LONG-TERM OUTCOMES OF NEONATAL ABSTINENCE SYNDROME: IMPLICATIONS FOR PROVIDERS AND CAREGIVERS

October 29, 2018
2:30 pm – 3:30 pm EST
Today’s Speakers

Peggy Honein, PhD, MPH
Director, Division of Congenital and Developmental Disorders

Michael Warren, MD, MPH, FAAP
Associate Administrator, Maternal and Child Health Bureau, Health Resources and Services Administration

Mary-Margaret A. Fill, MD
Medical Epidemiologist, Tennessee Department of Health
Introduction and Welcome

Rebecca Russell, MSPH
SVP (Interim) Science and Strategy Senior Director,
Applied Research and Evaluation, March of Dimes
Maternal and Child Health Impact of the U.S. Opioid Epidemic

Margaret (Peggy) Honein, PhD, MPH
Director, Division of Congenital and Developmental Disorders
National Center on Birth Defects and Developmental Disabilities
Centers for Disease Control and Prevention

October 29, 2018
Overview of the Opioid Epidemic

- In 2016, about 11.8 million people in the U.S. misused opioids in the past year, including:
  - 11.5 million pain reliever misusers
  - 948,000 heroin users
- Increase in drug overdose deaths
- Vulnerable populations affected include pregnant women and infants

U.S. State Opioid Prescribing Rates, 2016
Opioid Use among Women

About 1 in 3 women of reproductive age filled an opioid prescription between 2008 – 2012.

Opioid use disorder rates at delivery increased by more than 4-fold during 1999 to 2014.


Every **15** minutes, a baby was born with NAS

Nearly **100** babies each day

Babies born with **NAS** experience serious medical problems

In 2014, for NAS total hospital costs in the US were over **$563 million**

Winkelman, Villapiano, Kozhimannil, Davis & Patrick, 2018
Protecting Our Infants Act, 2015

- Department of Health and Human Services:
  - Review and improve coordination
  - Develop a strategy to address gaps in research and federal programs
  - Study and develop recommendations for preventing and treating prenatal opioid use and neonatal abstinence syndrome
  - Improve data and public health response by supporting states and tribes
Outcomes Associated With Prenatal Opioid Exposure

Birth Defects?

Poor Pregnancy Outcomes?

Neonatal Abstinence Syndrome (NAS)

Long Term Outcomes

Conception

Delivery

Infancy

Childhood
Current NCBDDDD-Supported Efforts

- With March of Dimes on two NAS pilot projects
  - NAS surveillance based on birth defects surveillance
    - Grantees: Illinois, New Mexico, Vermont
    - Readmissions and adverse outcomes through one year of age
    - Inform NAS surveillance and prevention efforts in other states
  - Understanding the long-term outcomes of NAS: Tennessee Pilot

- With other groups at CDC and other partners
  - Assess various aspects about NAS across the U.S.
  - Broader impact of prenatal opioid exposure on the infant
FY19 Budget Initiatives

- $10 million for surveillance of emerging threats to mothers and babies
  - Leverage Zika pregnancy and birth defects surveillance system
  - Capture real-time data that can rapidly be translated into clinical guidance
  - Understand long-term implications of known or emerging threats, including infectious agents, vaccines, or medications, such as opioids

- $2 million for surveillance of neonatal abstinence syndrome

Leverage Zika Infrastructure for Prenatal Opioid Exposure

Anecdotal reports, but no formal data collection on impacts during pregnancy

2009 H1N1

2015 Ebola

2016 Zika

Opioid crisis?
### State Spotlight: Pennsylvania

**Background:** On January 10, 2018, PA Governor added neonatal abstinence syndrome (NAS) as a reportable condition as part of a 90-day state of emergency for the opioid epidemic. Prior to the 2017 implementation of PA’s Zika Birth Defects Surveillance (ZBDS), the state had never collected data on birth defects or NAS.

#### Methods
- Developed **strategy for facility outreach** based on live birth counts and reported neonatal intensive care units (NICUs)
- Created a brief **one-page NAS case report**
- Created **electronic survey** using REDCap Cloud

#### Results
- REDCap Cloud survey for **NAS** surveillance created in **2 days**
  - After 1 month: **342** cases of **NAS** reported from **57** (61% of) facilities
  - 7 weeks after distribution: **520** cases of **NAS** reported

**Rapid tracking of NAS data within the short 90-day timeframe of the opioid state of emergency**
**Fast turn-around to inform targeted community outreach**
**Blueprint for Pennsylvania’s disaster preparedness for other emerging surveillance needs**
Aligns with CDC’s Mission

- Protect the health, safety, and security of the nation
- Put science into action

**Bottom line:**
- Pregnancy and birth defects surveillance are key components of CDC’s preparedness work.
- Birth defects can be the first sign that an emerging infection causes serious harm.
Questions?

Thank you

For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
Long-Term Outcomes of Neonatal Abstinence Syndrome: Implications for Providers and Caregivers

Mary-Margaret A. Fill, MD
Michael D. Warren, MD, MPH, FAAP
Tennessee Department of Health
Objectives

• Review the clinical presentation and treatment options for infants with NAS

• Discuss possible long-term outcomes of NAS

• Outline opportunities for prevention or early intervention in children and families at risk for NAS
Neonatal Abstinence Syndrome (NAS)

NAS is a postnatal drug withdrawal syndrome that most commonly occurs after intrauterine opioid exposure.
Common Symptoms of NAS

Crying and irritability
Common Symptoms of NAS

Crying and irritability

Feeding difficulties
Common Symptoms of NAS

Crying and irritability

Tremors or hyperactive reflexes

Feeding difficulties
Common Symptoms of NAS

Crying and irritability

Tremors or hyperactive reflexes

Feeding difficulties

Yawning and sneezing
Common Symptoms of NAS

- Crying and irritability
- Tremors or hyperactive reflexes
- Failure to thrive
- Feeding difficulties
- Yawning and sneezing
Common Symptoms of NAS

- Crying and irritability
- Tremors or hyperactive reflexes
- Failure to thrive
- Feeding difficulties
- Yawning and sneezing
- Temperature instability
NAS Treatment

• Nonpharmacologic supportive care
  – Swaddling
  – Minimize environmental stimuli

• Pharmacologic therapy
  – Morphine
  – Buprenorphine
  – Methadone
A Problem of Pandemic Proportions

Year
Rate per 1,000 live births

0.0 1.0 2.0 3.0 4.0 5.0 6.0
W. Australia
Canada
US
UK


Rate per 1,000 live births

Year

TN
In the United States, every 25 MINUTES a baby is born affected by opioid withdrawal.
NAS: A Growing Problem in Tennessee

>1700% INCREASE
East Tennessee Disproportionately Impacted

Rate of NAS per 1,000 live births

- Missing / Excluded
- Less than 3.2 : Q1
- 3.2 to 14.35 : Q2
- 14.35 to 27.75 : Q3
- 27.75 and above : Q4
East Tennessee Disproportionately Impacted

Rate of NAS per 1,000 live births

- Missing / Excluded
- Less than 3.2 : Q1
- 3.2 to 14.35 : Q2
- 14.35 to 27.75 : Q3
- 27.75 and above : Q4
“The Call”

- Anecdotal reports from educators in east Tennessee
- Children with a history of NAS had learning challenges
- No studies examining educational outcomes in the United States
Objective

Examine associations between a history of NAS and educational outcomes.
Potential Educational Data

- Standardized reading / math test scores
  - TN Comprehensive Assessment Program: statewide (3rd grade)
  - Stanford Achievement Test: optional in some districts (K, 1st & 2nd)
- Absenteeism data
  - Excused / unexcused
- Disciplinary data
  - Suspension / expulsion
- Special education data
  - IEP
  - Accommodations
  - Therapies (PT/OT/ST)
Special Education Services in Tennessee

Birth

3 years old

Pre-K

21 years old

TEIS

Special Education
## Qualifying Educational Disabilities in TN

<table>
<thead>
<tr>
<th>Disability</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autism</td>
<td>Intellectually Gifted</td>
</tr>
<tr>
<td>Deaf-Blindness</td>
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</tbody>
</table>
Process Flow

Referral
Process Flow

Referral

Evaluation
Process Flow

1. Referral
2. Evaluation
3. Eligibility Determination
Process Flow

Referral

Evaluation

Eligibility Determination

Development of IEP*

* Individualized Education Program
Process Flow

Referral

Evaluation

Eligibility Determination

Development of IEP

Implementation of Services
Methods: Creation of Dataset

Tennessee Birth Cohort
2008–2011

ICD-9 Diagnosis Code: 779.5
(Drug withdrawal syndrome in newborn)

1:3 matched pairs
Birth certificate data
Enrolled in TennCare
Methods: Creation of Dataset

N = 1815

N = 7260

N = 5445

Special Education Database

*Updated through November 2016*
Outcomes of Interest

- Referral
- Evaluation
- Eligibility Determination
- Development of IEP
- Implementation of Services
Outcomes of Interest

Referral

Evaluation

Eligibility Determination

Development of IEP

Implementation of Services
Outcomes of Interest

- Referral
- Evaluation
- Eligibility Determination
- Development of IEP
- Implementation of Services
Outcomes of Interest

- Referral
- Evaluation
- Eligibility Determination
- Development of IEP
- Implementation of Services
Data Analysis

- Pearson’s Chi Square
  - Descriptive comparisons between groups

- Conditional multivariable logistic regression
  - Associations between a history of NAS and outcomes of interest

- SAS 9.4
## Matched Demographic Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>NAS (+)</th>
<th>NAS (–)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 1815</td>
<td>N = 5441</td>
</tr>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Male</td>
<td>967 (53.3)</td>
<td>2898 (53.3)</td>
</tr>
<tr>
<td>White</td>
<td>1694 (93.4)</td>
<td>5080 (93.4)</td>
</tr>
<tr>
<td>DOB 8/2010–8/2011</td>
<td>631 (34.8)</td>
<td>1893 (34.8)</td>
</tr>
<tr>
<td>East TN residence</td>
<td>1405 (77.4)</td>
<td>4213 (77.4)</td>
</tr>
<tr>
<td>TennCare insurance</td>
<td>1815 (100.0)</td>
<td>5441 (100.0)</td>
</tr>
</tbody>
</table>
## Delivery and Birth Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>NAS (+)</th>
<th>NAS (−)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight &lt;2500g</td>
<td>435 (24.0)</td>
<td>500 (9.2)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Gestational age &lt;37 weeks</td>
<td>392 (21.6)</td>
<td>625 (11.5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>NICU admission</td>
<td>379 (20.9)</td>
<td>315 (5.8)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Maternal tobacco use in pregnancy</td>
<td>1196 (65.9)</td>
<td>1640 (30.1)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
Outcomes of Interest

- Referral
- Evaluation
- Eligibility Determination
- Development of IEP
- Implementation of Services
Outcome #1: Referral for Evaluation

Percent Referred

NAS Status

NAS(+) 19.3%
NAS(−) 13.7%
Outcomes of Interest

- Referral
- Evaluation
- Eligibility Determination
- Development of IEP
- Implementation of Services
Outcome #2: Eligibility Determination

<table>
<thead>
<tr>
<th>Percent Qualified</th>
<th>NAS Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.6%</td>
<td>NAS(+)</td>
</tr>
<tr>
<td>11.7%</td>
<td>NAS(−)</td>
</tr>
</tbody>
</table>
Qualifying Educational Disabilities in TN

- Autism
- Deaf-Blindness
- Deafness
- Developmental Delay
- Emotional Disturbance
- Functional Delay
- Hearing Impairment
- Intellectual Disability
- Intellectually Gifted
- Multiple Disabilities
- Orthopedic Impairment
- Other Health Impairment
- Specific Learning Disabilities
- Speech or Language Impairment
- Traumatic Brain Disorder
- Visual Impairment
# Qualifying Educational Disabilities in TN

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</table>
### Special Education Exceptionalities

<table>
<thead>
<tr>
<th>Outcome</th>
<th>NAS (+) n (%)</th>
<th>NAS (-) n (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autism</td>
<td>6 (0.3)</td>
<td>22 (0.4)</td>
<td>0.8</td>
</tr>
<tr>
<td>Developmental Delay</td>
<td>96 (5.3)</td>
<td>193 (3.6)</td>
<td>0.001</td>
</tr>
<tr>
<td>Other Health Impairment</td>
<td>12 (0.7)</td>
<td>27 (0.5)</td>
<td>0.5</td>
</tr>
<tr>
<td>Specific Learning Disability</td>
<td>7 (0.4)</td>
<td>16 (0.3)</td>
<td>0.6</td>
</tr>
<tr>
<td>Speech / Language Impairment</td>
<td>187 (10.3)</td>
<td>451 (8.3)</td>
<td>0.009</td>
</tr>
</tbody>
</table>
Outcomes of Interest

- Referral
- Evaluation
- Eligibility Determination
- Development of IEP
- Implementation of Services
Outcome #3: Implementation of Services

NAS Status: NAS(+) and NAS(-)

Percent Received:
- NAS(+) = 15.3%
- NAS(-) = 11.4%

Legend:
- NAS(+) = Purple Bar
- NAS(-) = Green Bar
<table>
<thead>
<tr>
<th>Service</th>
<th>NAS (+) n (%)</th>
<th>NAS (−) n (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodations</td>
<td>98 (5.4)</td>
<td>225 (4.1)</td>
<td>0.02</td>
</tr>
<tr>
<td>Aide / Paraprofessional</td>
<td>3 (0.2)</td>
<td>12 (0.2)</td>
<td>0.2</td>
</tr>
<tr>
<td>Occupational Therapy</td>
<td>55 (3.0)</td>
<td>126 (2.3)</td>
<td>0.09</td>
</tr>
<tr>
<td>Physical Therapy</td>
<td>17 (0.9)</td>
<td>54 (1.0)</td>
<td>0.8</td>
</tr>
<tr>
<td>Speech Therapy</td>
<td>255 (14.0)</td>
<td>586 (10.8)</td>
<td>0.0002</td>
</tr>
<tr>
<td>Service</td>
<td>NAS (+) n (%)</td>
<td>NAS (-) n (%)</td>
<td>P Value</td>
</tr>
<tr>
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### Conditional Logistic Regression

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Adjusted Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referred for evaluation</td>
<td>1.44</td>
<td>1.23–1.67</td>
</tr>
<tr>
<td>Eligible for services</td>
<td>1.36</td>
<td>1.15–1.60</td>
</tr>
<tr>
<td>Received therapies/services</td>
<td>1.37</td>
<td>1.16–1.61</td>
</tr>
</tbody>
</table>

* Controlled for matching factors, maternal education status, and maternal tobacco use during pregnancy.
<table>
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<tr>
<th>Outcome</th>
<th>Adjusted Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Delay</td>
<td>1.34</td>
<td>1.03–1.76</td>
</tr>
<tr>
<td>Speech / Language Impairment</td>
<td>1.26</td>
<td>1.04–1.52</td>
</tr>
</tbody>
</table>

* Controlled for matching factors, maternal education status, and maternal tobacco use during pregnancy.
## Conditional Logistic Regression

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</tr>
</thead>
<tbody>
<tr>
<td>Accommodations</td>
<td>1.32</td>
<td>1.03–1.69</td>
</tr>
<tr>
<td>Speech Therapy</td>
<td>1.33</td>
<td>1.12–1.57</td>
</tr>
</tbody>
</table>

* Controlled for matching factors, maternal education status, and maternal tobacco use during pregnancy.
## Additional Regression Models

<table>
<thead>
<tr>
<th>Outcome</th>
<th>aOR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model: maternal education, maternal tobacco, birthweight, NICU</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Referred for evaluation</td>
<td>1.32</td>
<td>1.13–1.55</td>
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<tr>
<td>Eligible for services</td>
<td>1.26</td>
<td>1.07–1.49</td>
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</tr>
<tr>
<td>Eligible for services</td>
<td>1.30</td>
<td>1.10–1.54</td>
</tr>
<tr>
<td>Received therapies/services</td>
<td>1.31</td>
<td>1.10–1.55</td>
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<td><strong>Model: maternal education, maternal tobacco, birthweight, gest age</strong></td>
<td></td>
<td></td>
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<tr>
<td>Referred for evaluation</td>
<td>1.34</td>
<td>1.14–1.58</td>
</tr>
<tr>
<td>Eligible for services</td>
<td>1.28</td>
<td>1.08–1.51</td>
</tr>
<tr>
<td>Received therapies/services</td>
<td>1.28</td>
<td>1.09–1.52</td>
</tr>
</tbody>
</table>
Growing Body of Evidence?

Neonatal Abstinence Syndrome and High School Performance

Ju Lee Oei, MD,1,3,5 Edward Melhuish, PhD,3,5,6 Hannah Uebel,3 Nadin Azzam,3 Courtney Breen, PhD,6 Lucinda Burns, PhD,6 Lisa Hilder, MBBS,1,2 Barbara Bajuk, MPH,1 Mohamed E. Abdeh-Latif, MD,1,5,6 Meredith Ward, FRACP,2,5,6 Johe M. Feller, FRACP,2,5,6 Janet Falconer, CNC,3,6 Sara Clews, CNC,3,6 John Eastwood, FRACP, PhD,1,3,5,6,7 Annie Li,3,6 Ian M. Wright, FRACP,2,5,6,7

FIGURE 1
Linkage rates between children with NAS, control, and rest of NSW population to NAPLAN results.
FIGURE 2
Composite NAPLAN test scores between children with NAS, control, and other NSW children.
Limitations

1. Unable to analyze all children born with NAS in Tennessee during 2008–2011

2. Could not validate that all children in our sample had in utero opioid exposure

3. Matching to special education database may have failed to match some children who had indeed been referred

4. Unable to control for some factors which have been shown to increase the risk of NAS

5. Potential differential referral patterns among children with a history of NAS compared to those without

6. Unable to verify the diagnostic coding of NAS, or stratify results based on severity of NAS
Summary of Results

- Novel analysis linking health and education datasets
- Children with a history of neonatal abstinence syndrome were significantly more likely to
  - be referred for evaluation of an educational disability
  - meet criteria for a disability, specifically developmental delay, or speech or language impairment
  - receive therapies or services, specifically accommodations or speech therapy
Public Health Implications

• Ongoing primary prevention efforts are needed to reduce intrauterine opioid exposure and NAS.

• Identification of infants with a history of NAS, and prompt referral to early intervention services is important for the early diagnosis and treatment of possible developmental or learning disabilities.

• Additional resources may be needed for school systems in areas with high rates of NAS in order to provide students with needed services.
Individuals with Disabilities Act (IDEA)

- Federal law
- Originally established 1975
  - Last reauthorized 12/2004
- Ensures that children (3–21 years of age) with disabilities have the opportunity to receive free, appropriate public education (Part B)
- Provides assessments and early intervention services to children with disabilities as early as birth through 2 years of age (Part C)
Benefits of Early Intervention ...

- Infants/toddlers participating in Part C demonstrate:
  - Increased motor, social, and cognitive functioning
  - Acquisition of age-appropriate skills
  - Reduced negative impacts of their disabilities
  - Greater than expected growth in social relationships, use of knowledge & skills, taking action to meet needs

ECTA Center, 2017
NAS: Opportunities for Intervention

- Preconception
- Prenatal
- Birth
- Infancy/early childhood
- School-aged
NAS: Opportunities for Intervention

Preconception  Prenatal  Birth  Infancy/early childhood  School-aged

Prevention of substance abuse
Prevention of unintended pregnancy among at risk women
NAS: Opportunities for Intervention

Preconception  Prenatal  Birth  Infancy/early childhood  School-aged

Identification of maternal risk factors
Evidence-based treatment (MAT ...)
Delivery at appropriate facility
NAS: Opportunities for Intervention

Preconception  Prenatal  Birth  Infancy/early childhood  School-aged

Prompt diagnosis
Evidence-based treatment
Social/family support
NAS: Opportunities for Intervention

- Preconception
- Prenatal
- Birth
- Infancy/early childhood
- School-aged

Part C referral

Awareness & monitoring by family/healthcare providers for dev delay or other issues
NAS: Opportunities for Intervention

Preconception  Prenatal  Birth  Infancy/early childhood  School-aged

Consider Part B referral
Ongoing monitoring by family/healthcare providers
Acknowledgments

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  Dr. Tim Jones
  Dr. John Dunn
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  Dr. Michael Warren
  Dr. Angela Miller
  Mary Kennedy

Tennessee Department of Education
  Rachel Wilkinson
  Dave Williams

March of Dimes

TennCare
  Mary Lou Mangan
  Wesley Thompson

Vanderbilt University Medical Center
  Dr. Stephen Patrick

Centers for Disease Control and Prevention
  Dr. Stacey Bosch
  Dr. Jennifer Lind
  Dr. Daisy Christensen
  Dr. Marshalyn Yeargin-Allsopp
  Dr. Elizabeth Ailes
THANK YOU

marchofdimes.org
Directed Acyclic Graph (DAG)

- NAS
- Low 5 min APGAR
- Low birth weight
- Preterm birth
- NICU admission
- Educational disability
- Maternal smoking during pregnancy
- Maternal education
- Household income

Educational disability: Low birth weight → Preterm birth → NAS

Maternal smoking during pregnancy: NAS → Maternal smoking during pregnancy

Maternal education: NAS → Maternal education

Household income: NAS → Household income
Directed Acyclic Graph (DAG)

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Directed Acyclic Graph (DAG)

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Types of Prenatal Opioid Exposure in TN

- Rx Drugs Only
- Illicit Drugs Only
- Rx & Illicit
- Unknown

Percent (%)

Type(s) of Drug Use
Examples of Classroom & Assessment Accommodations

1. Presentation
   - Repeat directions, read aloud, use of larger bubbles on answer sheet

2. Response
   - Use of computer, use reference aids, mark answers in book

3. Timing/Scheduling
   - Extended time, frequent breaks

4. Setting
   - Study carrel, special lighting, separate room
## Other Demographic Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>NAS (+) n (%)</th>
<th>NAS (-) n (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Income &lt; $35,000</td>
<td>1184 (95.6)</td>
<td>3440 (89.7)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mother married</td>
<td>532 (29.3)</td>
<td>2182 (40.1)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mother education &lt; HS degree</td>
<td>611 (33.7)</td>
<td>1571 (28.9)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Enrolled in WIC</td>
<td>1281 (70.6)</td>
<td>4358 (80.1)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
# Prenatal Care

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>NAS (+)</th>
<th>NAS (−)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prenatal care</td>
<td>1677 (92.7%)</td>
<td>5351 (98.6%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mean no. prenatal visits (range)</td>
<td>9.4 (9.1–9.6)</td>
<td>11.8 (11.6–11.9)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
## Sub-analysis of ‘Referred’

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>NAS (+)</th>
<th>NAS (−)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referred</td>
<td>351/1815 (19.3)</td>
<td>745/5351 (13.7)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Eligible for Services</td>
<td>284/351 (80.9)</td>
<td>634/745 (85.1)</td>
<td>0.08</td>
</tr>
<tr>
<td>Receipt of Services</td>
<td>278/284 (97.9)</td>
<td>620/634 (97.8)</td>
<td>0.93</td>
</tr>
</tbody>
</table>
Matching Factors

1. Sex

2. Race/ethnicity

3. Kindergarten cohort (~ age)

4. Public health region of residence

5. TennCare enrollment status
RESOURCES

Preventing NAS in your baby & Caring for a baby with NAS

Educational Disabilities Among Children Born With Neonatal Abstinence Syndrome


NEW MOD INFOGRAPHICS COMING MONDAY, NOV 5\textsuperscript{TH}
RESOURCES

MARCHOFDIMES.ORG & NACERSANO.ORG
- Neonatal abstinence syndrome
- Prescription medicine during pregnancy; includes video: Prescription medicine before pregnancy
- Prescription opioids during pregnancy; includes link to the Health Action Sheet: Are you taking any of these prescription painkillers?

MARCHOFDIMES.ORG/NURSING
- Assessment of neonatal abstinence
- Impact of prenatal drug use: Managing the consequences of opioid and marijuana use
- Understanding addiction, drug use and abuse among women