The Burden of Neonatal Abstinence Syndrome (NAS) in Michigan

Michigan FIMR Quarterly Meeting
December 1, 2016
Outline

• Background
• Methods
• Results
  • State
  • Length of stay & cost
  • Region
  • Maternal characteristics
  • New method for calculating NAS rates
• Conclusion
• Public Health Implications
Background

• Neonatal Abstinence Syndrome (NAS), sometimes referred to as Neonatal Withdrawal Syndrome (NWS), occurs in a newborn who was exposed to addictive illegal or prescription drugs in utero.

• Two major types are recognized
  • Due to prenatal or maternal use during pregnancy
  • Postnatal NAS secondary to discontinuation of medications such as fentanyl or morphine used for pain therapy in the infant

• The risk is greatest when the mother uses prescription opioid pain relievers or heroin during pregnancy $^{1-2}$
Background-1

• Maternal substance use is a leading preventable cause of mental, physical and psychological problems in infants and children.
• Infants with NAS are more likely to be born with low birthweight, have breathing and feeding problems, and seizures.
• Signs can include tremors, twitching, fussiness, excessive crying, fever, trouble sleeping, diarrhea, vomiting, and/or stuffiness/sneezing.
Drugs Associated with NAS

- Opioids:
  - Heroin
  - Methadone
  - Fentanyl
  - Morphine
  - Demerol
  - OxyContin

- Non-opioid CNS Depressants:
  (May mimic NAS)
  - Benzodiazepines
  - SSRI’s
  - Barbiturates
  - Anticonvulsants
  - Antipsychotics
  - Alcohol
Background -2

1804: Morphine isolated
1817: Marketed as analgesic
1827: Commercial production

1853: Hypodermic needle developed

1874: Heroin synthesized
1898: Commercial production

1875: First reported case of neonatal withdrawal
1892: Series of 12 infants, 9 died. Paregoric was tried

1903: Morphine treatment for neonates reported

1937: Methadone developed
1964: Methadone maintenance treatment
1971: Methadone withdrawal in 5 neonates

1967: Buprenorphine developed
1966: Buprenorphine use in France
2002: FDA approval for opioid dependence
2002: First reported case of NAS due to oxycontin
2012: Epidemic of NAS

2001: Series of buprenorphine withdrawal in 13 infants

Opioid analgesic medications:
Vicodine (1984)
Oxycontin (1989)
Percocet (1999)
Background-3

• Prescription drug use is growing
  • Increase in overdoses and deaths associated with non-medical prescription drug use over the past decade
Number of Opioid-related* Drug Poisoning Deaths by Female, MI, 1999-2014

Source: Michigan Death Certificate Files, Division for Vital Records and Health Statistics, MDHHS

*Opioid-related includes opioid w/o heroin or cocaine; opioid w/ heroin, w/o cocaine; opioid w/ cocaine, w/o heroin; opioid with heroin and cocaine
The use of opioids during pregnancy can result in a drug withdrawal syndrome in newborns called Neonatal Abstinence Syndrome (NAS), which causes lengthy and costly hospital stays. According to a new study, an estimated 21,732 babies were born with this syndrome in the United States in 2012, a 5-fold increase since 2000.

Every 25 minutes, a baby is born suffering from opioid withdrawal.

Average length or cost of hospital stay:

<table>
<thead>
<tr>
<th></th>
<th>With NAS</th>
<th>W/O NAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEWBORN</td>
<td>16.9</td>
<td>2.1</td>
</tr>
<tr>
<td>NAS</td>
<td>3.5K</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Rate per 1000 hospital births:

- Newborns suffering from opioid withdrawal
- Maternal opioid use


• Treatment may be pharmacologic or non-pharmacologic.

• Michigan is participating in Vermont Oxford Network Quality Improvement initiative to improve NAS care
  • Goal is to improve care, reduce length of stay and costs
  • 18 NICUs participated
  • 20 NICUs and 6 Well Newborn and/or Special Care Nurseries continuing QI efforts as part of collaborative

• Once discharged, infants need a multidisciplinary approach

• Long term effects, beyond the first years of life are unknown.
Methods

• Data Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation. This file was linked to the Michigan Resident Live Birth File by the Division for Vital Records and Health Statistics, MDHHS).

• Case Definition based on ICD-9 779.5- Neonatal Abstinence Syndrome-pharmacologically treated
  • At the time of analysis this was based on consensus
  • Definition may be broadened to include NAS non-pharmacologically treated
  • Attempted to analyze drug exposure, but codes may be used inconsistently
Results - Michigan

Rate of Neonatal Abstinence Syndrome by Year among Michigan Infants, 2000-2014

From 2010 to 2014, the NAS rate nearly doubled statewide.

The rate in 2014 was six times the rate 10 years earlier (2005).

Data Source: Michigan Inpatient Database
NWS defined by ICD-9-CM diagnosis code 779.5
Results - Michigan (Length of Stay and Costs)

Average Hospital Length of Stay for Infants with Treated Neonatal Abstinence Syndrome (779.5), Michigan 2010-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Length of Stay</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>15.8</td>
</tr>
<tr>
<td>2011</td>
<td>15.1</td>
</tr>
<tr>
<td>2012</td>
<td>15.6</td>
</tr>
<tr>
<td>2013</td>
<td>13.9</td>
</tr>
<tr>
<td>2014</td>
<td>15.4</td>
</tr>
</tbody>
</table>

Median Per Child Hospitalization Charges (Treated NAS: 779.5)

<table>
<thead>
<tr>
<th>Year</th>
<th>Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>$24,302</td>
</tr>
<tr>
<td>2011</td>
<td>$25,415</td>
</tr>
<tr>
<td>2012</td>
<td>$28,413</td>
</tr>
</tbody>
</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
NAS is highest in the Upper Peninsula (Region 8), Region 3 and Region 7

Based on perinatal regions
Results - Region 1

Neonatal Abstinence Syndrome
Rate per 100,000 Births
Michigan - Perinatal Region 1

Perinatal Region 1

<table>
<thead>
<tr>
<th>Year</th>
<th>Births</th>
<th>N with Treated NAS (779.5)</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>11,492</td>
<td>40</td>
<td>348.1</td>
</tr>
<tr>
<td>2011</td>
<td>11,611</td>
<td>61</td>
<td>525.4</td>
</tr>
<tr>
<td>2012</td>
<td>11,372</td>
<td>63</td>
<td>554.0</td>
</tr>
<tr>
<td>2013</td>
<td>11,404</td>
<td>75</td>
<td>657.7</td>
</tr>
<tr>
<td>2014</td>
<td>11,758</td>
<td>90</td>
<td>765.4</td>
</tr>
</tbody>
</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
### Results - Region 2N

#### Neonatal Abstinence Syndrome Rate per 100,000 Births

<table>
<thead>
<tr>
<th>Year</th>
<th>Births</th>
<th>N with Treated NAS (779.5)</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>23,814</td>
<td>80</td>
<td>335.9</td>
</tr>
<tr>
<td>2011</td>
<td>24,077</td>
<td>125</td>
<td>519.2</td>
</tr>
<tr>
<td>2012</td>
<td>23,995</td>
<td>106</td>
<td>441.8</td>
</tr>
<tr>
<td>2013</td>
<td>24,437</td>
<td>165</td>
<td>675.2</td>
</tr>
<tr>
<td>2014</td>
<td>24,419</td>
<td>140</td>
<td>573.3</td>
</tr>
</tbody>
</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
Results - Region 2S

Neonatal Abstinence Syndrome Rate per 100,000 Births
Michigan - Perinatal Region 2S

<table>
<thead>
<tr>
<th>Year</th>
<th>Births</th>
<th>N with Treated NAS</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>29,610</td>
<td>84</td>
<td>283.7</td>
</tr>
<tr>
<td>2011</td>
<td>29,135</td>
<td>108</td>
<td>370.7</td>
</tr>
<tr>
<td>2012</td>
<td>28,363</td>
<td>132</td>
<td>465.4</td>
</tr>
<tr>
<td>2013</td>
<td>28,790</td>
<td>125</td>
<td>434.2</td>
</tr>
<tr>
<td>2014</td>
<td>28,612</td>
<td>146</td>
<td>510.3</td>
</tr>
</tbody>
</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
Results - Region 3

Neonatal Abstinence Syndrome
Rate per 100,000 Births
Michigan - Perinatal Region 3

<table>
<thead>
<tr>
<th>Year</th>
<th>Births</th>
<th>N with Treated NAS (779.5)</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>12,107</td>
<td>54</td>
<td>446.0</td>
</tr>
<tr>
<td>2011</td>
<td>11,749</td>
<td>96</td>
<td>817.1</td>
</tr>
<tr>
<td>2012</td>
<td>11,633</td>
<td>96</td>
<td>825.2</td>
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<tr>
<td>2013</td>
<td>11,632</td>
<td>118</td>
<td>1014.4</td>
</tr>
<tr>
<td>2014</td>
<td>11,715</td>
<td>165</td>
<td>1408.5</td>
</tr>
</tbody>
</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
Results - Region 5

Neonatal Abstinence Syndrome
Rate per 100,000 Births
Michigan - Perinatal Region 5

Perinatal Region 5

<table>
<thead>
<tr>
<th>Year</th>
<th>Births</th>
<th>N with Treated NAS (779.5)</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>11,592</td>
<td>32</td>
<td>276.1</td>
</tr>
<tr>
<td>2011</td>
<td>11,333</td>
<td>47</td>
<td>414.7</td>
</tr>
<tr>
<td>2012</td>
<td>11,132</td>
<td>62</td>
<td>557.0</td>
</tr>
<tr>
<td>2013</td>
<td>11,451</td>
<td>68</td>
<td>593.8</td>
</tr>
<tr>
<td>2014</td>
<td>11,494</td>
<td>65</td>
<td>565.5</td>
</tr>
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</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
Results - Region 6

Neonatal Abstinence Syndrome
Rate per 100,000 Births
Michigan - Perinatal Region 6

Perinatal Region 6

<table>
<thead>
<tr>
<th>Year</th>
<th>Births</th>
<th>N with Treated NAS (779.5)</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>18,644</td>
<td>46</td>
<td>246.7</td>
</tr>
<tr>
<td>2011</td>
<td>18,735</td>
<td>59</td>
<td>314.9</td>
</tr>
<tr>
<td>2012</td>
<td>18,765</td>
<td>86</td>
<td>458.3</td>
</tr>
<tr>
<td>2013</td>
<td>18,660</td>
<td>104</td>
<td>557.3</td>
</tr>
<tr>
<td>2014</td>
<td>18,826</td>
<td>102</td>
<td>541.8</td>
</tr>
</tbody>
</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
Results- Region 7

Neonatal Abstinence Syndrome
Rate per 100,000 Births
Michigan - Perinatal Region 7

<table>
<thead>
<tr>
<th>Year</th>
<th>Births</th>
<th>N with Treated NAS (779.5)</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>4,651</td>
<td>36</td>
<td>774.0</td>
</tr>
<tr>
<td>2011</td>
<td>4,684</td>
<td>29</td>
<td>619.1</td>
</tr>
<tr>
<td>2012</td>
<td>4,627</td>
<td>37</td>
<td>799.7</td>
</tr>
<tr>
<td>2013</td>
<td>4,595</td>
<td>49</td>
<td>1066.4</td>
</tr>
<tr>
<td>2014</td>
<td>4,781</td>
<td>47</td>
<td>983.1</td>
</tr>
</tbody>
</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
Results- Region 8

Neonatal Abstinence Syndrome Rate per 100,000 Births
Michigan - Perinatal Region 8

<table>
<thead>
<tr>
<th>Year</th>
<th>Births</th>
<th>N with Treated NAS (779.5)</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>2,807</td>
<td>32</td>
<td>1140.0</td>
</tr>
<tr>
<td>2011</td>
<td>2,835</td>
<td>29</td>
<td>1022.9</td>
</tr>
<tr>
<td>2012</td>
<td>2,831</td>
<td>40</td>
<td>1412.9</td>
</tr>
<tr>
<td>2013</td>
<td>2,762</td>
<td>45</td>
<td>1629.3</td>
</tr>
<tr>
<td>2014</td>
<td>2,854</td>
<td>60</td>
<td>2102.3</td>
</tr>
</tbody>
</table>

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
Maternal Characteristics  NAS treated vs. NAS not pharmacologically treated

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
Maternal Characteristics  NAS treated vs. NAS not pharmacologically treated, continued

Neonatal Abstinence Syndrome Rates (Treated vs. Not Treated) by Maternal Race/Ethnicity and Insurance Status, Michigan 2014

Source: Michigan Resident Inpatient Files, created using data from the Michigan Inpatient Database obtained with permission from the Michigan Health & Hospital Association Service Corporation.
New Method for Calculating NAS Rates

- Previous: Based on number of hospital discharges with ICD-9 779.5 code
  - Some infants have more than one hospital admission for NAS (duplicates)
- New: Based on number of infants with ICD-9 779.5 code
  - Only one occurrence per infant (no duplicates)

<table>
<thead>
<tr>
<th>Year</th>
<th>Previous Method</th>
<th>New Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>188.9</td>
<td>191.4</td>
</tr>
<tr>
<td>2009</td>
<td>289.0</td>
<td>282.1</td>
</tr>
<tr>
<td>2010</td>
<td>362.6</td>
<td>352.2</td>
</tr>
<tr>
<td>2011</td>
<td>479.2</td>
<td>481.8</td>
</tr>
<tr>
<td>2012</td>
<td>549.2</td>
<td>548.3</td>
</tr>
<tr>
<td>2013</td>
<td>656.8</td>
<td>653.3</td>
</tr>
<tr>
<td>2014</td>
<td>712.0</td>
<td>710.3</td>
</tr>
</tbody>
</table>
Conclusions

• NAS is increasing in Michigan
• Little change in average length of stay, but costs are increasing
• Rates are highest in the Upper Peninsula and Northern Lower Michigan
• Rates are highest among women 20 years of age and older, especially women 20-29 years
• Rates are highest for White, non-Hispanic and women who intended to pay for delivery using Medicaid Insurance.
• New calculation method doesn’t significantly impact NAS rates.
Public Health Implications

• Access to illicit substances and community response are factors that impact the trend

• Punitive measures are ineffective in reducing drug-use in women. \(^3\)-\(^4\)

• “Programs tailored for drug-using pregnant women need to address factors contributing to their drug abuse and adverse perinatal outcomes such as women’s reticence to access substance abuse treatment and prenatal care, their lack of medical insurance and social support, and poverty, especially in rural areas.”\(^5\)
References


