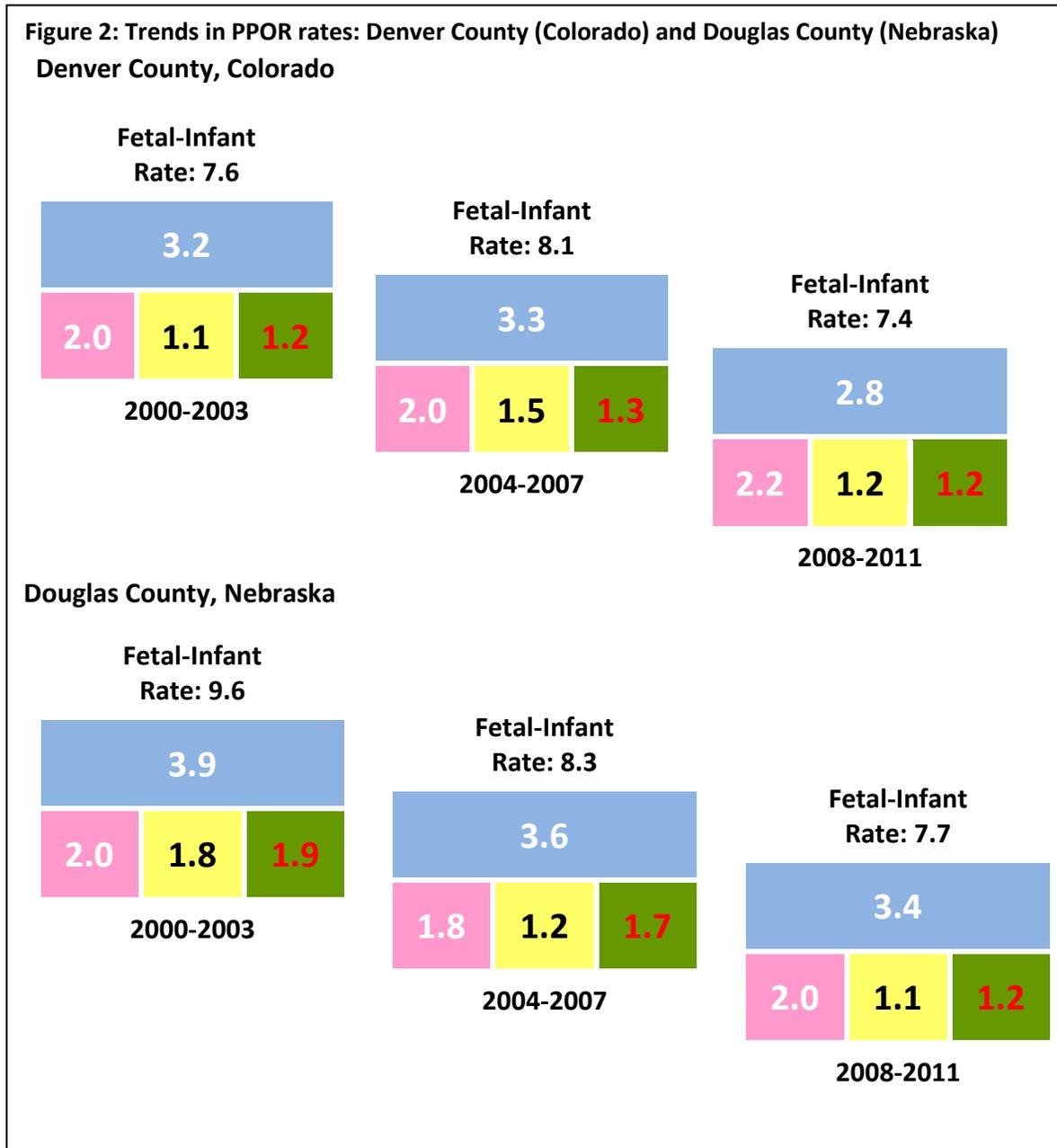
*per 1,000 live births and fetal deaths

Source: National Center for Health Statistics

Denver Compared to Douglas County, Nebraska

The PPOR methodology was developed with guidance from MCH advocates at CityMatCH which is located in Omaha, Nebraska. As a result, infant mortality has been well-studied in Douglas County, Nebraska (Omaha). Although significant demographic differences exist between Douglas County, NE and Denver County in terms of the Hispanic population (12% of Douglas County residents report Hispanic ethnicity compared to 32% in Denver), the proportion reporting African American/Black ethnicity is comparable at 12% and 10% respectively. Further, robust estimates are available for each category of the PPOR analysis and allow for interesting comparisons.

Over the last ten years, fetal-infant mortality rates in Douglas County, NE have been falling and those in Denver appear variable (figure 2). However, with the exception of rates due to **Maternal Care** (pink box), which are about the same in both locations, rates in Denver are consistently lower than those in Douglas County, NE.



II. Methods

In 2003, the Colorado Department of Public Health and Environment (CDPHE) released a comprehensive report, *Infant Mortality in Colorado* (see Table 1), which included county-specific Perinatal Periods of Risk (PPOR) analyses from 1997 to 2002. Using more recent data, we build upon that report and examine infant and fetal deaths in Denver by race/ethnicity, age and geography.

We chose the years 2005 through 2010 to provide an adequate number of events and assure reliable rates. During this time:

- 60,138 Denver women gave birth;
- 278 infant (500 grams and greater) death certificates were filed for babies who died between 0 and 364 days after birth;
- 192 fetal deaths (500 grams or greater) with an estimated gestational age of 24 weeks or greater were reported.

Depending on the disparity under examination, different referent groups were selected. As we examined each trait or condition, we choose a comparison group that would show us the biggest difference from the study group. Highlighting this difference is at the core of the PPOR method: if one group can have a low rate of infant mortality and fetal loss, why cannot any other group?

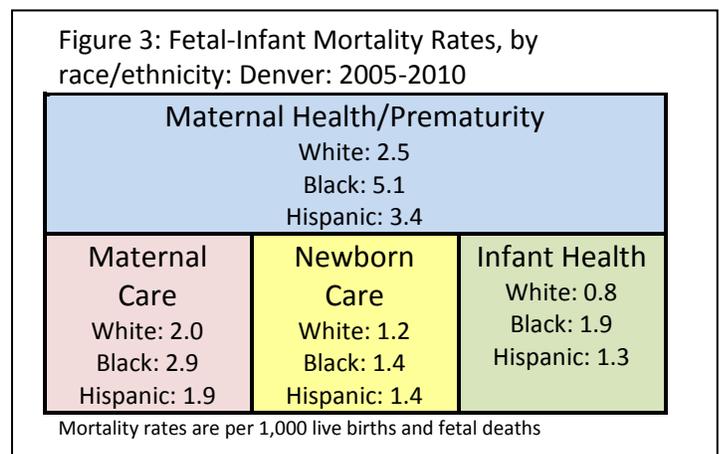
The number of events of deaths or losses are important not as pure rates or incidence, but in the context of an analysis that compares mortality among the most vulnerable groups to that of the most healthy (the referent group). The purpose of PPOR is to identify the “opportunity gap” generated by health disparities with regard to fetal loss and infant death – both of which are highly sensitive to social determinants of health.

III. Results

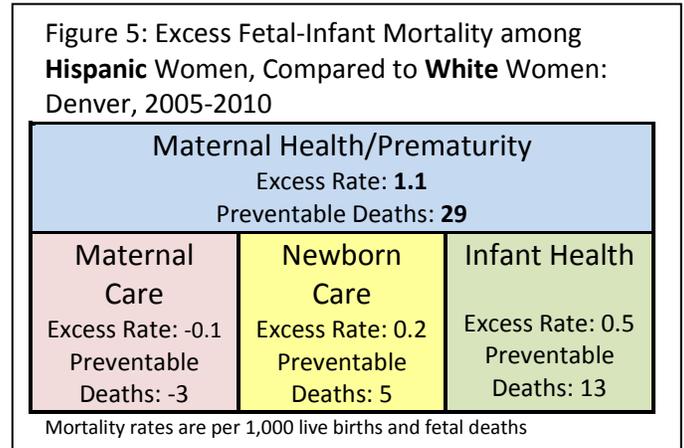
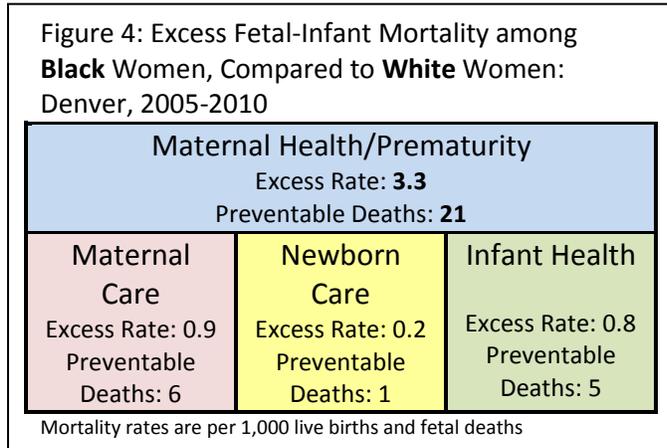
Fetal-infant Mortality Rates by race/ethnicity, Denver, 2005-2010: non-Hispanic White Referent Group

There is a large body of evidence to support the fact that white, non-Hispanic women experience more favorable birth outcomes than women of other racial/ethnic backgrounds, especially African American/Black women. We therefore compared this group (white non-Hispanic) to Hispanic and African American/Black women (we omitted all other races as the number of events was not adequate to produce reliable estimates). * Rates per PPOR category and race/ethnicity are shown at right (figure 3).

** Data on race/ethnicity for fetal loss and infant death comes from vital records (birth certificates, death certificates and fetal loss certificates). The mother’s race/ethnicity is recorded which is then the assumed race/ethnicity of the baby or fetus.*



Overall, the fetal-infant mortality rate among white women is 6.5 per 1,000, 8.0 among Hispanic women and 11.3 among black women. The burden varies by PPOR category and can be expressed as excess mortality rate and number of preventable deaths (from 2005 to 2010) as follows:



Maternal Health/Prematurity (blue box) comparing white women to black women: The excess mortality rate is 3.3, which means that there are 3.3 fetal/infant deaths among black women for every one fetal/infant death among white women. This translates to 21 preventable deaths from 2005 to 2010 among black babies. Although the excess rate among Hispanic women is not as high (1.1 deaths per 1,000 live births and fetal deaths), Hispanics comprise a greater proportion of births in Denver so the rate translates into 29 preventable deaths. The differences in mortality indicate a need for improving preconception health and addressing social determinants of health.

Maternal Care (pink box) comparing black women and Hispanic women to white women: The excess rate of fetal death attributable to medical care is approximately 1 excess death among black women for every fetal death experienced by white women resulting in 6 preventable fetal deaths from 2005 to 2010. This suggests a need for increased prenatal care in this population, especially for high-risk pregnancies. There is no difference between white and Hispanic women for deaths attributed to **Maternal Care (pink box)**.

Newborn Care (yellow box): No difference from this data could be detected with respect to outcomes associated with the medical care of the newborn. This may suggest consistent access to appropriate medical care for neonates among all Denver mothers, and/or protective factors in some groups (such as high social support during pregnancy).

Infant Health (green box) comparing black women and Hispanic women to white women: Deaths attributable to infant health show there is an excess mortality of 0.8 among black infants and 0.5 among Hispanic infants compared to whites resulting in 5 and 13 infant deaths respectively from 2005 to 2010. Future analyses are planned to more closely examine factors associated with these differences, specifically, protective factors such as breastfeeding, injury prevention and sleeping practices.

Rates by age, Denver, 2005-2010: Women aged 20-34 as Referent Group

Young mothers are often at high risk for adverse birth outcomes for several reasons. Pregnancies are more likely unintended and young mothers often lack experience and financial and social supports that improve the chances of a healthy pregnancy and baby. Conversely, older mothers often gain maturity and experience and may be more socially and financially stable which increases the chances of a healthy pregnancy but potentially have increased chances of adverse events due to age. As a result, we chose women between the ages of 20 and 34 as the referent population for this analysis.

Figure 6: Fetal-Infant Mortality Rates, Denver: 2005-2010

Maternal Health/Prematurity Age 20-34: 2.8 Age <19: 6.5 Age 35+: 2.5		
Maternal Care Age 20-34: 2.1 Age <19: 0.9 Age 35+: 2.5	Newborn Care Age 20-34: 1.3 Age <19: 1.9 Age 35+: 1.6	Infant Health Age 20-34: 1.3 Age <19: 2.0 Age 35+: 0.4

Mortality rates are per 1,000 live births and fetal deaths

Overall, unadjusted fetal-infant mortality rates are highest among teenagers (11.3 per 1,000), and approximately the same among 20-34 year olds (7.5 per 1,000) and those aged 35 or greater (7.0 per 1,000) (Figure 6). However, significant differences emerge when examining excess mortality by PPOR categories (Figures 7 and 8).

Figure 7: Excess Fetal-Infant Mortality among **Teenagers**, Compared to Women aged **20 to 34**: Denver, 2005-2010

Maternal Health/Prematurity Excess Rate: 3.7 Preventable Deaths: 24		
Maternal Care Excess Rate: -1.2 Preventable Deaths: -7	Newborn Care Excess Rate: 0.6 Preventable Deaths: 4	Infant Health Excess Rate: 0.7 Preventable Deaths: 5

Mortality rates are per 1,000 live births and fetal deaths

Figure 8: Excess Fetal-Infant Mortality among Women aged **35 or Greater**, Compared to Women aged **20 to 34**: Denver, 2005-2010

Maternal Health/Prematurity Excess Rate: -0.3 Preventable Deaths: -3		
Maternal Care Excess Rate: 0.4 Preventable Deaths: 5	Newborn Care Excess Rate: 0.3 Preventable Deaths: 4	Infant Health Excess Rate: -1.0 Preventable Deaths: -10

Mortality rates are per 1,000 live births and fetal deaths

Maternal Health/Prematurity (blue box) comparing teenagers and those aged 35 or greater to those aged 20-34: The largest disparity in mortality exists between teenagers and those aged 20 to 34. There was an excess of 3.7 infant deaths/fetal losses among Denver teenagers, translating to 24 preventable deaths from 2005 to 2010. The differences between women aged 20-34 and older women are negligible.

Maternal Care (pink box) comparing teenagers and those aged 35 or greater to those aged 20-34: A teen birth in this category is protective compared to those women aged 20 to 34. However, there is a slightly elevated risk among older mothers.

Newborn Care (yellow box) comparing teenagers and those aged 35 or greater to those aged 20-34: Excess mortality due to perinatal and neonatal care is slightly elevated for teenagers and for older mothers compared to women aged 20 to 34.

Infant Health (green box) comparing teenagers and those aged 35 or greater to those aged 20-34: Excess deaths attributable to infant care are more likely to occur among teenagers and less likely to occur among women 35 and greater, compared to women aged 20 to 34.

Rates by location (council district), Denver, 2005-2010: Low Mortality Districts as Referent Group

In 2012, in collaboration with key community stakeholders, Denver Public Health released the *Health of Denver, 2011*, to examine trends in the burden of conditions that affect the health of Denver residents. To facilitate substantive discourse, analyses were mapped by Council District when possible (Figure 9).

Similarly, in these analyses, we examined the fetal-infant mortality rates by council district and, to assure an adequate number of events for analysis, we categorized council districts in three tiers; low, medium or high fetal-infant mortality rates. Those districts with the lowest rate serve as the referent group.

Figure 9:

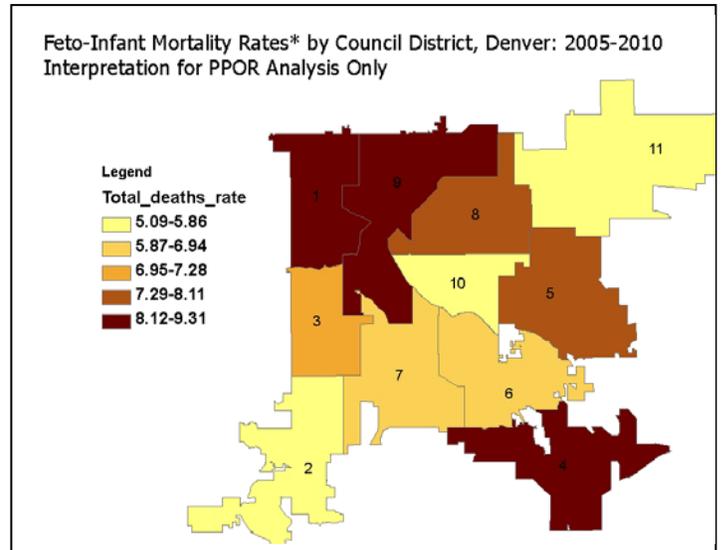


Figure 10: Fetal-Infant Mortality Rates, by Council Districts: Denver: 2005-2010

Maternal Health/Prematurity		
Lowest rates: 1.9		
Mid Rates: 2.8		
Highest rates: 4.2		
Maternal Care	Newborn Care	Infant Health
Lowest rates: 1.6	Lowest rates: 1.2	Lowest rates: 0.9
Mid Rates: 2.3	Mid Rates: 1.2	Mid Rates: 0.9
Highest rates: 2.1	Highest rates: 1.4	Highest rates: 1.2

Mortality rates are per 1,000 live births and fetal deaths

Council districts 2, 10 and 11 have the lowest fetal-infant mortality rate of 5.6 deaths per 1,000 births followed by districts 3, 5, 6 and 7 with a rate of 7.2 per 1,000 (Figure 10). The group of council districts with the highest combined rate (8.9 per 1,000) includes 1, 4, 8 and 9.

Figure 10: Excess Fetal-Infant Mortality among **Mid-rate** Districts, Compared to **Low-rate** Districts: Denver, 2005-2010

Maternal Health/Prematurity		
Excess Rate: 0.9		
Preventable Deaths: 20		
Maternal Care	Newborn Care	Infant Health
Excess Rate: 0.7	Excess Rate: 0.0	Excess Rate: 0.0
Preventable Deaths: 15	Preventable Deaths: 0	Preventable Deaths: 0

Mortality rates are per 1,000 live births and fetal deaths

Figure 12: Excess Fetal-Infant Mortality among **High-rate** Districts, Compared to **Low-rate** Districts: Denver, 2005-2010

Maternal Health/Prematurity		
Excess Rate: 2.3		
Preventable Deaths: 45		
Maternal Care	Newborn Care	Infant Health
Excess Rate: 1.5	Excess Rate: 0.2	Excess Rate: 0.3
Preventable Deaths: 10	Preventable Deaths: 4	Preventable Deaths: 6

Mortality rates are per 1,000 live births and fetal deaths

Maternal Health/Prematurity (blue box) comparing mid-rate and high-rate districts to low-rate districts: The fetal-infant mortality rates in the mid-rate and high-rate districts compared to those in the low-rate districts indicate an excess of 0.9 and 2.3 preventable deaths respectively for every demise among mothers living in council districts with the lowest rates (Figures 11 and 12).

Maternal Care (pink box) comparing mid-rate and high-rate districts to low-rate districts: Similarly, there is an excess mortality rate of 0.7 deaths in the mid-rate districts and 1.5 deaths in the high-rate districts, resulting in a combined 25 (15 and 10 respectively) preventable deaths in this category.

Newborn Care (yellow box) comparing mid-rate and high-rate districts to low-rate districts: Mortality among neonates is similar among all women in Denver regardless of what council district they live in, indicating reasonably consistent access to care for babies less than 28 days old.

Infant Health (green box) comparing mid-rate and high-rate districts to low-rate districts: Infant death rates indicate there is no excess mortality when comparing the rates among mid-rate districts with low-rate districts. There is a slightly elevated risk of mortality when comparing rates in the high-rate districts to the referent group.

IV. In Conclusion

Summary of Results and Recommendations

The results of these PPOR analyses are validated by comparisons with traditional infant mortality analyses, with the relationship of the disparities consistent in both. It is widely reported that black mothers experience poorer birth outcomes than white mothers throughout Colorado and the United States. Likewise, it is well-known that teen-aged mothers are more likely to experience adverse birth outcomes than their older counterparts. The same relationships are evident in the PPOR analyses. However, through PPOR, we are able to parse out these relationships by the type of death which presents two advantages: 1) it allows further analyses of the “opportunity gaps” and 2) it allows us to interpret these analyses within the context of potential preventive efforts.

Maternal Health/Prematurity (blue box)

Our most important findings are that, regardless of how data is stratified for analysis: 1) the burden of fetal-infant mortality is consistently and clearly attributable to factors associated with **Maternal Health/Prematurity (blue box)**, and 2) that burden is disproportionate for black and Hispanic mothers (compared to white), teen mothers (compared mothers in their 20's and 30's) and those mothers that comprise the Denver council districts with the poorest birth outcomes. These findings direct us to focus further analyses and our community engagement efforts to prevention strategies that focus on preconception and maternal health in these disproportionately affected populations. Strategies might focus on healthy lifestyle behaviors, avoiding unintended pregnancies, and adequate weight gain during pregnancy. In addition, systematic improvement of entry into and long-term retention in care of reproductive-aged women in these populations has the potential to improve birth outcomes.

Maternal Care (pink box)

The degree of disparity for deaths and losses related to **Maternal Care (pink box)** was distinguished in two ways: 1) the disparity was always smaller than for Maternal Health/Prematurity, and 2) the disparity varied depending on the referent group being used. With a focus on prenatal care of the mother and adequate identification and/or referral of high-risk pregnancies and obstetric care, these findings suggest targeted prevention efforts by geographic region or sub-population.

Newborn Care (yellow box)

These analyses revealed little disparity in deaths due to factors associated with **Newborn Care (yellow box)**. It is possible that we did not analyze the data in a way that could reveal at-risk populations. Conversely, access to neonatal health care in the Denver-metro area may be available to most mothers, regardless of age, race or location.

Infant Health (green box)

In our analysis of Denver fetal-infant mortality, the degree of disparity for deaths and losses related to **Infant Health (green box)** was distinguished in two ways: 1) the disparity was always smaller than for Maternal Health/Prematurity, and 2) the disparity varied depending on the referent group being used. With a focus on prevention efforts to improve infant health such as adequate access to health care, educational efforts about breast-feeding and safe-sleep practices, these findings suggest targeted prevention efforts by geographic region or sub-population. Additionally, potential improvement in outcomes may come with improved access to resources such as WIC and those that address maternal mental health post-partum.

Next Steps

PPOR analyses are conducted as a part of the community engagement process. Accordingly, the next phase of PPOR will be comprised of parallel efforts to identify the greatest risk factors contributing to the disparity in fetal-infant deaths and engage stakeholders and community members in identifying remedies that are acceptable to the community. In this way, commitment to reduce infant mortality health disparities is gradually transferred to a growing number of health equity champions in the community. To do this we will:

- Share and discuss the initial findings with:
 - Community leaders,
 - Local medical community and
 - Public health stakeholders and partners.
- Create an advisory group to:
 - Engage the community,

- Review initial findings,
- Inform continued analyses and
- Establish a plan to address the identified issues.

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