Disclosure

• I have no relevant financial relationships with the manufacturers of any commercial products and/or providers of services discussed and/or referenced in this program.

• I will not discuss any unapproved or investigative use of a commercial product or device.
Learning Objectives

• To review important definitions related to understanding infants with intrauterine exposure to maternal substance use
• To discuss screening vs. testing following these exposures
• To identify methodology for diagnosing withdrawal in these newborns
FIGURE 1
Time line of NAS. FDA, Food and Drug Administration.
Every hour, 1 BABY is born suffering from opiate withdrawal.

Average length or cost of hospital stay

- With NAS: 16.4 days, $53,400
- Without NAS: 3.3 days, $9,500

NAS and maternal opiate use on the rise

- Newborns in drug withdrawal
- Maternal opiate use

Rate per 1000 hospital births

Source: Patrick et. al., JAMA 2012
Opioid use during pregnancy can result in a drug withdrawal syndrome in newborns called neonatal abstinence syndrome, or neonatal opioid withdrawal syndrome (NAS/NOWS), which causes costly hospital stays. A recent analysis showed that an estimated 32,000 babies were born with this syndrome in the United States in 2014, a more than 5-fold increase since 2004.

Every ~ 15 minutes, a baby is born suffering from opioid withdrawal.

NAS/NOWS Statistics *

• National incidence rate of NAS/NOWS (2016): 7 cases per 1,000 hospital births

• Highest rates reported among American Indian/Alaska Native and White Non-Hispanic individuals

• Hospital costs (2016) $572.7 million (after adjusting for inflation)

• Rate of NAS/NOWS in Indiana (2017): 10.4 cases per 1,000 hospital births (most recent data available)

• *National Institute on Drug Abuse-April, 2020
Definitions for Current Discussion

• Neonatal Abstinence Syndrome (NAS)
  • Terminology used to define withdrawal in infants following opioid and
    nonopioid (for ex. Benzodiazepines) exposure

• Neonatal Opioid Withdrawal Syndrome (NOWS)
  • Identifies infants with withdrawal following in utero opioid exposure (alone or
    in combination with other substances)

• Abstinence syndrome
  • Signs and symptoms worsen as drug levels decrease

• Toxicity
  • Signs and symptoms lessen as drug elimination takes place
Definitions for Current Discussion

• Screening
  • Refers to the use of a validated, verbal instrument to assess substance use

• Testing
  • Refers to the use of a diagnostic test, typically using specimens for toxicology testing
Maternal Screening

- ACOG recommends universal screening for substance use at the first prenatal visit; plan for urine toxicology testing
- Assessment for other risks should also be completed
- Suggested Screening Tools:
  - 4 Ps; 4Ps Plus; 5Ps (adults)
  - CRAFFT (adolescents)
  - State Prescription Drug Monitoring Program (INSPECT)
- Antenatal Counseling and Education
  - Risks for NAS/NOWS
  - Anticipated managements for infant
Toxicology Testing in Infant
### Estimated Detection Window for Various Biological Specimens

<table>
<thead>
<tr>
<th>Recent Use/Exposure</th>
<th>Hours</th>
<th>Days</th>
<th>Weeks</th>
<th>Months</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood</td>
<td></td>
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<tr>
<td>Oral Fluid</td>
<td></td>
<td></td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
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<tr>
<td>Breast Milk</td>
<td></td>
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<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
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<tr>
<td>Placenta</td>
<td></td>
<td></td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
</tr>
<tr>
<td>Sweat*</td>
<td></td>
<td></td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
</tr>
<tr>
<td>Urine</td>
<td></td>
<td></td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
</tr>
<tr>
<td>Vernix</td>
<td></td>
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<tr>
<td>Amniotic Fluid</td>
<td></td>
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<td></td>
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<tr>
<td>Nails*</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair, Neonatal</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Umbilical Cord Tissue</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Meconium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair, Maternal*</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

^ Actual detection window is drug-dependent and also reflects patterns of use, dose, and performance of laboratory testing

* Characterization of chronology and duration of drug use depends on time reflected by the collection
Urine Toxicology Testing in Infants

• Urine
  • Collection of 1st urine should be attempted
  • Detection dependent on timing related to drug metabolism
Urine Screening Detection Times

• Alcohol
  • ~6-8hrs

• Amphetamines
  • ~5 days

• Cocaine
  • ~1-2 days up to 1-3 wks (heavy use)

• Marijuana
  • ~2-4 days up to 1 month (chronic use)

• Methadone
  • ~3 days

• Opiates
  • ~2 days
Meconium

• Meconium
  • Longer window of timing starting as early as 12-20 wks gestation
  • Labor intensive: ensure only meconium “pure” collection; requires several days; may be significantly delayed with premature infant
  • Immunoassay → confirmed by gas or liquid chromatography; increases detection up to 4.5% over urine screening and up to 28% over maternal reporting
Umbilical Cord

• Umbilical Cord Tissue
  • Readily available so easier collection process
  • Considered comparable to meconium (timing and results) however variable according to some studies
• Stability:
  • 7 days at room temperature
  • 3 months, if refrigerated
  • 1 year, if frozen
Clinical Presentations
Timing of Withdrawal Clinical Presentations

- Heroin: <24 hrs. – 7 days
- Methadone: 24-72 hrs. – 7 days
- Buprenorphine: 1-5 days
- Other opioids: 2-7 days
- ETOH: 3-12 hrs. following delivery
- Barbiturates: 1-14 days
- Benzodiazepines: 1-4 days
Signs and Symptoms of NAS/NOWS

- Neurological (tremors, irritability, high pitched cry, increased tone, exaggerated reflexes, seizures)
- Gastrointestinal (vomiting, diarrhea, feeding issues)
- Autonomic signs (sweating, fever, mottling)
- Dehydration
- Poor weight gain
Scoring
NAS Scoring Tools

• Finnegan Neonatal Abstinence Scoring System-1975
• Neonatal Drug Withdrawal Scoring System (Lipsitz)-1975
• Ostrea Tool-1975
• Neonatal Narcotic Withdrawal Index-1981
• Neonatal Withdrawal Inventory-1998
• Maternal Opioid Treatment: Human Experimental Research (MOTHER) Study Score (Modified Finnegan)- 2010
• Eat, Sleep and Console- 2011
Scoring Tools

• Modified Finnegan Scoring (2010)

• Eat, Sleep, Console (2011)
Finnegan Neonatal Abstinence Scoring System

• Nineteen to twenty one signs/symptoms are scored
• Each given score generally 1-3
• Decisions made as to need for pharmacologic treatment which generally starts with 2 or more scores ≥8

• Note: Traditional version/FNASS 1975; Modified 2010
# Finnegan Scoring System

## Signs and Symptoms

<table>
<thead>
<tr>
<th>System</th>
<th>Signs and Symptoms</th>
<th>AM</th>
<th>PM</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive High-pitched (or Other) Cry</td>
<td>2</td>
<td></td>
<td>Daily Weight</td>
<td></td>
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<tr>
<td>Continuous High-pitched (or Other) Cry</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sleeps &lt; 1 Hour After Feeding</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleeps &lt; 2 Hours After Feeding</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleeps &lt; 3 Hours After Feeding</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Hyperactive Moro Reflex</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markedly Hyperactive Moro Reflex</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Mild Tremors Disturbed</td>
<td>1</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Moderate-Severe Tremors Disturbed</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Mild Tremors Undisturbed</td>
<td>3</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Moderate-Severe Tremors Undisturbed</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Increased Muscle Tone</td>
<td>2</td>
<td></td>
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<tr>
<td>Excretion (Specify Area):</td>
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<tr>
<td>Myotonic Jerks</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>Generalized Convulsions</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Central Nervous System Disturbances

- Sweating
- Fever < 101; 99-100.8°F (37.2-38.2°C)
- Fever > 101; 38.4°C and Higher
- Frequent Yawning (> 3-4 times/interval)
- Moaning
- Nasal Stuffiness
- Sneezing (> 3-4 times/interval)
- Nasal Flaring
- Respiratory Rate > 60/Min.
- Respiratory Rate > 50/Min. with retractions

## Respiratory Disturbances

- Excessive Sucking
- Poor Feeding
- Regurgitation
- Projectile Vomiting
- Loose Stools
- Watery Stools

### Total Score

**INITIALS OF SCORER**

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**Guidelines for the use of neonatal abstinence scoring system**

1. Record time of scoring (end of observation interval).
2. Give points for all behaviors or symptoms observed during the scoring interval, even though they may not be present at the time of recordings. (For example, if the baby was diagnosed at 11:00 A.M. and is scored at 11:00 A.M., and this baby is not showing signs of withdrawal, then you score the "waking" point.)
3. Avoid the child before assessing muscle tone, respiration, or Moro reflex. Many of the signs of hunger can appear the same as withdrawal. Appearance after feeding gives a good idea of muscle activity.
4. Count respirations for a full minute. Always take temperature at the same site. The temperatures on the sheet are rectal levels; an auxiliary temperature that is too far above mouth temperature that is 2 degrees cooler may also indicate withdrawal.
5. Do not give points for perspiration if it occurs due to swaddling.
6. A sterile reflex should not be substituted for the Moro reflex.
7. Record doses administered (dose/time/intake) on sheet. One hour swaddle is acceptable in dosing a fairly stable baby.
8. Record daily weight on graphic sheet.
9. Do not hesitate to get your experienced colleagues' opinions.
<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td><strong>Cry:</strong></td>
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<tr>
<td>High-pitched (2)</td>
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</tr>
<tr>
<td>Continuous (3)</td>
<td></td>
</tr>
<tr>
<td>Sleep hours after feed:</td>
<td></td>
</tr>
<tr>
<td>1 h (3)</td>
<td></td>
</tr>
<tr>
<td>2 h (2)</td>
<td></td>
</tr>
<tr>
<td>3 h (1)</td>
<td></td>
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<tr>
<td>Moro reflex:</td>
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</tr>
<tr>
<td>Hyperactive (2)</td>
<td></td>
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<tr>
<td>Marked (3)</td>
<td></td>
</tr>
<tr>
<td>Tremors when disturbed:</td>
<td></td>
</tr>
<tr>
<td>Mild (2)</td>
<td></td>
</tr>
<tr>
<td>Marked (3)</td>
<td></td>
</tr>
<tr>
<td>Tremors when undisturbed:</td>
<td></td>
</tr>
<tr>
<td>Mild (3)</td>
<td></td>
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<tr>
<td>Marked (4)</td>
<td></td>
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<tr>
<td>Muscle tone increased:</td>
<td></td>
</tr>
<tr>
<td>Mild (3)</td>
<td></td>
</tr>
<tr>
<td>Marked (6)</td>
<td></td>
</tr>
<tr>
<td>Convulsions:</td>
<td>(8)</td>
</tr>
<tr>
<td>Feeding:</td>
<td></td>
</tr>
<tr>
<td>Frantic sucking of fists</td>
<td>(1)</td>
</tr>
<tr>
<td>Poor feeding ability</td>
<td>(1)</td>
</tr>
<tr>
<td>Regurgitation</td>
<td>(1)</td>
</tr>
<tr>
<td>Projectile vomiting</td>
<td>(1)</td>
</tr>
<tr>
<td>Stools:</td>
<td></td>
</tr>
<tr>
<td>Loose (2)</td>
<td></td>
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<tr>
<td>Watery (3)</td>
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<tr>
<td>Fever:</td>
<td></td>
</tr>
<tr>
<td>100–101 °F (2)</td>
<td></td>
</tr>
<tr>
<td>Over 101 °F (2)</td>
<td></td>
</tr>
<tr>
<td>Respiratory rate:</td>
<td></td>
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<tr>
<td>&gt;60/min (1)</td>
<td></td>
</tr>
<tr>
<td>Retractions (2)</td>
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</tr>
<tr>
<td>Excoriations:</td>
<td></td>
</tr>
<tr>
<td>Nose (1)</td>
<td></td>
</tr>
<tr>
<td>Knees (1)</td>
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<tr>
<td>Toes (1)</td>
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<tr>
<td>Frequent yawning:</td>
<td>(1)</td>
</tr>
<tr>
<td>Sneezing:</td>
<td>(1)</td>
</tr>
<tr>
<td>Nasal stuffiness:</td>
<td>(1)</td>
</tr>
<tr>
<td>Sweating:</td>
<td>(1)</td>
</tr>
<tr>
<td>Total scores per day</td>
<td></td>
</tr>
</tbody>
</table>

Once an objective score has been attained, a dose for treatment can be decided on.
Eat, Sleep and Console

• “ESC Approach”:  
  • Able to eat ≥ 1 oz per feed or breast feed well  
  • Able to sleep undisturbed ≥1 hour  
  • Consoled, if crying, within 10 minutes

• If above criteria are not met, medical team alerted to determine need to address need for additional treatments (nonpharmacologic or pharmacologic)

• Treatment decisions compared with Finnegan Neonatal Abstinence Scoring System
Diagnosis
Diagnosis of NAS/NOWS

• Maternal screening and testing
• Infant assessments and testing
• Differential Diagnoses considered
• “Objective” scoring

• CONSISTENCY IS CRUCIAL
NAS Diagnosis Criteria*

• Symptomatic (tremor/jitteriness, difficult to console, poor feeding, or abnormal sleep); and
• Have one of the following:
  • A positive toxicology test, or
  • A maternal history with a positive verbal screen or toxicology test

*Perinatal Substance Use Practice Bundle; IPQIC, Perinatal Substance Use Task Force; October 2018
Neonatal Abstinence Syndrome and In-Utero Drug Exposure Algorithm

UNIVERSAL MATERNAL TESTING: verbal screening and toxicology testing for maternal use of illicit drugs, opiates or alcohol at the first prenatal visit and again at presentation for delivery.

INFANT SCREENING AND TESTING: all newborns will have umbilical cord samples saved for two weeks.

DISCHARGE

Permission granted for toxicology test: Send original urine sample for toxicology testing

Permission refused for toxicology test and verbal screening positive

Permission refused for toxicology test and verbal screening negative

Verbal screening is conducted and permission requested for toxicology test

Verbal screening and toxicologic tests are positive

Refer for Behavioral Health Consult and/or additional screening if appropriate

Verbal screening and toxicologic tests are negative

Upon delivery, send umbilical cord for testing

Observe infant for signs

If no signs, continue observation and provide routine newborn care

If signs, or at risk for opiate or benzo withdrawal, initiate Finnegan scoring

If signs, send cord for testing and initiate Finnegan scoring

If no signs, continue observation and provide routine newborn care

Upon delivery, observe infant for signs for 48 hours

Infant has a confirmed NAS Diagnosis with or without pharmacologic treatment

Routine Newborn Discharge

Follow Discharge Readiness Protocol

Follow Discharge Readiness Protocol

Follow Discharge Readiness Protocol

Follow Discharge Readiness Protocol

Follow Discharge Readiness Protocol
References

• Patrick SW, Barfield WD, Poindexter BB; AAP Committee on Fetus and Newborn, Committee on Substance Use and Prevention; Neonatal Opioid Withdrawal Syndrome. Pediatrics. 2020;146(5):e2020029074

• National Institute on Drug Abuse; National Institutes of Health; U.S. Department of Health and Human Services

• Wabuyele SL, Colby JM, McMillin GA; Detection of Drug-Exposed Newborns; Ther Drug Monit. 2018; Vol 40, No 2

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- Perinatal Substance Use Practice Bundle; IPQIC, PSU Task Force; Oct, 2018