
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
  • 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
  • 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
  • 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.
Infant Mortality by Race/Ethnicity 2010-2018

- Total
- NH White
- NH Black
- Hispanic
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**

#### MATERNAL AND CHILD HEALTH

<table>
<thead>
<tr>
<th>Maternal/Child Health Indicators</th>
<th>Total</th>
<th>White</th>
<th>African American</th>
<th>American Indian</th>
<th>Hispanic/Latino</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant Death Rate (per 1,000 live births), 2012-16</td>
<td>1.2</td>
<td>5.4</td>
<td>11.0</td>
<td>2.4</td>
<td>9.0</td>
<td>1.7</td>
</tr>
<tr>
<td>Low Birth Weight (&lt;2,500 grams) Births (%) 2014-16</td>
<td>9.3</td>
<td>7.5</td>
<td>14.1</td>
<td>1.9</td>
<td>12.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Late or No Prenatal Care (%) 2014-16</td>
<td>30.6</td>
<td>23.9</td>
<td>30.7</td>
<td>1.6</td>
<td>35.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Maternal Smoking During Pregnancy (%) 2014-16</td>
<td>9.4</td>
<td>11.9</td>
<td>9.0</td>
<td>0.8</td>
<td>22.3</td>
<td>1.9</td>
</tr>
</tbody>
</table>

- **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.
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
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 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

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

**PPOR: Phase 1 Analysis**

**Rate** = \( \frac{\text{Fetal Deaths} + \text{Infant Deaths}}{\text{Fetal Deaths} + \text{Live Births}} \times 1,000 \)

<table>
<thead>
<tr>
<th>MH/P</th>
<th>MC</th>
<th>NC</th>
<th>IH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,669</td>
<td>1,190</td>
<td>588</td>
<td>903</td>
</tr>
</tbody>
</table>
Calculating Fetal-Infant Mortality Rate for North Carolina, 2014-2017

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

MH/P

- 1,669
- 3.45

MC

- 1,190
- 2.46

NC

- 588
- 1.22

IH

- 903
- 1.87
Calculating Fetal-Infant Mortality Rate for North Carolina, 2014-2017

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
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

### Overall Rate

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

<table>
<thead>
<tr>
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<th>MH/P</th>
<th>MC</th>
<th>NC</th>
<th>IH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>711</td>
<td>422</td>
<td>191</td>
<td>319</td>
</tr>
<tr>
<td>Rate</td>
<td>6.18</td>
<td>3.67</td>
<td>1.66</td>
<td>2.77</td>
</tr>
</tbody>
</table>

*Overall Rate* = 6.18 + 3.67 + 1.66 + 2.77 = 14.28 per 1000
Study Group: Non-Hispanic White women (not in reference group)

Overall Rate = 3.30 + 3.05 + 1.47 + 3.24 = 11.06 per 1000
**PPOR: Phase 1 Analysis**

*Study Group: All Hispanic women*

<table>
<thead>
<tr>
<th>Group</th>
<th>Count</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH/P</td>
<td>210</td>
<td>2.88</td>
</tr>
<tr>
<td>MC</td>
<td>162</td>
<td>2.23</td>
</tr>
<tr>
<td>NC</td>
<td>72</td>
<td>0.96</td>
</tr>
<tr>
<td>IH</td>
<td>93</td>
<td>1.11</td>
</tr>
</tbody>
</table>

*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

Overall Rate = 11.54 per 1000
“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
## PPOR: Phase 1 Analysis

### Calculating Excess Mortality

<table>
<thead>
<tr>
<th>Racial Groups</th>
<th>Maternal Health/Prematurity</th>
<th>Maternal Care</th>
<th>Newborn Care</th>
<th>Infant Health</th>
<th>Overall Fetal-Infant Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC Total</td>
<td>3.45</td>
<td>2.46</td>
<td>1.22</td>
<td>1.87</td>
<td>9.13</td>
</tr>
<tr>
<td>NH White</td>
<td>3.30</td>
<td>3.05</td>
<td>1.47</td>
<td>3.24</td>
<td>11.06</td>
</tr>
<tr>
<td>NH Black</td>
<td>6.18</td>
<td>3.67</td>
<td>1.66</td>
<td>2.77</td>
<td>14.28</td>
</tr>
<tr>
<td>NH AIAN</td>
<td>5.30</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>11.54</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2.88</td>
<td>2.23</td>
<td>0.99</td>
<td>1.28</td>
<td>7.38</td>
</tr>
<tr>
<td>Reference</td>
<td>2.13</td>
<td>1.68</td>
<td>0.96</td>
<td>1.11</td>
<td>5.87</td>
</tr>
</tbody>
</table>
# PPOR: Phase 1 Analysis

## Calculating Excess Mortality

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<td>0.96</td>
<td>1.11</td>
<td>5.87</td>
</tr>
<tr>
<td>NH White Excess</td>
<td>1.17</td>
<td>1.37</td>
<td>0.51</td>
<td>2.13</td>
<td>5.19</td>
</tr>
</tbody>
</table>
### PPOR: Phase 1 Analysis

#### Calculating Excess Mortality

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<th>Overall Fetal-Infant Mortality</th>
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<tbody>
<tr>
<td>NH White</td>
<td>1.17</td>
<td>1.37</td>
<td>0.51</td>
<td>2.13</td>
<td>5.19</td>
</tr>
<tr>
<td>NH Black</td>
<td>4.05</td>
<td>1.99</td>
<td>0.70</td>
<td>1.66</td>
<td>8.41</td>
</tr>
<tr>
<td>NH AIAN</td>
<td>3.17</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>5.67</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.75</td>
<td>0.55</td>
<td>0.03</td>
<td>0.17</td>
<td>1.51</td>
</tr>
</tbody>
</table>
Estimated Excess Deaths
= Excess Rate * Denominator / 1,000
### PPOR: Phase 1 Analysis

#### Calculating Excess Mortality, 2014-2017

<table>
<thead>
<tr>
<th>Racial Groups</th>
<th>Excess Fetal-Infant Mortality</th>
<th>Live Births and Fetal Deaths</th>
<th>Calculate</th>
<th>Number of Excess Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH White</td>
<td>5.19</td>
<td>72,775</td>
<td>$\frac{5.19 \times 72,775}{1,000}$</td>
<td>378</td>
</tr>
<tr>
<td>NH Black</td>
<td>8.41</td>
<td>115,096</td>
<td>$\frac{8.41 \times 115,096}{1,000}$</td>
<td>968</td>
</tr>
<tr>
<td>NH AIAN</td>
<td>5.67</td>
<td>6,415</td>
<td>$\frac{5.67 \times 6,415}{1,000}$</td>
<td>37</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.51</td>
<td>72,795</td>
<td>$\frac{1.51 \times 72,795}{1,000}$</td>
<td>110</td>
</tr>
</tbody>
</table>
## PPOR: Phase 1 Analysis

### Calculating Excess Mortality

<table>
<thead>
<tr>
<th>Racial Groups</th>
<th>Maternal Health/Prematurity</th>
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<th>Newborn Care</th>
<th>Infant Health</th>
<th>Overall Fetal-Infant</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH White</td>
<td>86</td>
<td>100</td>
<td>38</td>
<td>155</td>
<td>378</td>
</tr>
<tr>
<td>NH Black</td>
<td>467</td>
<td>229</td>
<td>81</td>
<td>192</td>
<td>968</td>
</tr>
<tr>
<td>Hispanic</td>
<td>55</td>
<td>41</td>
<td>3</td>
<td>13</td>
<td>110</td>
</tr>
</tbody>
</table>
PPOR: Phase 1 Analysis

Distribution of Excess Mortality, by Study Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Maternal Health/Prematurity</th>
<th>Maternal Care</th>
<th>Newborn Care</th>
<th>Infant Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH White</td>
<td>23%</td>
<td>27%</td>
<td>10%</td>
<td>41%</td>
</tr>
<tr>
<td>NH Black</td>
<td>48%</td>
<td>24%</td>
<td>8%</td>
<td>20%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>50%</td>
<td>36%</td>
<td>11%</td>
<td>2%</td>
</tr>
</tbody>
</table>

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

- Excess Mortality differs by Race/Ethnic Study Group

<table>
<thead>
<tr>
<th>Racial Groups</th>
<th>Maternal Health/ Prematurity</th>
<th>Maternal Care</th>
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<th>Infant Health</th>
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<tbody>
<tr>
<td>NH White</td>
<td>1.17</td>
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<td>NH AIAN</td>
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<td>***</td>
<td>***</td>
<td>***</td>
<td>5.67</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.75</td>
<td>0.55</td>
<td>0.03</td>
<td>0.17</td>
<td>1.51</td>
</tr>
</tbody>
</table>
Key Takeaway #2

• The distribution of Excess Mortality among the Periods of Risk differs by Study Group

<table>
<thead>
<tr>
<th>Study Group</th>
<th>MH-P</th>
<th>MC</th>
<th>NC</th>
<th>IH</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH White</td>
<td>23%</td>
<td>27%</td>
<td>10%</td>
<td>41%</td>
</tr>
<tr>
<td>NH Black</td>
<td>48%</td>
<td>24%</td>
<td>8%</td>
<td>20%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>50%</td>
<td>36%</td>
<td>11%</td>
<td>2%</td>
</tr>
</tbody>
</table>

MH-P: Maternal Health/Prematurity, MC: Maternal Care, NC: Newborn Care, IH: Infant Health
PPOR: Phase 1 Analysis

To Focus the Intervention Options

Maternal Health/Prematurity

→ Preconception Health
   Health Behaviors
   Perinatal Care

→ Prenatal Care
   High Risk Referral
   Obstetric Care

→ Perinatal Management
   Neonatal Care
   Pediatric Surgery

→ Sleep Position
   Smoking
   Injury Prevention

Maternal Care

Newborn Care

Infant Health

Health Behaviors
Perinatal Care
Prenatal Care
High Risk Referral
Obstetric Care
Perinatal Management
Neonatal Care
Pediatric Surgery
Sleep Position
Smoking
Injury Prevention
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 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

<table>
<thead>
<tr>
<th></th>
<th>Excess Mortality Rate</th>
<th>Birthweight Component</th>
<th>Mortality Rate Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH White</td>
<td>1.17</td>
<td>1.11</td>
<td>0.06</td>
</tr>
<tr>
<td>NH Black</td>
<td>4.05</td>
<td>4.30</td>
<td>-0.26</td>
</tr>
<tr>
<td>NH AIAN</td>
<td>3.17</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.76</td>
<td>0.46</td>
<td>0.29</td>
</tr>
</tbody>
</table>
PPOR Phase 2: Maternal Health/ Prematurity

Step 1: Identify Cause of Excess Mortality

Birthweight Distribution vs. Weight-specific Mortality

NHW

NHB

HISP
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

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

REF, NHW, NHB, NHAIAN, HISP
PPOR Phase 2: Maternal Health/ Prematurity

Step 3: Estimate the impact of risk factors on VLBW

<table>
<thead>
<tr>
<th>Reference</th>
<th>VLBW</th>
<th>Non-VLBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>2,069</td>
<td>191,940</td>
</tr>
<tr>
<td>Pre-pregnancy Smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td>267</td>
<td>17,153</td>
</tr>
<tr>
<td>NO</td>
<td>1,802</td>
<td>174,517</td>
</tr>
</tbody>
</table>
PPOR Phase 2: Maternal Health/ Prematurity

Step 3: Estimate the impact of risk factors on VLBW

<table>
<thead>
<tr>
<th></th>
<th>Entire Group</th>
<th>Unexposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLBW</td>
<td>Not VLBW</td>
<td>Not VLBW</td>
</tr>
<tr>
<td><strong>Not VLBW</strong></td>
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</tbody>
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Step 3: Estimate the impact of risk factors on VLBW

PPOR Phase 2: Maternal Health/ Prematurity

Entire Group

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Population Attributable Risk</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unexposed

<table>
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<th>Not VLBW</th>
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<tbody>
<tr>
<td></td>
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Step 3: Estimate the impact of risk factors on VLBW

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</table>

\[
PAR\% = \left( \frac{R_p - R_u}{R_p} \right) \times 100
\]
PPOR Phase 2: Maternal Health/ Prematurity

Step 3: Estimate the impact of risk factors on VLBW

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\[
PAR\% = \left( \frac{2,069}{194,009} - \frac{1,802}{176,319} \right) \times 100 = \left( \frac{0.0107 - 0.0102}{0.0107} \right) \times 100 = 4.17
\]
Step 3: Estimate the impact of risk factors on VLBW
## PPOR Phase 1 Recap: Excess Mortality

### Distribution of Excess Mortality, by Study Group

<table>
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<tr>
<td><strong>NH Black</strong></td>
<td>48%</td>
<td>24%</td>
<td>8%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Hispanic</strong></td>
<td>50%</td>
<td>36%</td>
<td>11%</td>
<td>2%</td>
</tr>
</tbody>
</table>
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

![Graph showing cause-specific mortality rate for different categories and ethnicities.](image)

- **Congen. Malform.**
- **Infect. and Dis.**
- **Accid. Suff. or SIDS**
- **Other ill-def. causes**
- **Injury, Accid. and Hom**
- **All Other**

Columns represent different populations and causes, and bars indicate the specific mortality rate.
Step 1: Cause-specific EXCESS Mortality Rate

PPOR Phase 2: Infant Health
PPOR Phase 2: Infant Health

Step 2: Prevalence of Cause-specific Risk Factors

**Graph:**
- Smoking during pregnancy
- Inadequate PNC
- No Breastfeeding at discharge

**Legend:**
- REF
- NHW
- NHB
- NHAIAN
- HISP
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
  – 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 Remarks and Questions 10m
Closing Remarks
Questions?

Vito Di Bona, MS
State Center for Health Statistics

January 23, 2020
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).
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.
12. **Fetal Deaths**

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