The Perinatal Periods of Risk Approach

Phase 1 analysis
Why do we need PPOR?

Infant mortality is complex

- Sensitive measure of a community’s health
- Complex interweaving of a social & health problem
- Many contributors and risk factors
- Strong contributors and risk factors
- Small number of events in most communities
- Limited data and analytic capacity in most communities
Communities needed help!

Dr. Bill Sappenfield, CDC’s first assignee to CityMatCH, and Dr. Magda Peck, founder of CityMatCH, teamed up!
OUR EXPERTS CONSULTED WITH THEIR EXPERTS

Dr. Brian McCarthy and colleagues at the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) knew that causes of perinatal death are closely related to both age at death and birth weight.

Why not use both pieces of information to learn more about why babies are dying?
## 6-stage PPOR approach following the community planning cycle

| Stage 1: Assure Community and Analytic Readiness |
| Stage 2: Conduct Analytic Phases of PPOR |
| Stage 3: Develop Strategic Actions for Targeted Prevention |
| Stage 4: Strengthen Existing and/or Launch New Prevention Initiatives |
| Stage 5: Monitor and Evaluate Approach |
| Stage 6: Sustain Stakeholder Investment and Political Will |
What IS this thing called PPOR Analysis?

Stage 1: Assure Community and Analytic Readiness

Stage 2: Conduct Analytic Phases of PPOR

Stage 3: Develop Strategic Actions for Targeted Prevention

Stage 4: Strengthen Existing and/or Launch New Prevention Initiatives

Stage 5: Monitor and Evaluate Approach

Stage 6: Sustain Stakeholder Investment and Political Will
PPOR analytic methods were constructed on existing infant mortality study methods.

- Cause of death is closely related to both age at death and birth weight.
- We can use these two pieces of information to help us investigate the causes of mortality in communities.
First Dimension of PPOR Analysis

Age at Death

Conception

20 wks 28 wks 4 wks

Spontaneous Abortion Early Fetal Late Fetal Neonatal Postneonatal

Birth

20 wks 28 wks 4 wks

Fetal Neonatal

Infant

Feto-Infant

1 Year
Second Dimension: Birthweight

- **Extremely Low Birthweight**
  <1,000 grams (2.2 pounds)

- **Very Low Birthweight**
  <1,500 grams (3.3 pounds)

- **Low Birthweight**
  <2,500 grams (5.5 pounds)

- **Normal Birthweight**
  2,500 grams or more (5.5 pounds)
World Health Organization

Periods of Risk “map”

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Fetal Deaths</th>
<th>Early Neonatal</th>
<th>Late Neonatal</th>
<th>Post Neonatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>500-999 g</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>1000-1499 g</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>1500-2499 g</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>2500+ g</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>
Simplifying the WHO Model to create the PPOR Map

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Fetal Deaths</th>
<th>Late Neonatal</th>
<th>Early Neonatal</th>
<th>Post Neonatal</th>
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<tr>
<td>500-999 g</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
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<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>2500+ g</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>

- Fetal Death >=24 weeks
- Neonatal 0-27 days
- Post-neonatal 28-364 days
Phase 1 Narrows the Choices of Action

- **Maternal Health/Prematurity**
  - Preconception Health
  - Health Behaviors
  - Perinatal Care
  - etc.

- **Maternal Care**
  - Prenatal Care
  - High Risk Referral
  - Obstetrical Care
  - etc.

- **Newborn Care**
  - Perinatal Management
  - Neonatal Care
  - Pediatric Surgery
  - etc.

- **Infant Health**
  - Sleep Position
  - Smoking
  - Injury Prevention
  - etc.
PPOR Analytic Methods

**Analytic Preparation**
Acquire, assess, and process data files

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

**Phase 2 Analysis**
Explains why the excess deaths occurred and directs prevention efforts
Define the study population

Include infants and fetal deaths whose mothers were residents of the study area at the time of the birth.
Steps of Data Preparation

- Acquire and prepare vital records files for the defined study population
- Assess data quality
- Restrict study population by birthweight and gestational age
- Assess study sample size and re-define study population if needed
Preparation of Data: Acquiring Three Data Files

- Live birth certificate files
- Fetal death certificate files
- Linked birth—infant death certificate files

ALL are produced in every state, but sometimes difficult to obtain by local health departments
Linked Birth & Infant Death Certificates

Infant Deaths

Live Birth Certificate
Birth Characteristics

Infant Death Certificate
Death Characteristics

Fetal Deaths

Fetal Death Certificates
Birth & Death Characteristics

Note: Spontaneous and induced abortions are NOT included
Preparation of Data: Data Quality Checks

- Run frequencies
- Read the code book (variable definitions and value labels)
- Compute counts for the missing values (in SAS, use `/missing`)
- Check for implausible data and other errors
Preparation of Data:
Minimum Number of Deaths

- At least **sixty deaths** overall and/or at least **ten deaths** in each period of risk, for each population being studied.

- May combine up to **5 years** to reach adequate number of deaths (no more, due to changes in medical practice and community characteristics).

- May combine geographic areas to reach adequate number of deaths (areas are meaningful).

- Phase 2 analyses require even more deaths.
Why at least 60 deaths?
95% Confidence Limits for Mortality Rates by Number of Deaths

<table>
<thead>
<tr>
<th>Number of Deaths</th>
<th>City A</th>
<th>City B</th>
<th>City C</th>
<th>City D</th>
<th>City E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>10</td>
<td>25</td>
<td>50</td>
<td>250</td>
</tr>
</tbody>
</table>

Conf. Limits

Rate
Preparation of Data

- Preparing data can take significant time
- Depends on staff experience and expertise
- Essential before going on to Phase 1 analysis
Steps of PPOR Phase 1 Analysis

- **Calculate numbers and rates for the fetal-infant mortality map**
  - Make fetal-infant mortality maps for different time periods, subpopulations and geographic areas
  - Select reference populations (and make a fetal-infant mortality map)
  - Calculate excess mortality and identify opportunity gaps
Sort the fetal and infant deaths into the PPOR Map

Age at Death

- Fetal Death >=24 weeks
- Neonatal 0-27 days
- Post-neonatal 28-364 days

Birthweight

- 500-1499 g
- 1500+ g

Maternal Health/Prematurity

- Maternal Care
- Newborn Care
- Infant Health
SORT the Fetal and Infant Deaths

*Example:* Infant death--2499g & 22 days old

- **Maternal Health/Prematurity**
  - 500-1499 g
  - 1500+ g

- **Fetal Death**
- **Neonatal**
- **Post-neonatal**
  - >=24 weeks
  - 0-27 days
  - 28-364 days

- **Maternal Care**
- **Newborn Care**
- **Infant Health**
SORT the Fetal and Infant Deaths

*Example: fetal death--820g

Fetal Death  Neonatal  Post- neonatal
>=24 weeks  0-27 days  28-364 days

500-1499 g

1500+ g

Maternal Health/ Prematurity

Maternal Care  Newborn Care  Infant Health
SORT the Fetal and Infant Deaths

*Example*: live birth--480g & <1 day

- 500-1499 g
  - Fetal Death >=24 weeks
  - Neonatal 0-27 days
  - Post-neonatal 28-364 days

- 1500+ g
  - Maternal Care
  - Newborn Care
  - Infant Health

Maternal Health/ Prematurity
PPOR Map of Fetal-Infant Deaths

Urban County

- 97 Maternal Health/ Prematurity (35 fetal deaths, 62 live births)
- 48 Maternal Care (fetal deaths)
- 44 Newborn Care (live births)
- 47 Infant Health (live births)

35 + 48 = 83 Fetal Deaths
97 + 48 + 44 + 47 = 236 Total deaths
23,199 Live Births
Calculating Fetal-Infant Mortality Rate

Urban County

Formula:
Rate = \frac{\text{deaths} \times 1,000}{\text{denominator}}

The denominator is the population at risk

83 Fetal Deaths + 23,199 Live Births

= 23,282
Calculating Fetal-Infant Mortality Rate

Urban County

97 deaths x 1,000 ÷ 23,282
= 4.17

Period rates add up to overall rate

4.17 + 2.06 + 1.89 + 2.02
= 10.14

Overall rate = 236 x 1,000 ÷ 23,282 = 10.14
PPOR Map of Fetal-Infant Mortality Rates

Urban County

Maternal Health/ Prematurity
4.2

2.1 Maternal Care
1.9 Newborn Care
2.0 Infant Health

Overall Rate
= 10.1
Fetal and Infant Deaths per thousand
Steps of PPOR Phase 1 Analysis

- Calculate numbers and rates for the fetal-infant mortality map
- Make fetal-infant mortality maps for different time periods, subpopulations and geographic areas
- Select reference populations (and make a fetal-infant mortality map)
- Calculate excess mortality and identify opportunity gaps
Urban County: Comparing Different Time Periods

Fetal-Infant Rate = 10.7

1993-1996
4.0
2.3 1.4 2.9

Fetal-Infant Rate = 10.3

1997-2000
4.1
2.5 1.8 1.9

Fetal-Infant Rate = 8.8

2001-2005
3.5
1.9 1.4 2.0

Fetal-Infant Rate = 8.2

2006-2009
3.9
2.0 1.0 1.3
Urban County: Comparing Different Subpopulations

White Fetal-Infant Rate = 8.6
(Denom. = 16,045)

- White non-Hispanic
  - Rate: 3.1
  - 2.0
  - 1.9
  - 1.6

Black Fetal-Infant Rate = 17.6
(Denom. = 3,291)

- Black non-Hispanic
  - Rate: 8.8
  - 2.4
  - 2.4
  - 4.0
Seeing disparities like this makes the community begin to ask questions such as

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

PPOR formalizes this question and suggests ways to find answers.
Steps of PPOR Phase 1 Analysis

- Calculate numbers and rates for the fetal-infant mortality map
- Make fetal-infant mortality maps for different time periods, subpopulations and geographic areas

- Select reference populations (and make a fetal-infant mortality map)

- Calculate excess mortality and identify opportunity gaps
PPOR Uses a Reference Group

- Our assumption is that if one population group can have low mortality, other groups can reach that goal.
- Instead of comparing racial/ethnic groups, we compare all groups to this agreed-upon reference group.
Reference Group

- It should have better or optimal pregnancy outcomes.
- In general, this group should represent roughly 15% or more of the population.
- It needs to have at least 60 deaths.
- The community should be involved!!!
Reference Group

**Internal**
- A subgroup from the area under study

**External**
- State
- Similar city
- National reference group
Potential Reference Groups

- Non-Hispanic White Mothers age 20 or older, with 13 or more years of education, residents of the city at the time of baby’s birth
- Asian or Hispanic mothers
- Black mothers with 13 or more years of education
USA Reference Group 2000-2002

Defined by *maternal* characteristics
- 20 or more years of age
- 13 or more years of education
- Non-Hispanic white women
- residents of the US at the time of baby’s birth

Total Fetal-Infant Mortality Rate = 5.7
Steps of PPOR Phase 1 Analysis

- Calculate numbers and rates for the fetal-infant mortality map
- Make fetal-infant mortality maps for different time periods, subpopulations and geographic areas
- Select reference populations (and make a fetal-infant mortality map)

- **Calculate excess mortality and identify opportunity gaps**
Back to Urban County Example

. . . What we had done so far . . .

Overall Fetal-Infant Mortality Rate = 10.1
## Calculating Excess Rates
(Urban County vs USA 2000-2002 Reference Group)

<table>
<thead>
<tr>
<th>Urban County</th>
<th>Maternal Health/ Prematurity</th>
<th>Maternal Care</th>
<th>Newborn Care</th>
<th>Infant Health</th>
<th>Fetal-Infant Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>4.2</td>
<td>2.1</td>
<td>1.9</td>
<td>2.0</td>
<td>10.1</td>
</tr>
<tr>
<td>USA Reference Group</td>
<td>2.2</td>
<td>1.5</td>
<td>1.1</td>
<td>0.9</td>
<td>5.7</td>
</tr>
<tr>
<td>Excess Mortality Rates</td>
<td>2.0</td>
<td>0.6</td>
<td>0.8</td>
<td>1.1</td>
<td>4.4</td>
</tr>
</tbody>
</table>
Displaying EXCESS Mortality
(Urban County vs USA 2000-2002 Reference Group)

EXCESS Fetal-Infant Mortality Rate
4.4

Excess Mortality

- MH/P 44%
- IH 25%
- NC 18%
- MC 13%
## Fetal-Infant Mortality Rates by Race/Ethnicity

(Urban County vs USA 2000-2002 Reference Group)

<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>White, non-Hispanic</td>
<td>3.1</td>
<td>2.0</td>
<td>1.9</td>
<td>1.6</td>
<td>8.6</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>8.8</td>
<td>2.4</td>
<td>2.4</td>
<td>4.0</td>
<td>17.6</td>
</tr>
<tr>
<td>Hispanic and other races</td>
<td>4.6</td>
<td>2.0</td>
<td>1.3</td>
<td>2.3</td>
<td>10.2</td>
</tr>
<tr>
<td>USA Reference Group</td>
<td>2.2</td>
<td>1.5</td>
<td>1.1</td>
<td>0.9</td>
<td>5.7</td>
</tr>
</tbody>
</table>
# Excess Fetal-Infant Mortality Rates

(Urban County vs USA 2000-2002 Reference Group)

<table>
<thead>
<tr>
<th>Racial/Ethnic Groups</th>
<th>Maternal Health/Prematurity</th>
<th>Maternal Care</th>
<th>Newborn Care</th>
<th>Infant Health</th>
<th>Fetal-Infant Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>White, non-Hispanic</td>
<td>0.9</td>
<td>0.5</td>
<td>0.8</td>
<td>0.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>6.6</td>
<td>0.9</td>
<td>1.3</td>
<td>3.1</td>
<td>11.9</td>
</tr>
<tr>
<td>Other Races</td>
<td>2.4</td>
<td>0.5</td>
<td>0.2</td>
<td>1.4</td>
<td>4.5</td>
</tr>
<tr>
<td>All</td>
<td>2.0</td>
<td>0.6</td>
<td>0.8</td>
<td>1.1</td>
<td>4.4</td>
</tr>
</tbody>
</table>
EXCESS Mortality
(Urban County vs USA 2000-2002 Reference Group)

White Excess Mortality
- IH: 24%
- MH/P: 31%
- NC: 28%
- MC: 19%

Black Excess Mortality
- IH: 26%
- MH/P: 55%
- NC: 11%
- MC: 8%
CALCULATING *EXCESS NUMBER OF DEATHS* FROM Fetal-Infant Mortality Rates (Urban County vs USA 2000-2002 Reference Group)

Formula:

\[
\text{estimated number of excess deaths} = \text{excess rate} \times \frac{\text{denominator}}{1,000}
\]
## CALCULATING *EXCESS NUMBER OF DEATHS* FROM Fetal-Infant Mortality Rates
(Urban County vs USA 2000-2002 Reference Group)

<table>
<thead>
<tr>
<th>Racial/ Ethnic Group</th>
<th>Overall Excess Mortality Rate</th>
<th>Live Births and Fetal deaths</th>
<th>Multiply</th>
<th>Number of Excess Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Non-Hispanic</td>
<td>2.9</td>
<td>16,045</td>
<td>(2.9 \times 16,045) (\text{1,000})</td>
<td>47</td>
</tr>
<tr>
<td>Black Non-Hispanic</td>
<td>11.9</td>
<td>3,291</td>
<td>(11.9 \times 3,291) (\text{1,000})</td>
<td>39</td>
</tr>
<tr>
<td>Other Race</td>
<td>4.5</td>
<td>3,947</td>
<td>(4.5 \times 3,947) (\text{1,000})</td>
<td>18</td>
</tr>
<tr>
<td>All</td>
<td>4.4</td>
<td>23,282</td>
<td>(4.4 \times 23,282) (\text{1,000})</td>
<td>103</td>
</tr>
</tbody>
</table>
Estimated *Excess Number of Deaths*

(Urban County vs USA 2000-2002 Reference Group)

<table>
<thead>
<tr>
<th>Racial/Ethnic Groups</th>
<th>Maternal Health/ Prematurity</th>
<th>Maternal Care</th>
<th>Newborn Care</th>
<th>Infant Health</th>
<th>Fetal-Infant Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>White, non-Hispanic</td>
<td>14</td>
<td>8</td>
<td>13</td>
<td>11</td>
<td>47</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>22</td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>39</td>
</tr>
<tr>
<td>Other Races</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>All</td>
<td>46</td>
<td>13</td>
<td>18</td>
<td>26</td>
<td>103</td>
</tr>
</tbody>
</table>
Rates and Numbers Can Tell Different Stories
(Urban County vs USA 2000-2002 Reference Group)

Excess Rates
- White: 4.5
- Black: 2.9
- Other: 11.9

Excess Numbers
- White: 18
- Black: 39
- Other: 47

How do we choose?
- Large differences in rates can point to “low hanging fruit”
- Large numbers can show overall “burden”
Phase 1 Narrows the Choices of Action

- **Maternal Health/Prematurity**
  - Preconception Health
  - Health Behaviors Perinatal Care etc.

- **Maternal Care**
  - Prenatal Care
  - High Risk Referral Obstetric Care etc.

- **Newborn Care**
  - Perinatal Management
  - Neonatal Care Pediatric Surgery etc.

- **Infant Health**
  - Sleep Position
  - Smoking Injury Prevention etc.
Phase 1 is NOT enough.

Phase 2 analyses are REQUIRED to determine which RISK FACTORS are most important in YOUR COMMUNITY…
PPOR Phase 1: EXERCISE