AN ANALYSIS OF MATERNAL NEAR MISSES AND FAILURE TO RESCUE USING TWO NATIONAL DATA SETS

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BACKGROUND

• The U.S. maternal mortality rate increased from 18.8 per 100,000 in 2000 to 23.8 per 100,000 in 2014 (MacDorman et al., 2016).
• For each woman who dies as the direct or indirect result of pregnancy as many as 50 to 100 women experience life-threatening complications (Creagno et al., 2015; Grobman et al., 2014).

METHODS

• Use of a descriptive, epidemiological, cohort design to analyze the U.S. CDC’s National Birth and Multiple-Cause-Of-Death records.
• Calculation of failure to rescue using an approach endorsed by the National Quality Measure Clearinghouse and the Agency for Healthcare Research and Quality that is tailored for the maternal population.

$$\frac{(D_a + D_{uc})}{(B_a + B_{uc})} \quad \text{Where:}$$

- \(D_a = \) Deaths from a subset of complications documented on the birth record
- \(D_{uc} = \) Deaths with undocumented complications from the death record
- \(B_a = \) Births with a subset of complications documented on the birth record
- \(B_{uc} = \) Births with undocumented complications on the birth record

• We will extract data documenting five specific complications.

1) hemorrhage, 2) hypertension (both chronic and gestational), 3) diabetes (both chronic and gestational), 4) eclampsia, and 5) cesarean delivery

Table 1. Planned Analysis for Each Aim

<table>
<thead>
<tr>
<th>Aim</th>
<th>Statistical Analysis</th>
<th>Examples of Functions if applicable</th>
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</thead>
<tbody>
<tr>
<td>Aim I</td>
<td>Frequency counts, contingency tables (Chi-square test)</td>
<td>Logistic Regression: $$\text{Logit} \ P(Y) = \log \left( \frac{P(Y)}{1-P(Y)} \right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_j x_j$$</td>
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<td></td>
<td>Multiple Logistic Regression Decision Tree (CHAID) Analysis</td>
<td>$y \sim \text{occurrence of maternal morbidity (yes or no)}$; $x_1 \sim$ delivery in medically underserved and/or health profession shortage area (yes or no); $x_2 \sim$ cesarean section (yes or no); $x_3 \sim$ demographic variable 1; $x_4 \sim$ demographic variable 2; $\cdots$</td>
</tr>
<tr>
<td>Aim II</td>
<td>Correlation (including Spatial Correlation) Chi-square test of independence Multiple Linear Regression</td>
<td>Linear Regression: $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_j x_j$ $y \sim$ maternal mortality rate of a county $x_1 \sim$ percentage of death cause A $x_2 \sim$ percentage of death cause B $x_3 \sim$ county factor A $x_4 \sim$ county factor B $\cdots$</td>
</tr>
<tr>
<td>Aim III</td>
<td>Multiple Linear Regression Modified AHRQ Calculation of failure to rescue</td>
<td>Linear Regression: $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_j x_j$ $y \sim$ failure to rescue $x_1 \sim$ county factor A $x_2 \sim$ county factor B $\cdots$</td>
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OPERATIONAL DEFINITIONS OF VARIABLES

• Maternal Morbidity: those complications that increase the risk for maternal mortality that are recorded on the birth certificate as a maternal complication, risk, or condition.
• Maternal Mortality: an underlying cause of death within 1 year of end of pregnancy (recorded on the death certificate as an ICD10 code O00-O999). These codes are defined as deaths from causes originating during pregnancy, childbirth, and the postpartum period. These death codes indicate a cause/temporal relationship to pregnancy and maybe underlying, direct, or indirect causes of the maternal death.
• Near Miss: is delivery in which the mother experienced maternal morbidity and survived for at least 1 year after delivery.
• Failure to Rescue: a calculation using data from national birth and death records that represents a population-level assessment of how well-health-care services have responded to prevent maternal mortalities in the presence of maternal morbidities.

PURPOSE

The purpose of this study is to use a population-level approach to identify and quantify maternal near miss events and failure to rescue in the United States from 2012 through 2015. Specific aims are as follows:

1) explore and describe the relationships between maternal morbidity and selected demographic and clinical variables;
2) use U.S. population-level birth and mortality data to estimate the rate of near-miss events per 100,000 births; and
3) use U.S. population-level birth and mortality data to estimate the rate of failure to rescue per 100,000 births.

DISCUSSION

Applying the concept of “near misses” and “failure to rescue” to analysis of U.S. birth data will increase unexplored, but essential, knowledge related to rising maternal morbidity and mortality rates, guiding system modifications that would facilitate safe birth.