Hospital Variations in Unexpected Newborn Complications

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Agenda

1. Background and study objectives
2. Methods
3. Findings
4. Conclusions
Background

• A gap in perinatal outcome measures for low-risk term babies
  – Frequent focus on preterm, low birth weight, congenital anomalies, medical conditions

• Unexpected complications in term newborns
  – Of term babies without preexisting conditions, how many have unexpected complications?
Unexpected Newborn Complications

• Measure developed by the California Maternal Quality Care Collaborative
• Endorsed by the National Quality Forum
• CMQCC special report (2013)
  – 8-fold variation in hospital complication rates in CA
  – Opportunities for improvement
Study objectives

1. Examine individual and hospital factors associated with unexpected complications in Florida
2. Assess extent to which they explain hospital variation in complication rates
3. Explore potential reasons for the differences
Methods

• Study design: retrospective cohort
• Data:
  – Florida linked birth certificate + maternal inpatient hospital discharge records
  – Years: 2004-2013
Methods

• Study population:
  – Singleton livebirths
  – Term (37-41 completed weeks gestation)
  – ≥2500 grams birth weight
  – Nonanomalous and unexposed to maternal drug use

• Study exclusion: hospitals w/ less than 100 births/year
Severe complications

- Severe respiratory, infectious, birth injury, and neurologic
- Apgar Score ≤3 at 5 or 10 min of life
- Transfer to another hospital*
- Neonatal death
- Calculation:

\[
\text{Severe complication births} \times 1000 \text{ livebirths} \div \text{Study population}
\]

https://www.cmqcc.org/focus-areas/quality-metrics/unexpected-complications-term-newborns
Moderate complications

- Less severe respiratory, trauma, and neurologic
- Infections w/ longer LOS w/o sepsis
- LOS > 5 days w/o jaundice/social reason
- Calculation:

\[
\frac{\text{Moderate complication births} \times 1000 \text{ livebirths}}{\text{Study population}}
\]

https://www.cmqcc.org/focus-areas/quality-metrics/unexpected-complications-term-newborns
Total complications

\[
\frac{(\text{Severe} + \text{moderate complication births}) \times 1000 \text{ livebirths}}{\text{Study population}}
\]
Statistical analysis

• Logistic mixed effects models
  – Risk factors for complications
    • Adjusted odds ratio (aOR) and 95% confidence interval (CI)
  – Percentage of hospital variation in complication rates explained by factors

• Descriptive tables
  – Reasons for hospital differences (diagnosis subcategories)
Unexpected Complication Rates
Hospital rates, Florida, 2004-2013

Population rates (1604774 births):
- Severe, 18.0 per 1000 births
- Moderate, 18.7 per 1000 births
- Total, 36.7 per 1000 births
Individual and Hospital Risk Factors for Unexpected Complications
Significant factors identified

**Socioeconomic:**
Maternal age, race/ethnicity, marital status, father’s acknowledgement on birth certificate, education, insurance

**Medical:**
Birth order and history, prepregnancy BMI, tobacco use

**Health service-related:**
Adequacy of prenatal care, timing/reason for delivery initiation, day of week delivered, delivery year

**Hospital:**
Level of NICU/birth volume, hospital Medicaid births percentage, hospital geographic location
## Complications by selected individual factors

<table>
<thead>
<tr>
<th></th>
<th>Live births</th>
<th>Severe Complications</th>
<th>Moderate Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rate/1000</td>
<td>aOR (95% CI)</td>
</tr>
<tr>
<td><strong>Timing/reason for delivery initiation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI I/CS, 37-38 weeks</td>
<td>139893</td>
<td>27.1</td>
<td><strong>2.28 (2.19,2.38)</strong></td>
</tr>
<tr>
<td>39+ weeks, w/o MI</td>
<td>603353</td>
<td>14.4</td>
<td>Reference</td>
</tr>
<tr>
<td><strong>Prenatal care (GINDEX)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive/Adequate</td>
<td>550705</td>
<td>17.0</td>
<td>Reference</td>
</tr>
<tr>
<td>No care</td>
<td>15237</td>
<td>38.1</td>
<td><strong>1.80 (1.63,1.98)</strong></td>
</tr>
<tr>
<td><strong>Birth order &amp; history</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First delivery</td>
<td>676167</td>
<td>22.3</td>
<td><strong>1.60 (1.56,1.65)</strong></td>
</tr>
<tr>
<td>Second/third, no previous CS</td>
<td>542965</td>
<td>14.0</td>
<td>Reference</td>
</tr>
<tr>
<td><strong>Prepregnancy BMI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>745076</td>
<td>16.2</td>
<td>Reference</td>
</tr>
<tr>
<td>Obese III</td>
<td>50704</td>
<td>26.9</td>
<td><strong>1.47 (1.39,1.56)</strong></td>
</tr>
</tbody>
</table>

**Notes.** Some categories omitted for simplicity.
Odds ratios adjusted for significant individual and hospital factors.

Our Practice Is Our Passion
## Complications by hospital factors

<table>
<thead>
<tr>
<th>Geographic location</th>
<th>Live births</th>
<th>Severe Complications</th>
<th>Moderate Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate/1000</td>
<td>aOR (95% CI)</td>
<td>Rate/1000</td>
</tr>
<tr>
<td>Eastern FL</td>
<td>332057</td>
<td>17.6</td>
<td>14.8</td>
</tr>
<tr>
<td>Southern FL</td>
<td>235834</td>
<td>19.6</td>
<td><strong>1.91 (1.45,2.51)</strong></td>
</tr>
</tbody>
</table>

### NICU level/Birth volume quartile

<table>
<thead>
<tr>
<th>NICU level/Birth volume quartile</th>
<th>Live births</th>
<th>Severe Complications</th>
<th>Moderate Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I, bottom</td>
<td>42392</td>
<td>9.5</td>
<td><strong>1.58 (1.31,1.91)</strong></td>
</tr>
<tr>
<td>Level I, top</td>
<td>185799</td>
<td>15.8</td>
<td>1.27 (1.08,1.49)</td>
</tr>
<tr>
<td>Level III, bottom</td>
<td>89239</td>
<td>16.6</td>
<td>Reference</td>
</tr>
<tr>
<td>Level III, top</td>
<td>273924</td>
<td>21.2</td>
<td><strong>1.10 (0.96,1.27)</strong></td>
</tr>
</tbody>
</table>

### Medicaid births percentage quartile

<table>
<thead>
<tr>
<th>Medicaid births percentage quartile</th>
<th>Live births</th>
<th>Severe Complications</th>
<th>Moderate Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom</td>
<td>624678</td>
<td>15.5</td>
<td>13.4</td>
</tr>
<tr>
<td>Top</td>
<td>150523</td>
<td>22.0</td>
<td><strong>1.42 (1.30,1.56)</strong></td>
</tr>
</tbody>
</table>

**Notes.** Some categories omitted for simplicity. Odds ratios adjusted for significant individual and hospital factors.
Contributions to Variation in Complication Rates
Between-Hospital variability in complications

Between-Hospital Variance (Log-odds)

<table>
<thead>
<tr>
<th>Model</th>
<th>Severe</th>
<th>Moderate</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.33</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.31</td>
<td>0.26</td>
<td>0%</td>
</tr>
<tr>
<td>3</td>
<td>0.20</td>
<td>0.18</td>
<td>-41.0%</td>
</tr>
<tr>
<td>4</td>
<td>0.18</td>
<td>0.19</td>
<td>-26.2%</td>
</tr>
</tbody>
</table>

Model 1: no covariates (unadjusted); 2: individual factors 3: individual + hospital factors; 4: individual + hospital factors + year
## Complications diagnosis subcategories by hospital factors

<table>
<thead>
<tr>
<th></th>
<th>Severe Complications/1000 births</th>
<th>Moderate Complications/1000 births</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diagnosis subcategories</td>
<td>Diagnosis subcategories</td>
</tr>
<tr>
<td></td>
<td>Respiratory</td>
<td>Infection</td>
</tr>
<tr>
<td>Population total</td>
<td>2.4</td>
<td>7.9</td>
</tr>
<tr>
<td>Geographic location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern FL</td>
<td>1.8</td>
<td>7.8</td>
</tr>
<tr>
<td>Southern FL</td>
<td>2.1</td>
<td>18.9</td>
</tr>
<tr>
<td>NICU Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level I</td>
<td>2.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Level III</td>
<td>2.3</td>
<td>8.2</td>
</tr>
<tr>
<td>Medicaid births</td>
<td></td>
<td></td>
</tr>
<tr>
<td>percentage quartile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom</td>
<td>1.9</td>
<td>6.4</td>
</tr>
<tr>
<td>Top</td>
<td>2.8</td>
<td>11.0</td>
</tr>
</tbody>
</table>

Hospital transfer rates range:
- Level I, 0 to 67 per 1000
- Level III, 0 to 3 per 1000

Notes. <sup>a</sup> Long length of stay without specified diagnosis. Subcategories are not mutually exclusive. Unadjusted rates shown.
Conclusions

1. High hospital rates of severe or moderate complications may reflect different issues
   – A hospital’s rate for one did not predict its rate for the other.
   – Significant hospital factors differed by severe versus moderate.

2. Variation in complication rates driven more by hospital than individual factors
   – Substantial reduction in variability after adjusting for sig. hospital factors
   – Specific diagnosis subcategories appear to explain hospital factors
Conclusions

3. Differences in complications rates may be related to differences in quality of care and hospital coding practice

– Variation in specific complication subcategories by and within level of care
Implications

• Utility of the unexpected complications measure
  – Specific complication subcategories may guide quality improvement.

• Potential different quality issues to be addressed by level of care

• Potential opportunities for maternal prevention
  – Individual medical and health service-related factors
Limitations

• Neonatal transfer: Level of care of receiving hospital
• Underreporting and accuracy issues for some procedures and conditions in dataset
• Inability to tease out differences due to quality of care vs. quality of reporting
  – A direction for hospital quality improvement