**2020 Public Health Leaders' Conference**

**Advancing Health Equity**

**Perinatal Periods of Risk:**
**Analysis of Fetal-Infant Mortality in NC, 2014-2017**

**Vito Di Bona, MS**
**State Center for Health Statistics**

**January 23, 2020**

# Presentation Road Map

- Perinatal Periods of Risk (PPOR) Background:      10m

- Pause/Discuss/Stretch      2m

- Analytic Prep and PPOR Phase 1 Analysis:      15m
  - Calculate state mortality map
  - Make mortality maps for subgroups
  - Select reference population
  - Calculate excess mortality

- Pause/Discuss/Stretch      2m

- PPOR Phase 2 Analysis:      15m
  - Identify causes of excess mortality
  - Evaluate prevalence of risk factors
  - Estimate the impact of risk factors/interventions

- Pause/Discuss/Stretch      2m

- Closing Thoughts and Questions      10m

# PPOR Background



North Carolina Infant Mortality Rates by County
2013 - 2017

Rates Per 1,000 Live Births
- 3.9 - 6.2
- 6.3 - 7.5
- 7.6 - 9.7
- 9.8 - 18.2
- Suppressed*
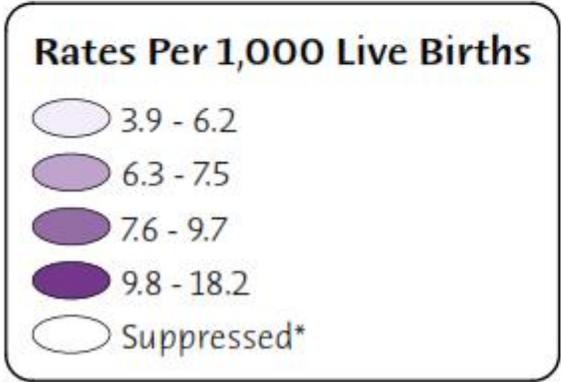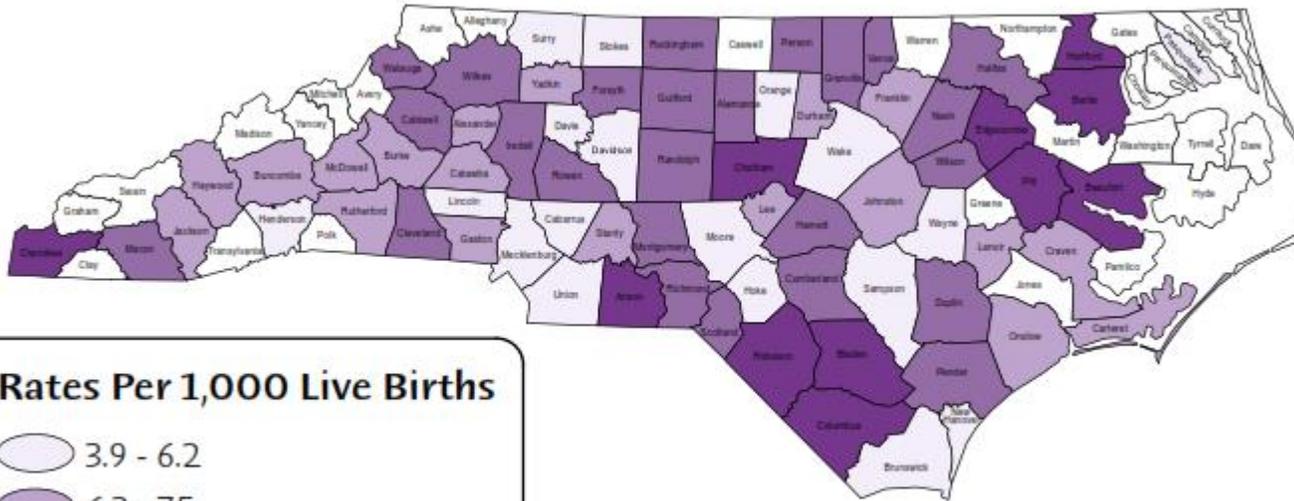
* Rates based on less than 10 deaths are unreliable and have been suppressed.

# PPOR Background



Infant Mortality by Race/Ethnicity 2010-2018
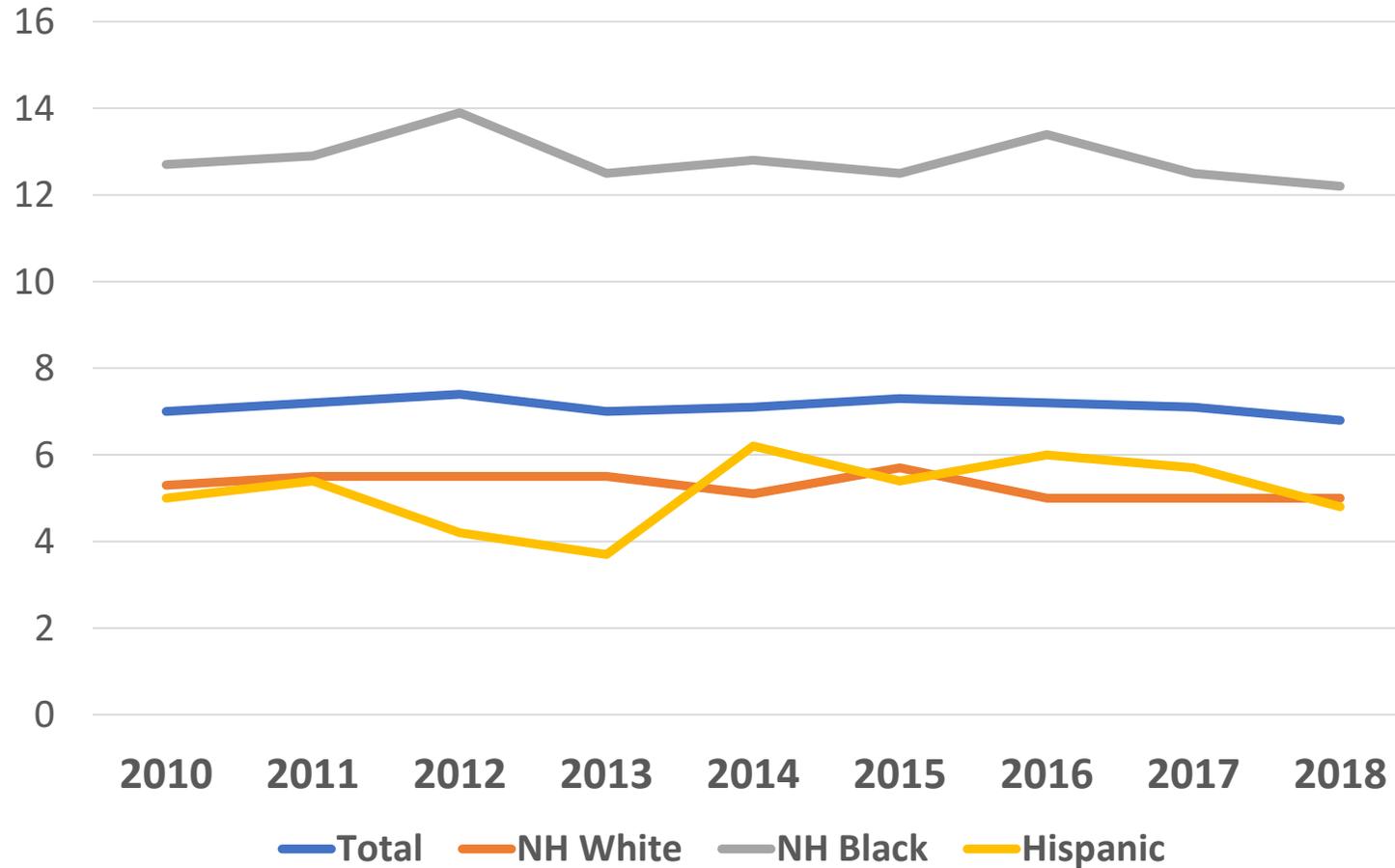
# PPOR Background



Fetal Death Rates by Race/Ethnicity 2010-2018
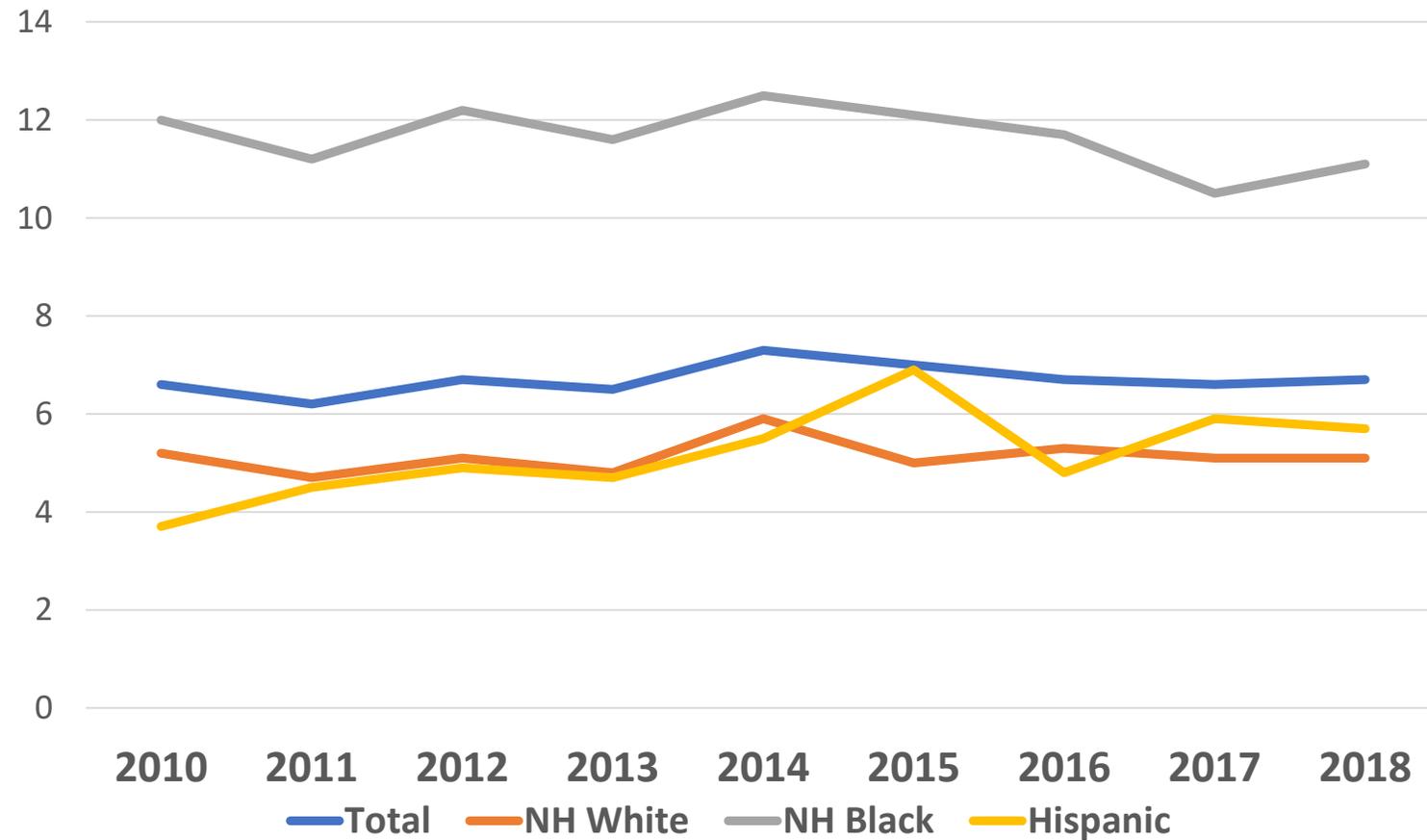
# PPOR Background

HEALTHY NORTH CAROLINA 2020:
## A Better State of Health

**RACIAL AND ETHNIC HEALTH DISPARITIES IN NORTH CAROLINA**

NORTH CAROLINA HEALTH EQUITY REPORT 2018

NC DEPARTMENT OF
**HEALTH AND HUMAN SERVICES**
Office of Minority Health and Health Disparities

**MATERNAL AND CHILD HEALTH**

| Maternal/Child Health Indicators | Total | White | African American | | American Indian | | Hispanic/Latinx | | Other | |
|---|---|---|---|---|---|---|---|---|---|---|
| | %/Rate | %/Rate | %/Rate | Disparity Ratio | %/Rate | Disparity Ratio | %/Rate | Disparity Ratio | %/Rate | Disparity Ratio |
| Infant Death Rate (per 1,000 live births), 2012-16 [10] | 7.2 | 5.4 | 13.0 | 2.4 | 9.0 | 1.7 | 5.1 | 0.9 | 5.3 | 1.0 |
| Low Birth Weight (<=2500 grams) Births (%), 2014-16 [11] | 9.1 | 7.5 | 14.1 | 1.9 | 12.0 | 1.6 | 7.0 | 0.9 | 8.6 | 1.1 |
| Late or No Prenatal Care (%), 2014-16 [11] | 30.6% | 23.9% | 39.1% | 1.6 | 35.9% | 1.5 | 41.1% | 1.7 | 32.6% | 1.4 |
| Maternal Smoking During Pregnancy (%), 2014-16 [11] | 9.4% | 11.9% | 9.0% | 0.8 | 23.1% | 1.9 | 1.7% | 0.1 | 1.6% | 0.1 |

■ Green indicates a group is faring better than the referent group
■ Red indicates a group is faring worse than the referent group
□ White indicates there is no significant difference between the referent and comparison group

# PPOR Background

# Perinatal Periods of Risk Methodology

- **Analytic Preparation**
  Acquire, access and process Vital Records

- **Phase 1 Analysis**
  Identify the populations and periods of risk with the largest excess mortality

- **Phase 2 Analysis**
  Explain why the excess deaths occurred and direct prevention efforts

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- Closing Remarks and Questions    10m

# PPOR: Analytic Preparation

- **481,388 Birth Records**

- **1,923 Fetal Death Records**

- **2,427 Infant Death Records**

# PPOR: Phase 1 Analysis
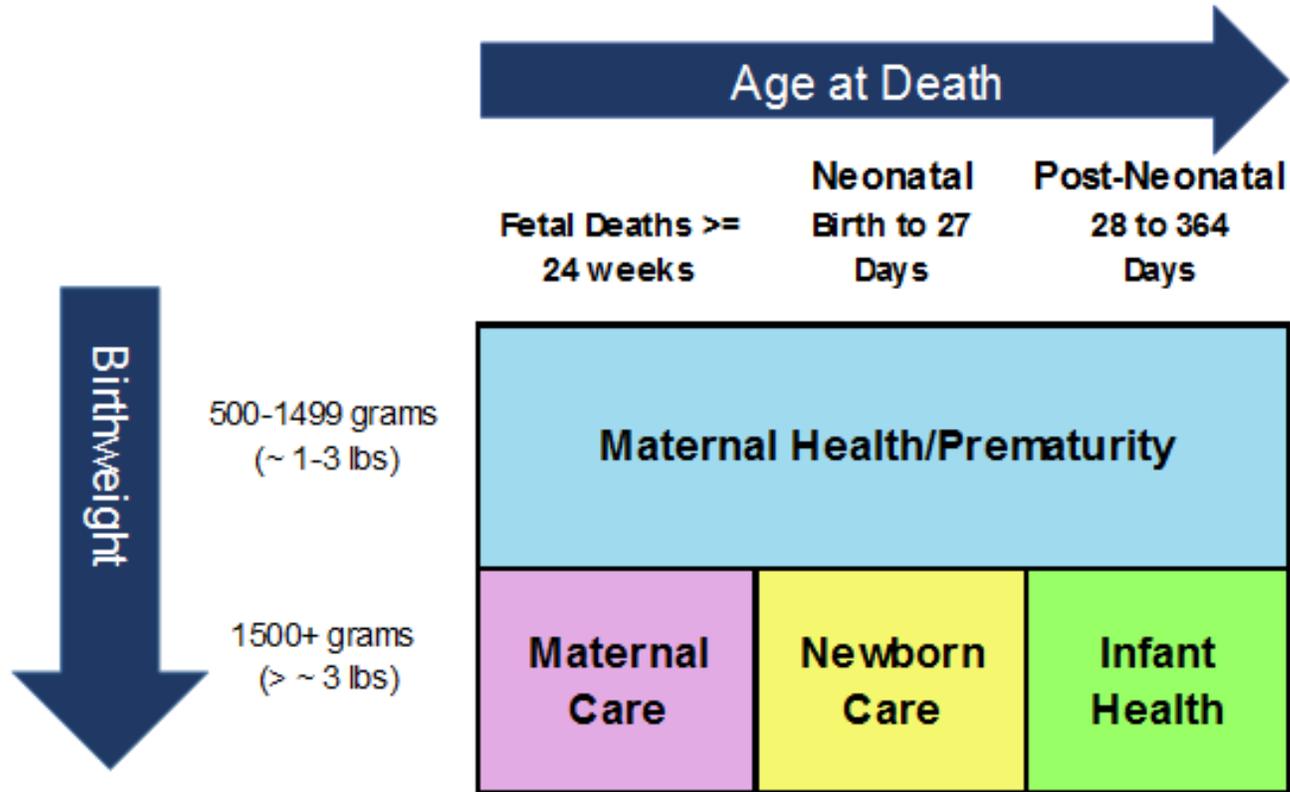
# PPOR: Phase 1 Analysis

- **Calculate numbers and rates for the Fetal-Infant Mortality Map**

- Make fetal-infant mortality maps for sub-populations

- Select reference population

- Calculate excess mortality and identify opportunity gaps
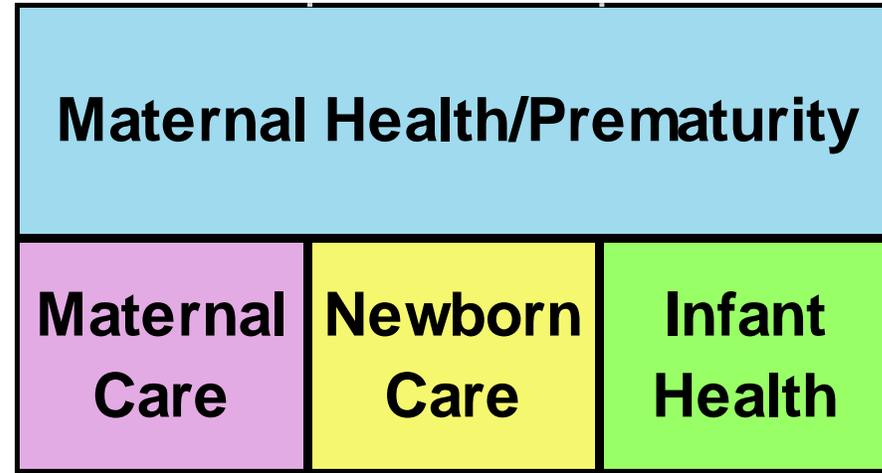
| Maternal Health/Prematurity | | |
|:---:|:---:|:---:|
| Maternal Care | Newborn Care | Infant Health |

# PPOR: Phase 1 Analysis

### Calculating Fetal-Infant Mortality Rate for North Carolina, 2014-2017

| MH/P 1,669 | | |
|---|---|---|
| MC 1,190 | NC 588 | IH 903 |

$$Rate = \frac{Fetal\ Deaths + Infant\ Deaths}{Fetal\ Deaths + Live\ Births} \times 1,000$$

# PPOR: Phase 1 Analysis

**Calculating Fetal-Infant Mortality Rate for North Carolina, 2014-2017**

| MH/P |  |  |
|:---:|:---:|:---:|
| **1,669** |  |  |
| **3.45** |  |  |
| **MC** | **NC** | **IH** |
| **1,190** | **588** | **903** |
| **2.46** | **1.22** | **1.87** |

$$Rate = \frac{Fetal\ Deaths + Infant\ Deaths\ (Period)}{Fetal\ Deaths + Live\ Births\ (Total)} \times 1,000$$

# PPOR: Phase 1 Analysis

## Calculating Fetal-Infant Mortality Rate for North Carolina, 2014-2017

| MH/P |
|:---:|
| 1,669 |
| **3.45** |

| MC | NC | IH |
|:---:|:---:|:---:|
| 1,190 | 588 | 903 |
| **2.46** | **1.22** | **1.87** |

$$Overall\ Rate = 3.54 + 2.46 + 1.22 + 1.87 = 9.00\ per\ 1000$$

# PPOR: Phase 1 Analysis

- Calculate numbers and rates for the Fetal-Infant Mortality Map

- **Select reference population**

- Make fetal-infant mortality maps for sub-populations

- Calculate excess mortality

| Maternal Health/Prematurity | | |
| --- | --- | --- |
| Maternal Care | Newborn Care | Infant Health |
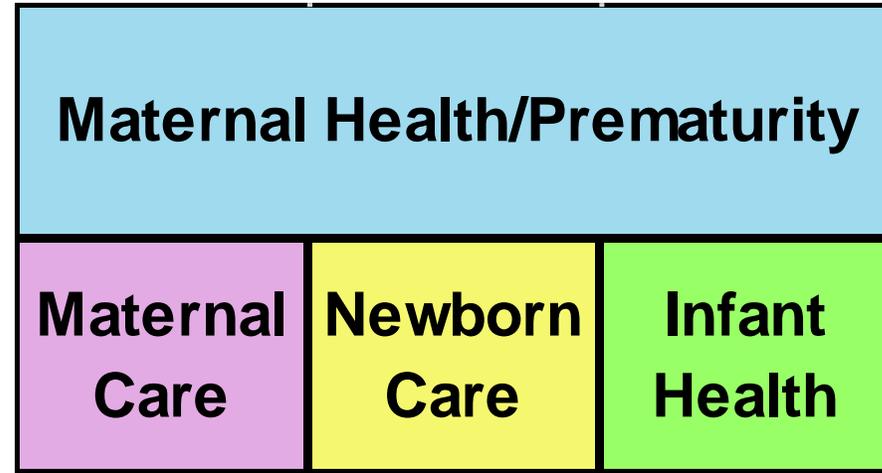
# PPOR: Phase 1 Analysis

**Reference Group:** Non-Hispanic White women over 20 years of age and more than 12 years of formal education

# PPOR: Phase 1 Analysis

**Reference Group:** Non-Hispanic White women over 20 years of age and more than 12 years of formal education

| MH/P |  |  |
|:---:|:---:|:---:|
| 413 |  |  |
| **2.13** |  |  |
| **MC** | **NC** | **IH** |
| 325 | 186 | 215 |
| **1.68** | **0.96** | **1.11** |

$$Overall\ Rate = 2.13 + 1.68 + 0.96 + 1.11 = 5.87\ per\ 1000$$

# PPOR: Phase 1 Analysis

- Calculate numbers and rates for the Fetal-Infant Mortality Map

- Select reference population

- **Make fetal-infant mortality maps for sub-populations**

- Calculate excess mortality

| Maternal Health/Prematurity | | |
|:---:|:---:|:---:|
| Maternal Care | Newborn Care | Infant Health |
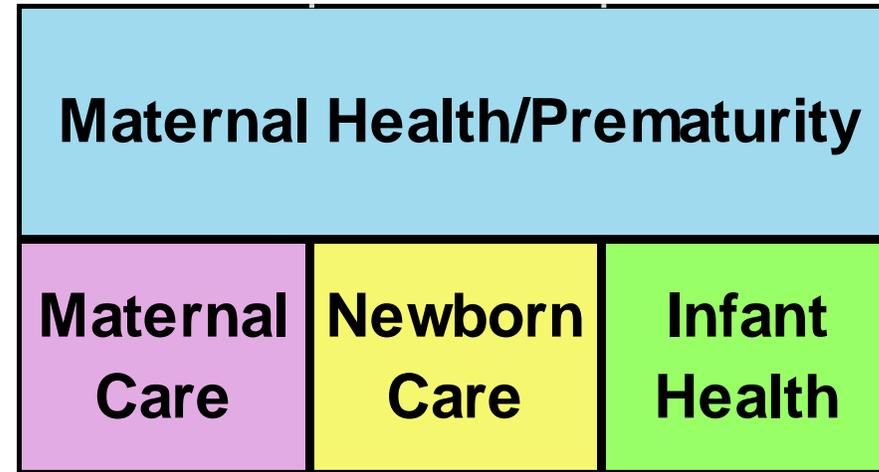
# PPOR: Phase 1 Analysis

**Study Group: Non-Hispanic Black women**

| MH/P 711 **6.18** | | |
|:---:|:---:|:---:|
| **MC** 422 **3.67** | **NC** 191 **1.66** | **IH** 319 **2.77** |

$$Overall\ Rate = 6.18 + 3.67 + 1.66 + 2.77 = 14.28\ per\ 1000$$

# PPOR: Phase 1 Analysis

**Study Group:** Non-Hispanic White women
(not in reference group)

| MH/P |  |  |
|---|---|---|
| 240 |  |  |
| **3.30** |  |  |

| MC | NC | IH |
|---|---|---|
| 222 | 107 | 236 |
| **3.05** | **1.47** | **3.24** |

$$Overall\ Rate = 3.30 + 3.05 + 1.47 + 3.24 = 11.06\ per\ 1000$$

# PPOR: Phase 1 Analysis

**Study Group: All Hispanic women**

| MH/P 210 2.88 | | |
|:---:|:---:|:---:|
| **MC** 162 **2.23** | **NC** 72 **0.96** | **IH** 93 **1.11** |

$$Overall\ Rate = 2.88 + 2.23 + 0.96 + 1.11 = 7.38\ per\ 1000$$

# PPOR: Phase 1 Analysis

**Study Group:** All American Indian and Alaskan Native women



| MH/P 34 |  |  |
|---|---|---|
| **5.30** | | |
| MC 17 | NC 4 | IH 19 |
| *** | *** | **** |
| * | * |  |

*Overall Rate = 11.54 per 1000*

# PPOR: Phase 1 Analysis

## "If one group can experience good outcomes, why can't all groups?"

# PPOR: Phase 1 Analysis

- Calculate numbers and rates for the Fetal-Infant Mortality Map

- Make fetal-infant mortality maps for sub-populations

- Select reference population

- **Calculate excess mortality**

| Maternal Health/Prematurity | | |
|---|---|---|
| **Maternal Care** | **Newborn Care** | **Infant Health** |
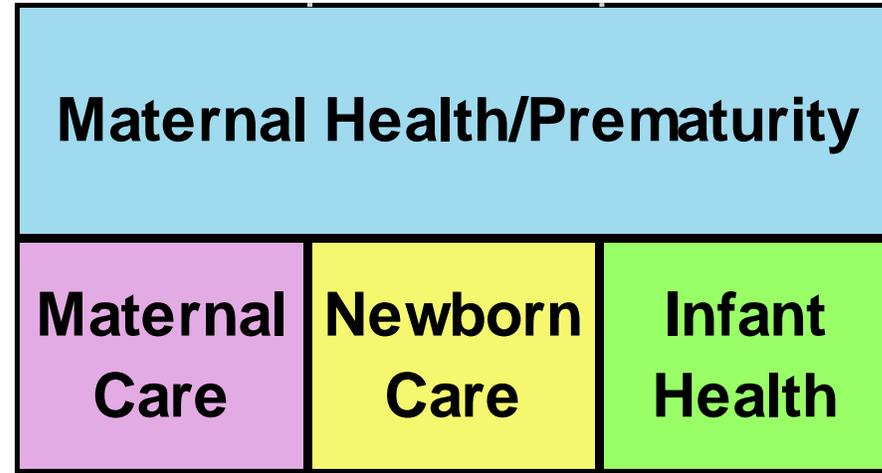
# PPOR: Phase 1 Analysis
## Calculating Excess Mortality

| Racial Groups | Maternal Health/ Prematurity | Maternal Care | Newborn Care | Infant Health | Overall Fetal-Infant Mortality |
|---|---|---|---|---|---|
| NC Total | 3.45 | 2.46 | 1.22 | 1.87 | 9.13 |
| NH White | 3.30 | 3.05 | 1.47 | 3.24 | 11.06 |
| NH Black | 6.18 | 3.67 | 1.66 | 2.77 | 14.28 |
| NH AIAN | 5.30 | *** | *** | *** | 11.54 |
| Hispanic | 2.88 | 2.23 | 0.99 | 1.28 | 7.38 |
| Reference | 2.13 | 1.68 | 0.96 | 1.11 | 5.87 |

# PPOR: Phase 1 Analysis

## Calculating Excess Mortality

| Racial Groups | Maternal Health/ Prematurity | Maternal Care | Newborn Care | Infant Health | Overall Fetal-Infant Mortality |
|---|---|---|---|---|---|
| NH White | 3.30 | 3.05 | 1.47 | 3.24 | 11.06 |

| | | | | | |
|---|---|---|---|---|---|
| Reference | 2.13 | 1.68 | 0.96 | 1.11 | 5.87 |

| | | | | | |
|---|---|---|---|---|---|
| NH White Excess | 1.17 | 1.37 | 0.51 | 2.13 | 5.19 |

# PPOR: Phase 1 Analysis
## Calculating Excess Mortality

| Racial Groups | Maternal Health/ Prematurity | Maternal Care | Newborn Care | Infant Health | Overall Fetal-Infant Mortality |
|---|---|---|---|---|---|
| NH White | 1.17 | 1.37 | 0.51 | 2.13 | 5.19 |
| NH Black | 4.05 | 1.99 | 0.70 | 1.66 | 8.41 |
| NH AIAN | 3.17 | *** | *** | *** | 5.67 |
| Hispanic | 0.75 | 0.55 | 0.03 | 0.17 | 1.51 |

# PPOR: Phase 1 Analysis

## Calculating Excess Mortality Formula

## Estimated Excess Deaths
## = Excess Rate * Denominator / 1,000

# PPOR: Phase 1 Analysis
## Calculating Excess Mortality, 2014-2017

| Racial Groups | Excess Fetal-Infant Mortality | Live Births and Fetal Deaths | Calculate | Number of Excess Deaths |
|---|---|---|---|---|
| NH White | 5.19 | 72,775 | $\frac{5.19 * 72,775}{1,000}$ | 378 |
| NH Black | 8.41 | 115,096 | $\frac{8.41 * 115,096}{1,000}$ | 968 |
| NH AIAN | 5.67 | 6,415 | $\frac{5.67 * 6,415}{1,000}$ | 37 |
| Hispanic | 1.51 | 72,795 | $\frac{1.51 * 72,795}{1,000}$ | 110 |

# PPOR: Phase 1 Analysis
## Calculating Excess Mortality

| Racial Groups | Maternal Health/ Prematurit | Maternal Care | Newborn Care | Infant Health | Overall Fetal- Infant |
|---|---|---|---|---|---|
| NH White | 86 | 100 | 38 | 155 | 378 |
| NH Black | 467 | 229 | 81 | 192 | 968 |
| Hispanic | 55 | 41 | 3 | 13 | 110 |

# PPOR: Phase 1 Analysis

**Distribution of Excess Mortality, by Study Group**



| Study Group | Maternal Health/Prematurity | Maternal Care | Newborn Care | Infant Health |
|---|---|---|---|---|
| NH White | 23% | 27% | 10% | 41% |
| NH Black | 48% | 24% | 8% | 20% |
| Hispanic | 50% | 36% | 2% | 11% |

**Maternal Health/Prematurity** **Maternal Care** **Newborn Care** **Infant Health**
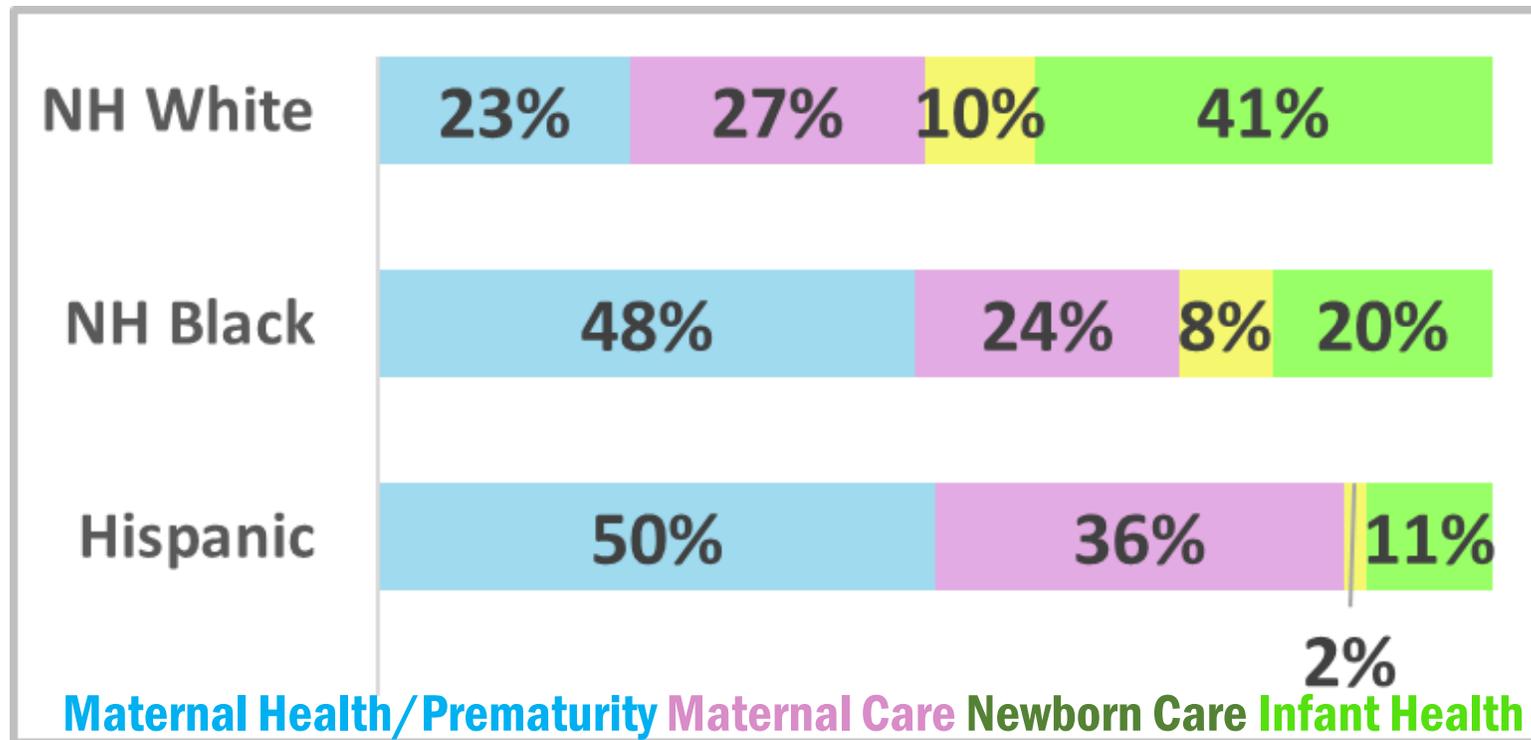
# Key Takeaway #1

- **Excess Mortality differs by Race/Ethnic Study Group**

| Racial Groups | Maternal Health/ Prematurity | Maternal Care | Newborn Care | Infant Health | Overall Fetal-Infant Mortality |
|---|---|---|---|---|---|
| NH White | 1.17 | 1.37 | 0.51 | 2.13 | 5.19 |
| NH Black | 4.05 | 1.99 | 0.70 | 1.66 | 8.41 |
| NH AIAN | 3.17 | *** | *** | *** | 5.67 |
| Hispanic | 0.75 | 0.55 | 0.03 | 0.17 | 1.51 |

# Key Takeaway #2

- **The distribution of Excess Mortality among the Periods of Risk differs by Study Group**
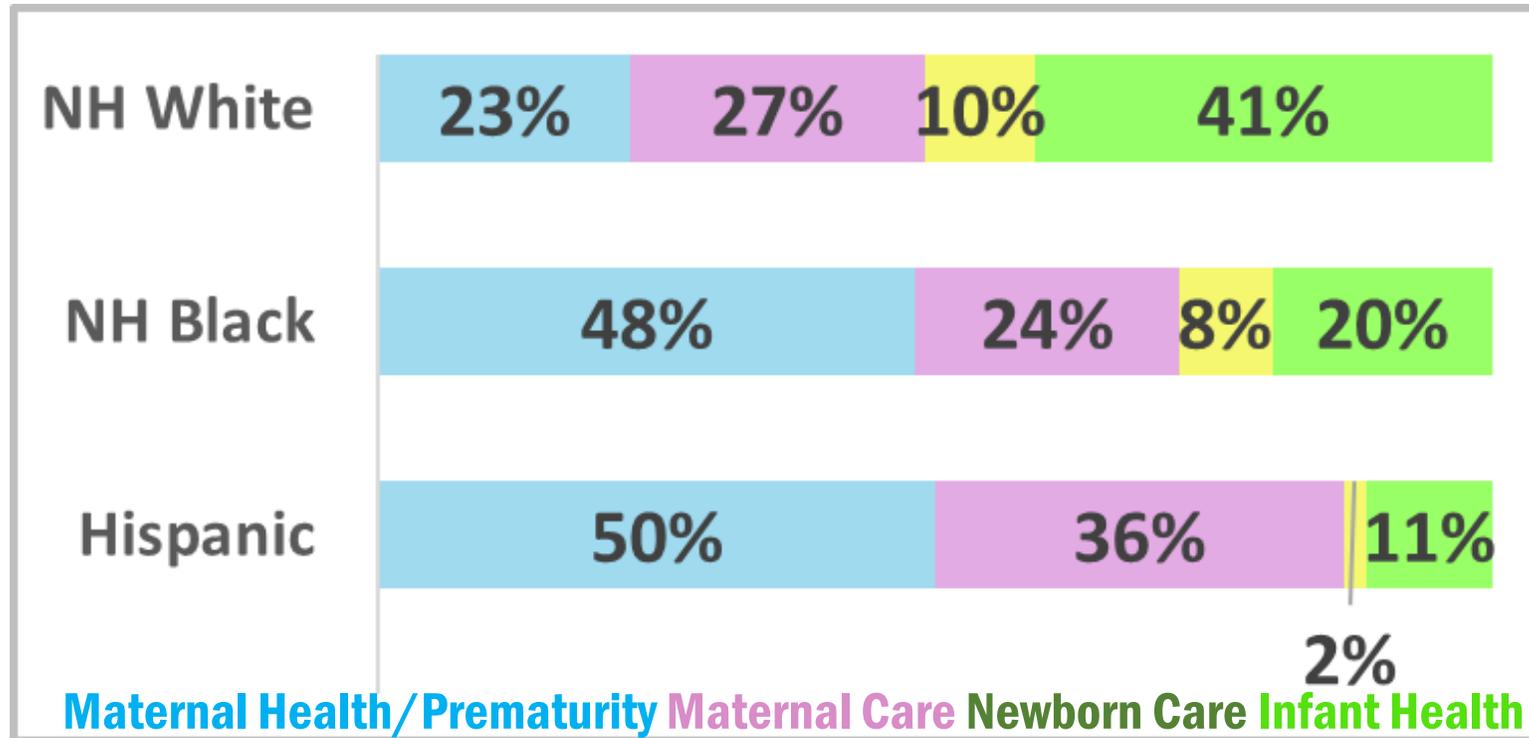
# PPOR: Phase 1 Analysis
## To Focus the Intervention Options
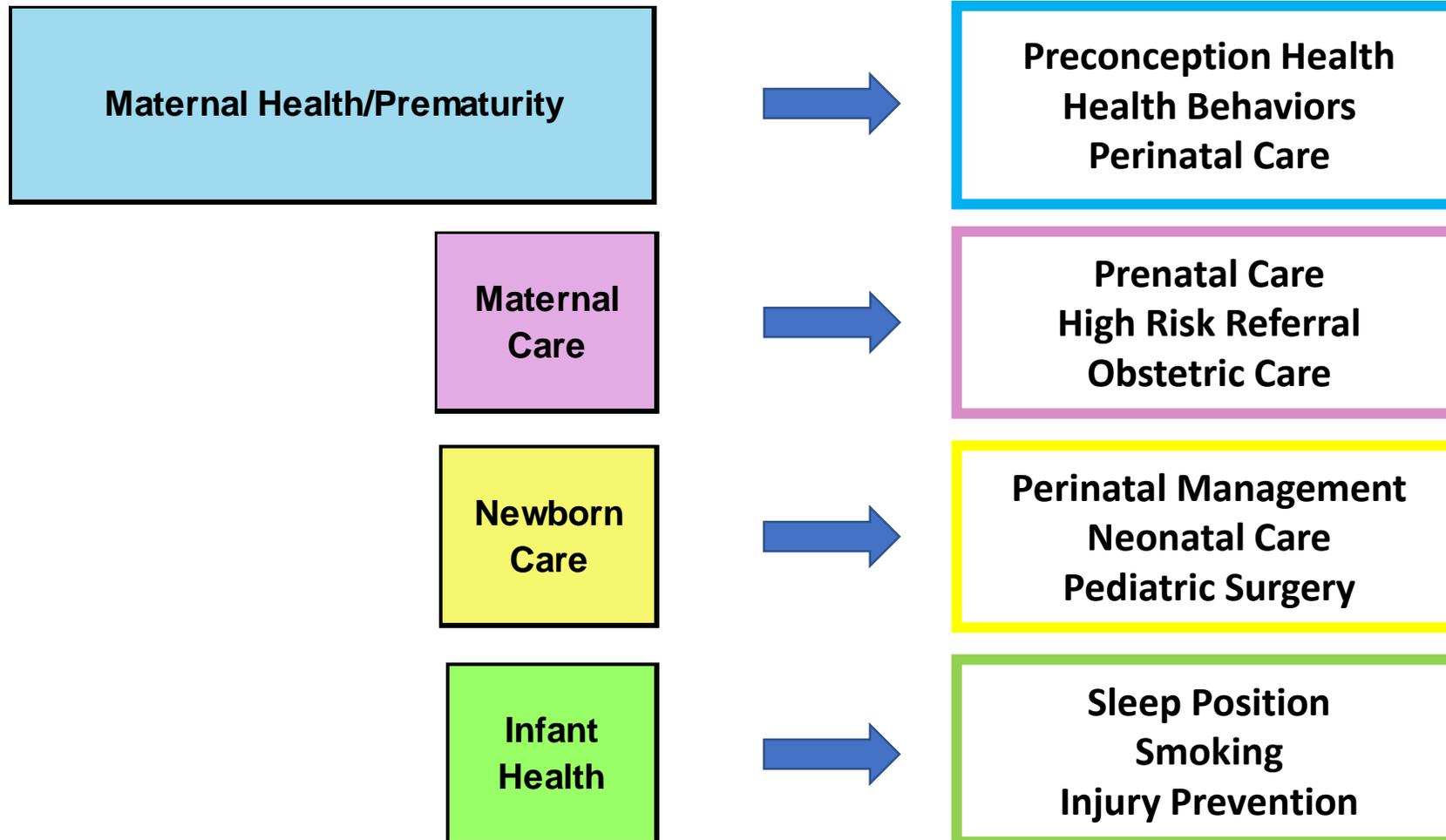
**Maternal Health/Prematurity** → **Preconception Health**
**Health Behaviors**
**Perinatal Care**

**Maternal Care** → **Prenatal Care**
**High Risk Referral**
**Obstetric Care**

**Newborn Care** → **Perinatal Management**
**Neonatal Care**
**Pediatric Surgery**

**Infant Health** → **Sleep Position**
**Smoking**
**Injury Prevention**

# Presentation Road Map

- Perinatal Periods of Risk (PPOR) Background:      10m

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  - Select reference population
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- <span style="color:green">Pause/Discuss/Stretch       2m</span>

- PPOR Phase 2 Analysis:       15m
  - Identify causes of excess mortality
  - Evaluate prevalence of risk factors
  - Estimate the impact of risk factors/interventions

- Pause/Discuss/Stretch       2m

- Closing Remarks and Questions       10m

# PPOR Phase 2: 3 Steps for Analysis

1. **Identify causes** of excess mortality.

2. **Estimate prevalence** of risk factors.

3. **Estimate the impact** of risk factors.

# PPOR Phase 2: Maternal Health/ Prematurity

## Step 1: Identify Cause of Excess Mortality

|  | Excess Mortality Rate | Birthweight Component | Mortality Rate Component |
|---|---|---|---|
| **NH White** | 1.17 | 1.11 | 0.06 |
| **NH Black** | 4.05 | 4.30 | -0.26 |
| **NH AIAN** | 3.17 | *** | *** |
| **Hispanic** | 0.76 | 0.46 | 0.29 |
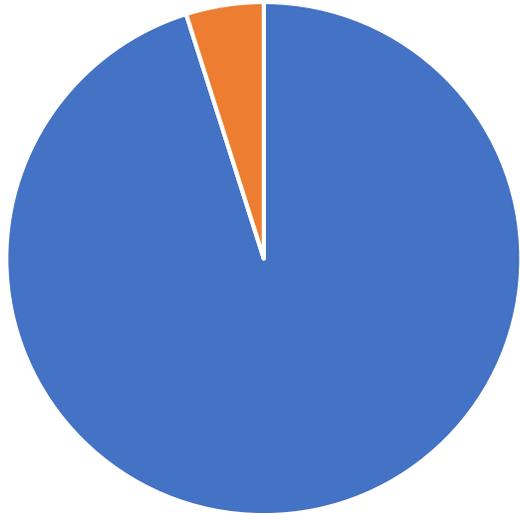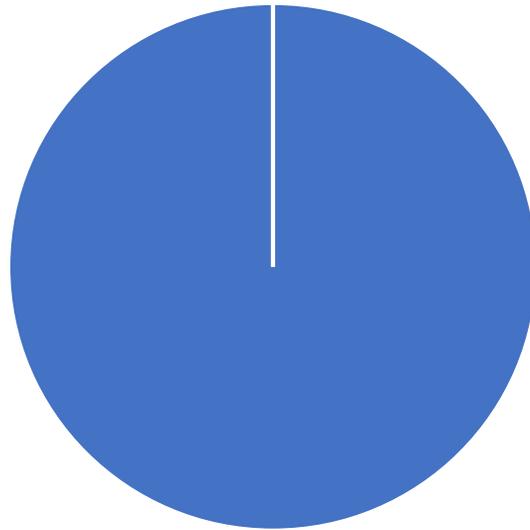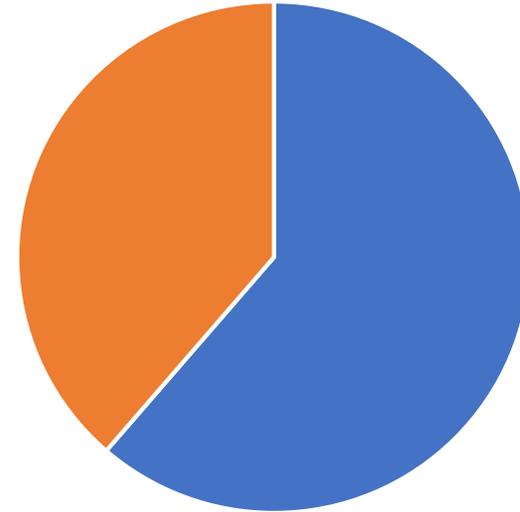
# PPOR Phase 2: Maternal Health/ Prematurity

## Step 2: Identify VLBW Risk Factors

- Pre-pregnancy Smoking
- Smoking during pregnancy
- Inadequate PNC
- STD Present
- Prior Preterm Birth

# PPOR Phase 2: Maternal Health/ Prematurity

## Step 2: Prevalence (%) of Risk Factors for VLBW
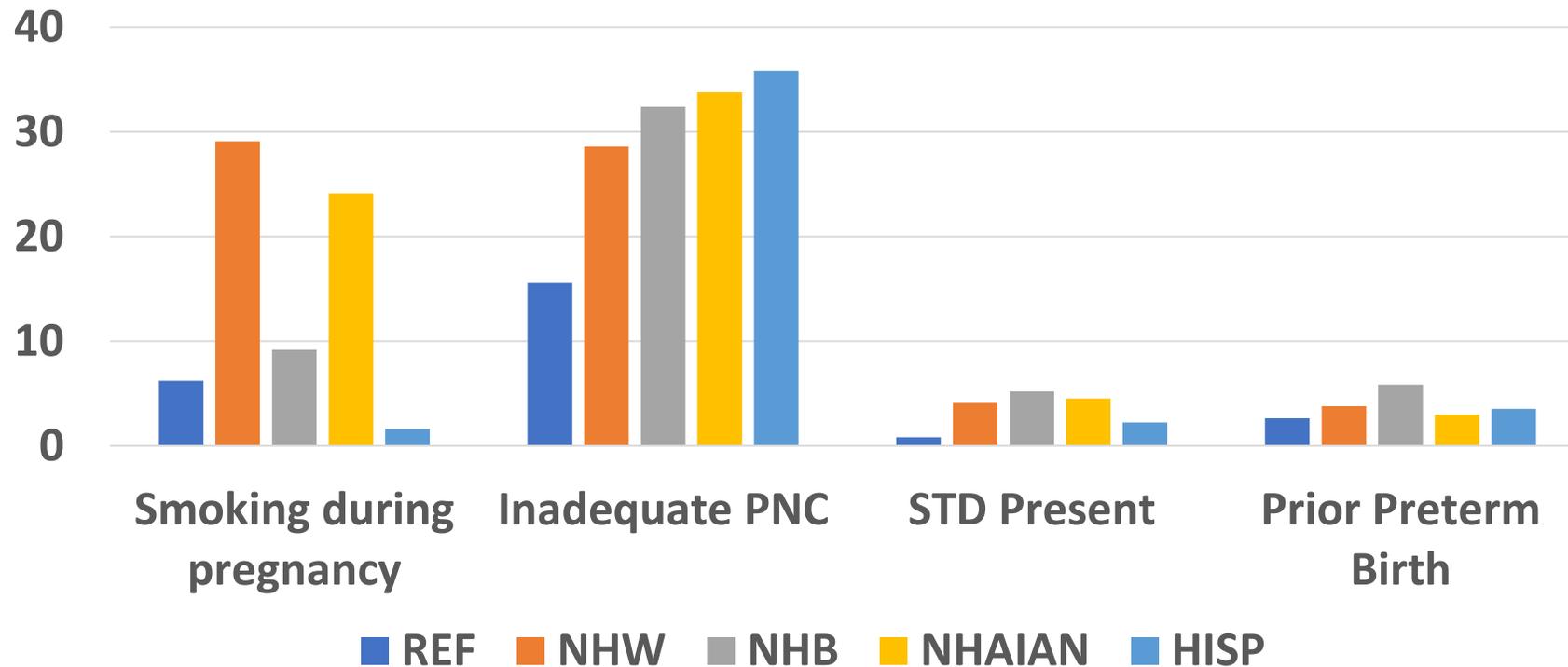
# PPOR Phase 2: Maternal Health/ Prematurity

## Step 3: Estimate the impact of risk factors on VLBW

|  | Reference | |
| --- | --- | --- |
|  | VLBW | Non-VLBW |
| N | 2,069 | 191,940 |
| Pre-pregnancy Smoking | | |
| YES | 267 | 17,153 |
| NO | 1,802 | 174,517 |

# PPOR Phase 2: Maternal Health/ Prematurity
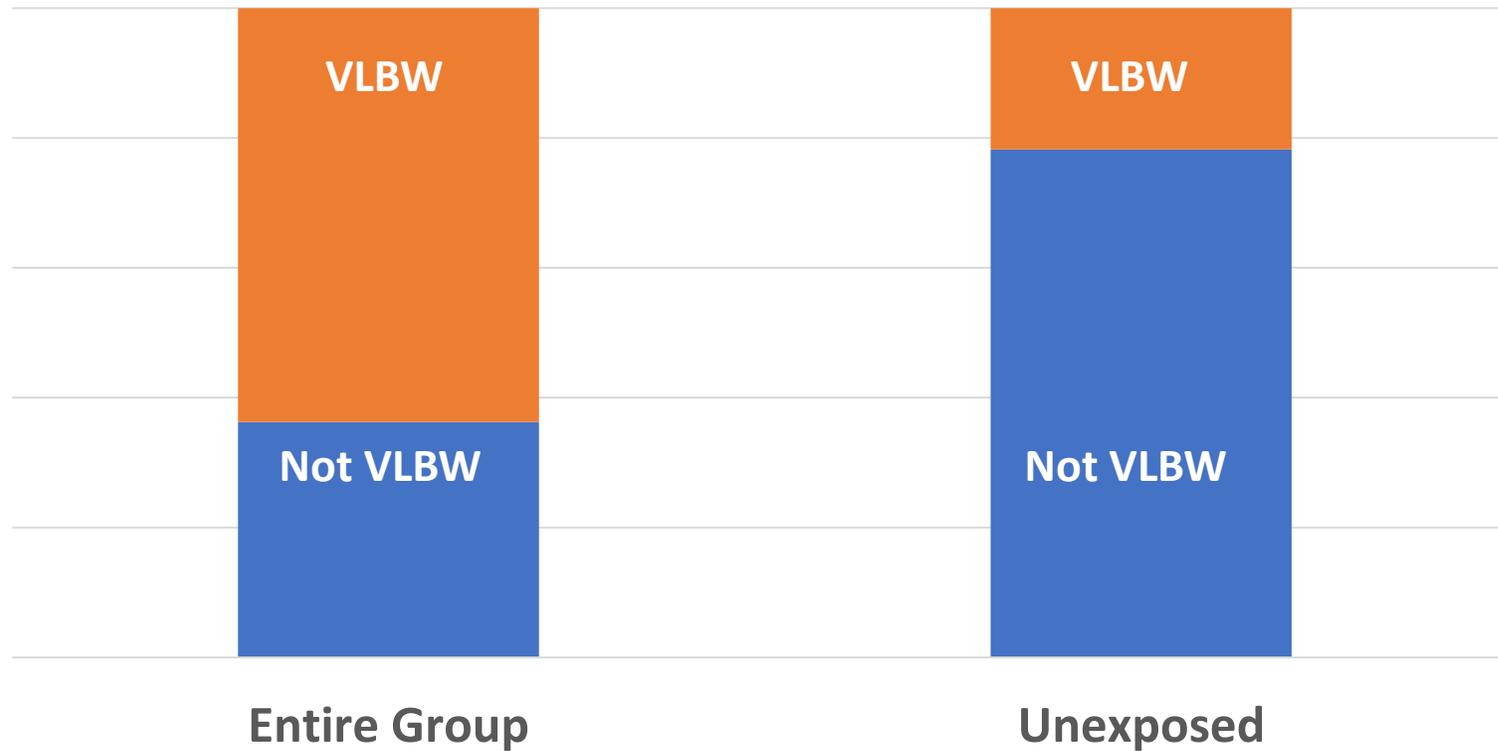
## Step 3: Estimate the impact of risk factors on VLBW

# PPOR Phase 2: Maternal Health/ Prematurity
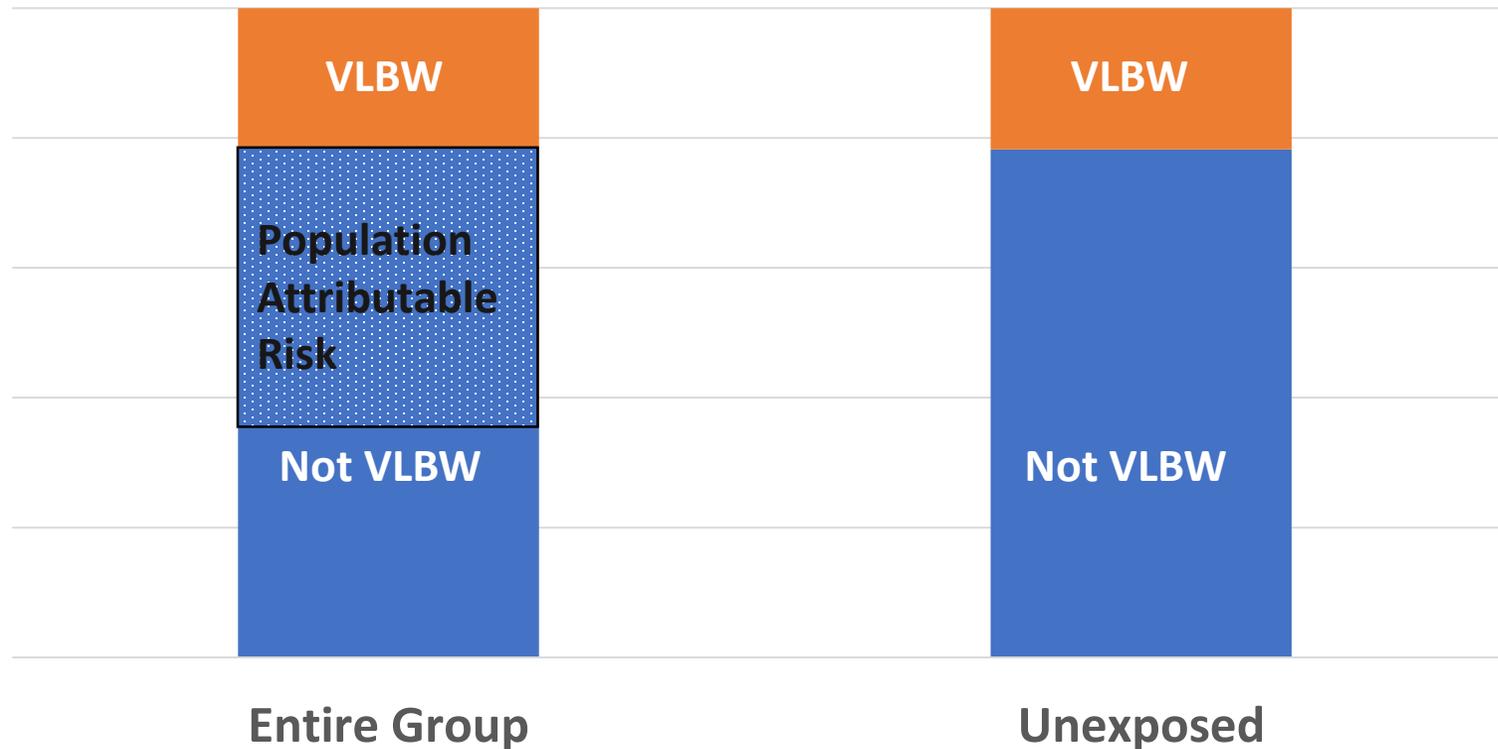
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| YES | 267 | 17,153 |
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$$PAR\% = \frac{R_p - R_u}{R_p} \times 100$$

# PPOR Phase 2: Maternal Health/ Prematurity

## Step 3: Estimate the impact of risk factors on VLBW

|  | Reference | |
|---|---|---|
|  | VLBW | Non-VLBW |
| N | 2,069 | 191,940 |
| Pre-pregnancy Smoking | | |
| YES | 267 | 17,153 |
| NO | 1,802 | 174,517 |

$$PAR\% = \frac{\frac{2,069}{194,009} - \frac{1,802}{176,319}}{\frac{2,069}{194,009}} \times 100 = \frac{0.0107 - 0.0102}{0.0107} \times 100 = \mathbf{4.17}$$

# PPOR Phase 2: Maternal Health/ Prematurity

## Step 3: Estimate the impact of risk factors on VLBW



Legend: REF, NHW, NHB, NHAIAN, HISP

Categories: Pre-pregnancy Smoking, Inadequate PNC, STI Present or Treated, Prior Preterm Birth
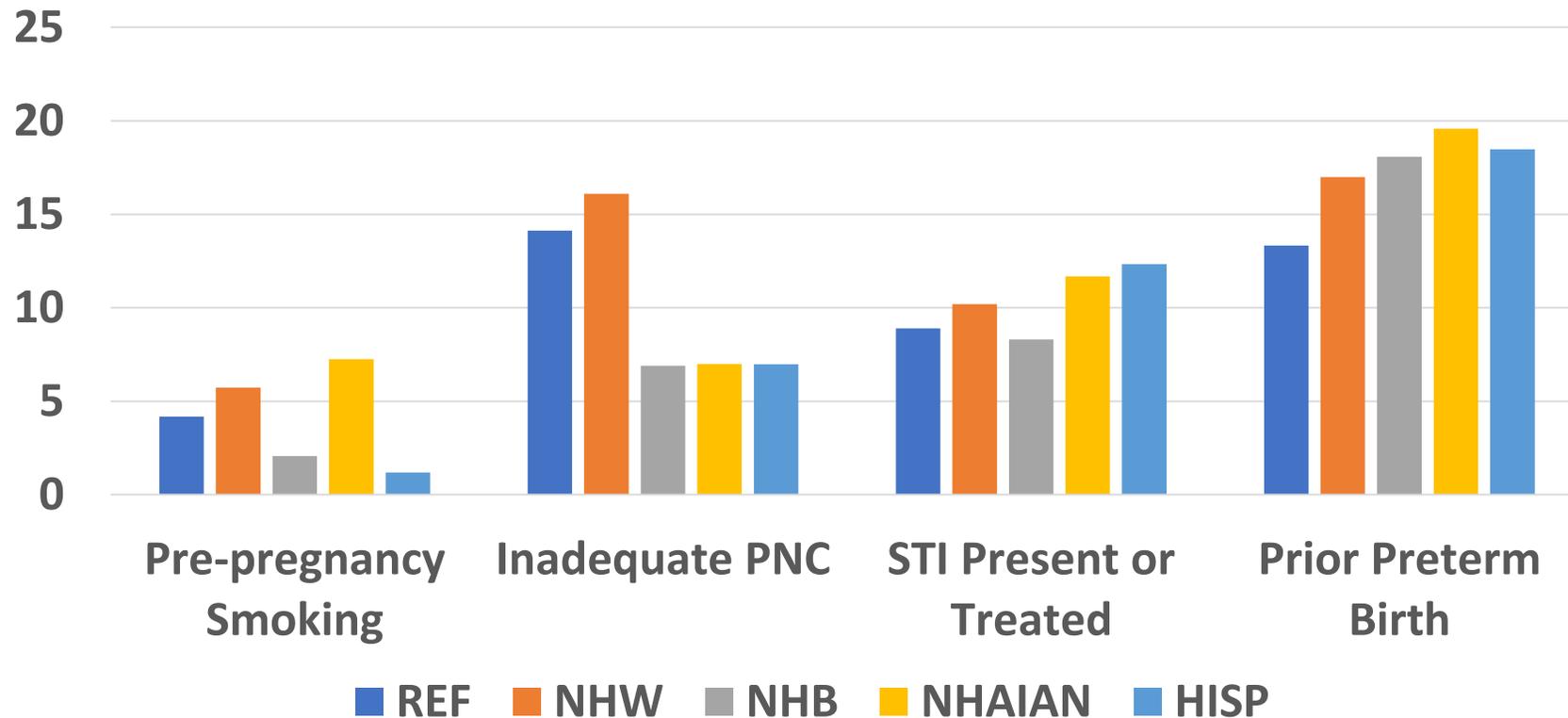
# PPOR Phase 1 Recap: Excess Mortality

**Distribution of Excess Mortality, by Study Group**
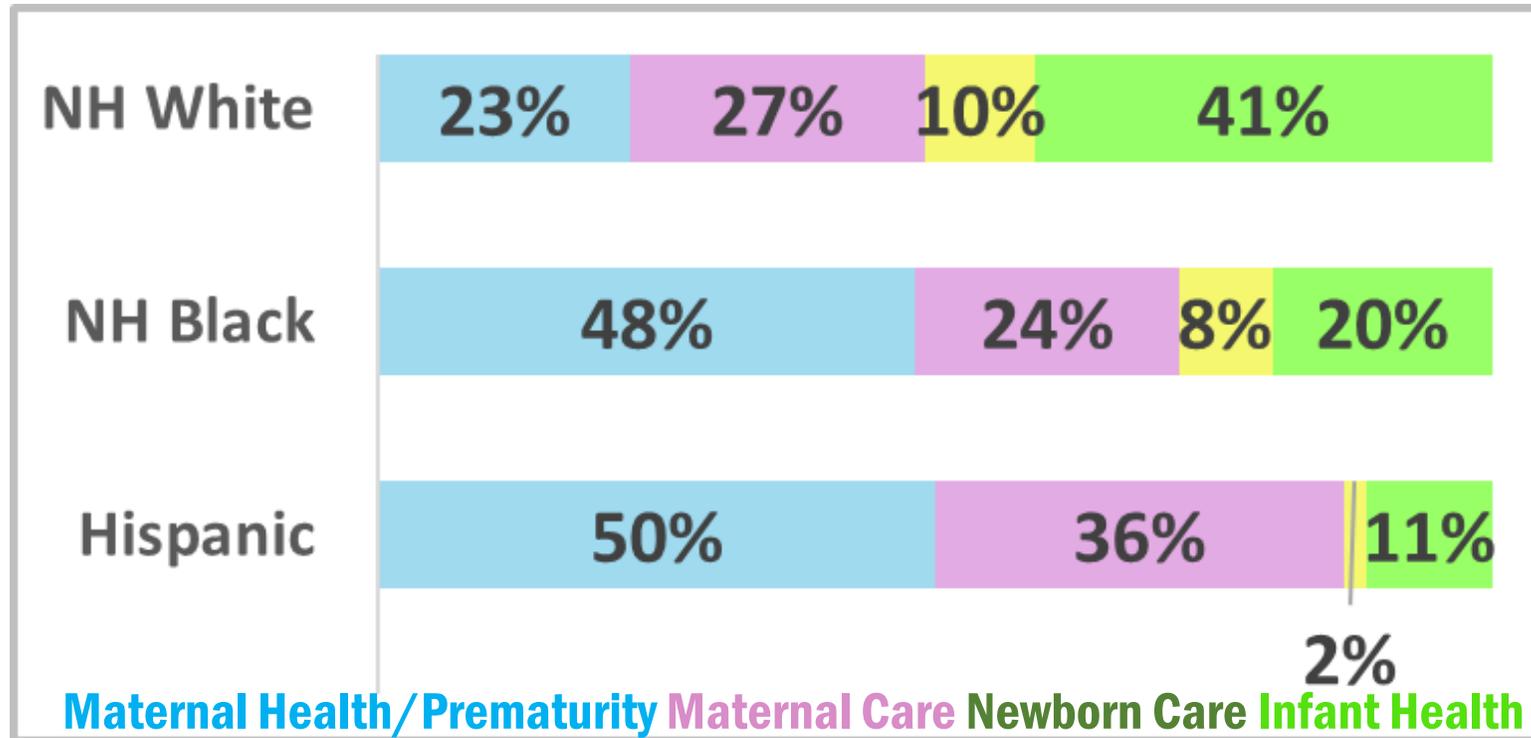
# PPOR Phase 2: 3 Steps for Analysis

1.  **Identify causes** of excess mortality.

2.  **Estimate prevalence** of risk factors.

3.  **Estimate the impact** of risk factors.

# PPOR Phase 2: Infant Health

## Step 1: Classification of Causes of Death

- **Congenital Malformations**
- **Infections & Parasitic Diseases**
- **Diseases of Circulatory System**
- **Diseases of the Respiratory System**
- **Accidental Suffocation /Strangulation**
- **Sudden Infant Death Syndrome**
- **Other Ill-Defined and unknown COD**
- **Unintentional Injuries/ Accidents**
- **Homicide/ Assault**
- **Newborn affected by maternal factors**
- **Other Perinatal Conditions**
- **Prematurity & Low Birth Weight**
- **Respiratory Conditions**
- **All Other Causes**

**Infections and Disease**

**Accidental Suffocation or SIDS**

**Injury, Accidents and Homicide**

**All Other Causes**

# PPOR Phase 2: Infant Health

## Step 1: Calculate Cause-Specific Mortality Rate
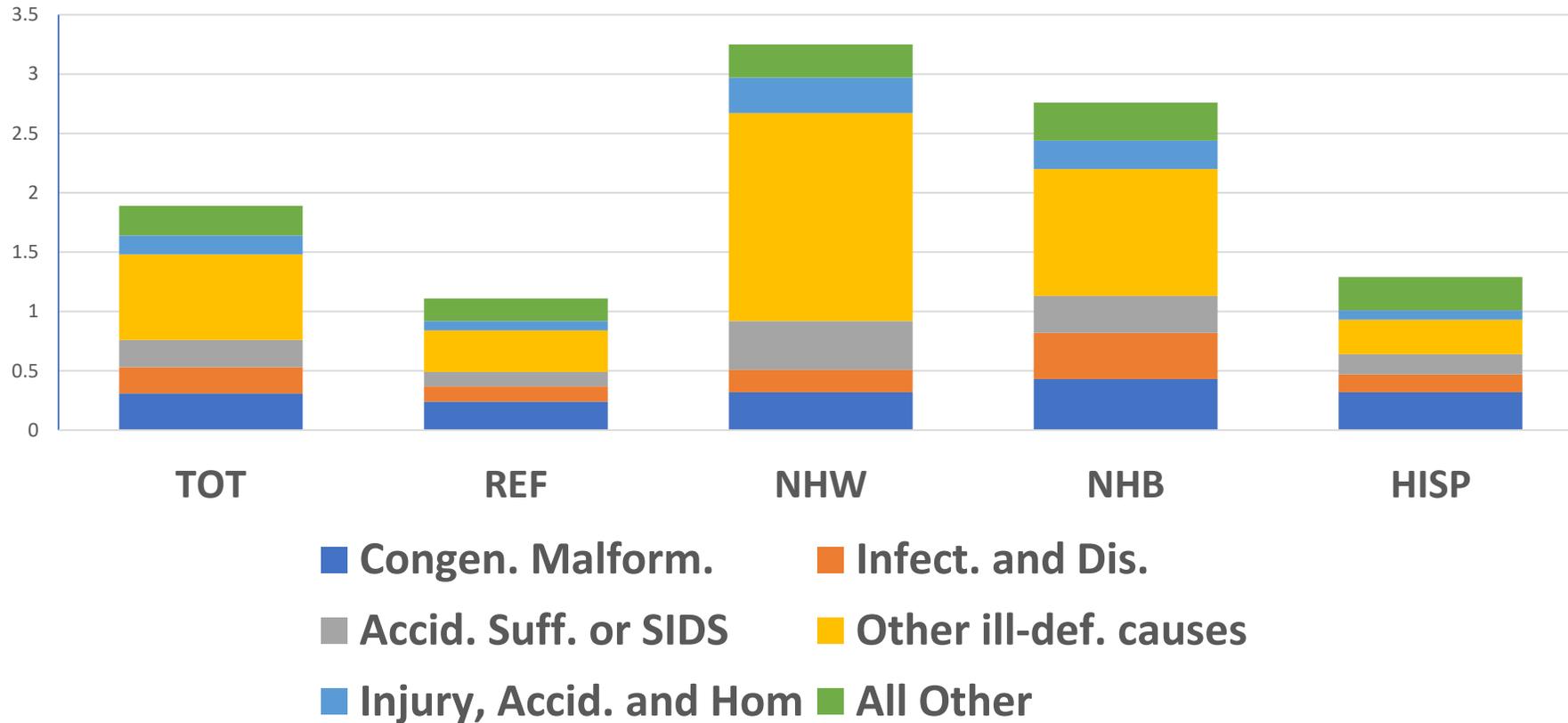
# PPOR Phase 2: Infant Health

## Step 1: Cause-specific EXCESS Mortality Rate
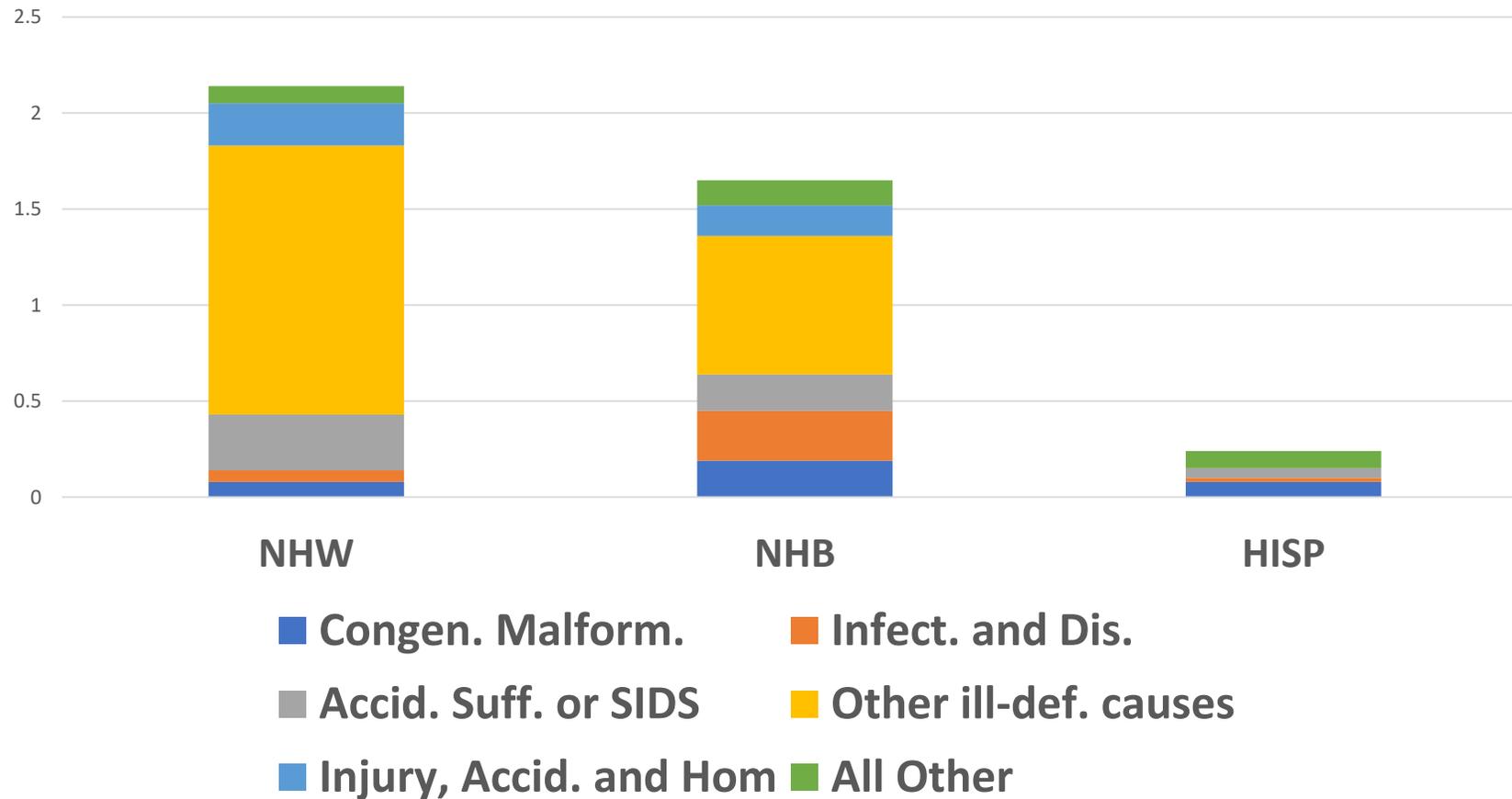
# PPOR Phase 2: Infant Health

## Step 2: Prevalence of Cause-specific Risk Factors
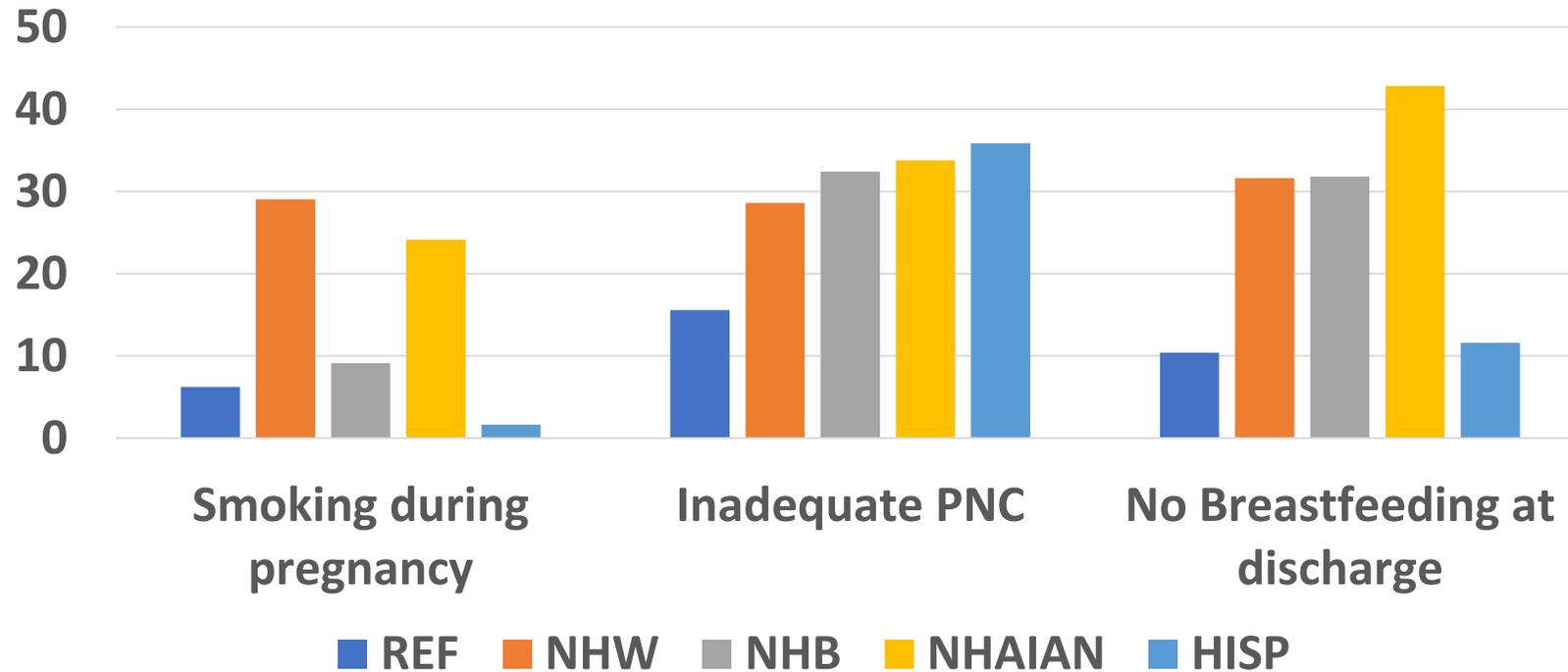
# PPOR Phase 2: Infant Health

## Step 3: Estimate the impact of risk factors on Cause-specific Mortality Rates
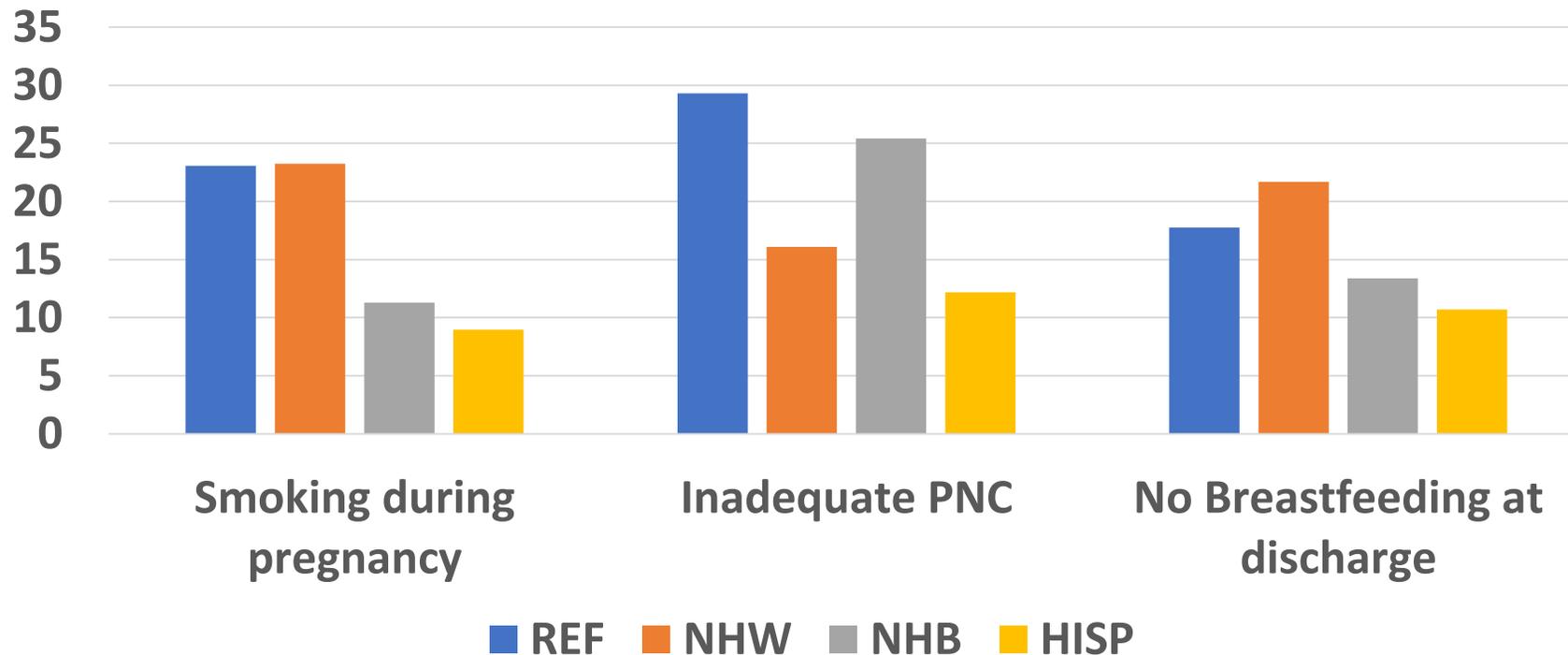
# Key Takeaway #3

- **Excess Deaths occurring during Maternal Health/Prematurity Period of Risk are primarily caused by Low Birth Weight.**

**Birthweight Distribution    vs.    Weight-specific Mortality**
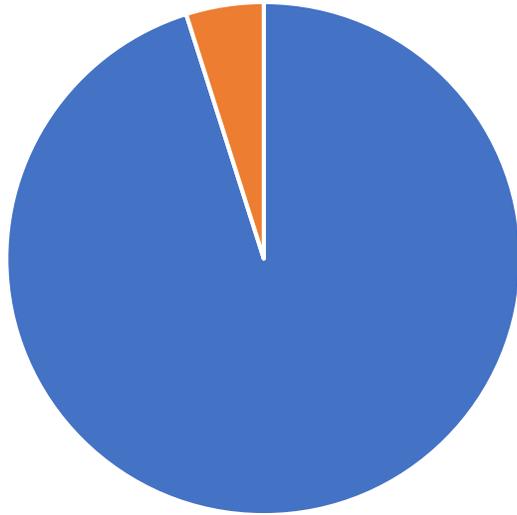


**NHW**
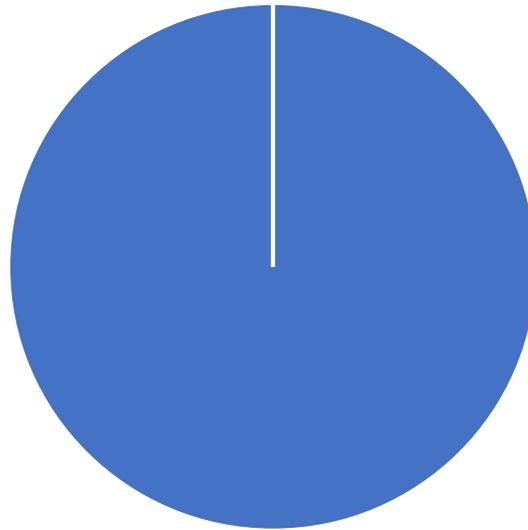
**NHB**
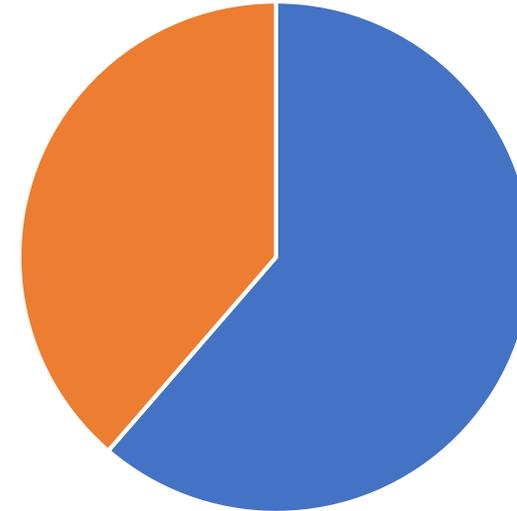
**HISP**

# Key Takeaway #4

- **Addressing the mothers with the risk factors we examined is likely to reduce the fetal-infant mortality rate, but not reduce the disparity ratio.**

# Presentation Road Map

- Perinatal Periods of Risk (PPOR) Background:          10m

- Pause/Discuss/Stretch                                                          2m

- Analytic Prep and PPOR Phase 1 Analysis:          15m
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  - Make mortality maps for subgroups
  - Select reference population
  - Calculate excess mortality

- Pause/Discuss/Stretch                                                          2m

- PPOR Phase 2 Analysis:                                                      15m
  - Identify causes of excess mortality
  - Evaluate prevalence of risk factors
  - Estimate the impact of risk factors/interventions

- Pause/Discuss/Stretch                                                          2m

- Closing Remarks and Questions                                    10m

# Closing Remarks

# Questions?
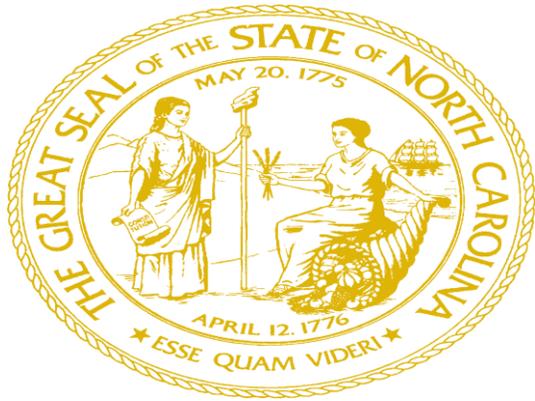
# Limitations

3. A **Live Birth** is the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy, which, after separation, breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord or any definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached (definition adopted by World Health Organization in 1950).

12. **Fetal Death** is death prior to the complete expulsion or extraction from its mother of a product of human conception, irrespective of the duration of pregnancy, as indicated by the fact that after such expulsion or extraction the fetus does not breathe or show any evidence of life, such as beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles (definition adopted by World Health Organization in 1950). Consistent with North Carolina law, this report includes only fetal deaths which do not qualify as therapeutic abortions and which result from pregnancies of 20 or more weeks gestation (see Section IV).

Vital Statistics, 2018 — Volume 1 ◆ January 2020
North Carolina Department of Health and Human Services
Division of Public Health ◆ State Center for Health Statistics

13. **Neonatal Death** is death of a liveborn infant under 28 days of age.

14. **Postneonatal Death** is death of a liveborn infant age 28 days and over but less than one year of age.

15. **Infant Death** is defined as death of a liveborn infant under one year of age.

Vital Statistics, 2018 — Volume 1 ◆ January 2020
North Carolina Department of Health and Human Services
Division of Public Health ◆ State Center for Health Statistics

## 12. Fetal Deaths

$$\text{Fetal mortality rate} = \frac{\text{Number of fetal deaths}}{\text{Number of live births plus number of fetal deaths}} \times 1{,}000$$

Vital Statistics, 2018 — Volume 1 ◆ January 2020
North Carolina Department of Health and Human Services
Division of Public Health ◆ State Center for Health Statistics