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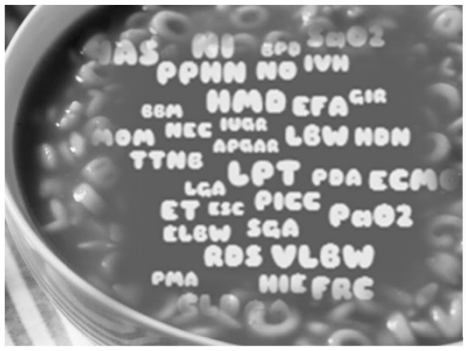
https://yazatel.com/wp-content/uploads/2016/08/cloud_alphabet_soup.jpg

Our legacy is yours.


## Objective:

Untangle the web of neonatal acronyms

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## Similar, yet different meanings

http://i0.kym-cdn.com/photos/images/original/000/573/729/a84.jpg

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## AGA, SGA, LGA, IUGR

Disorders of Growth

- AGA: Average (or Appropriate) for Gestational Age
  - > weight between 10th & 90th percentile
- SGA: Small for Gestational Age
  - > weight below 10th percentile
- LGA: Large for Gestational Age
  - > weight above 90th percentile
- IUGR: Intrauterine Growth Restriction
  - > pathologic process inhibits expression of normal intrinsic growth potential- baby is smaller than it should be
  - > 10-15% of SGA are IUGR

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## Things to think about

- ❖ Fetal growth trajectory = genetic programming + placenta
- ❖ SGA and LGA may be "constitutional"
- ❖ There are "fetal origins of adult disease"
- ❖ There can be normal weight growth restriction



**Uteroplacental blood flow**

- Diminished blood flow
- Increased vascular resistance
- Absent spiral artery remodeling
- Atherosis of vessels of parietal decidua

**Fetoplacental blood flow**

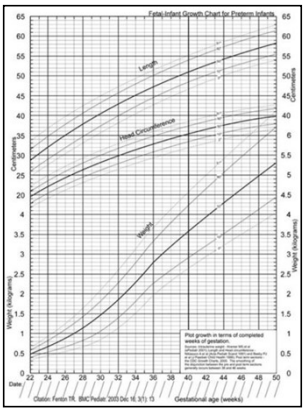
- Increased irregularity of luminal size
- Abnormal umbilical Doppler flow studies
- Decreased number of placental arterial vessels
- Decreased size of placental vessels
- Decreased artery to villus ratio

**Interface of maternal and fetal circulations**

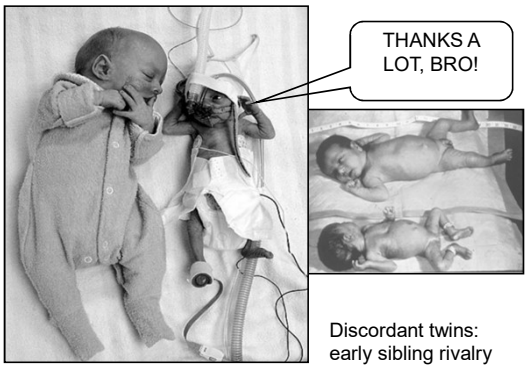
- Cytotrophoblastic hyperplasia
- Thickened basement membrane
- Chronic villitis



## Preterm Fenton Growth Chart






Discordant twins: early sibling rivalry



## Associated problems: SGA

- Stillbirth
- Respiratory distress
- Hyperviscosity
- Polycythemia
- Congenital malformations
- Infection
- Hypoglycemia
- Hypothermia
- Neonatal death
- Perinatal asphyxia
- Tobacco, drug use



## Associated problems: LGA

- Birth trauma
- Hypoglycemia
- Hard to start IVs ☹
- Out grow clothes- might need to start in 3 month size ☺

What do these babies have in common?




https://thequickword.files.wordpress.com/2014/06/spell1.jpg



## Infant of a Diabetic Mother (IDM)

- 3-10% of pregnancies are complicated by abnormal glycemic control
- Of these 80% are gestational diabetes
  > Mom is at risk for type 2 later on
- Will this number rise with the current trend in super sizing?



- In the past, 10-30% of pregnancies terminated with sudden and unexplained stillbirth
- Believed to have been secondary to chronic fetal hypoxia with subsequent polycythemia and vascular sludging
- Higher incidence was noted in pregnancies further complicated by maternal vascular disease
  > IDM can be SGA DM severe enough to cause vascular disease; the placenta is a vascular organ



## Insulin-dependent diabetes outcomes

- Perinatal mortality rate doubles
- Neonatal mortality rate triples
- 2 times more serious birth injury
- 3 times more likely to be born by C/S
- 4 times more congenital anomalies
- 4 times more likely admitted to NICU



- Good glucose control (mean plasma glucose level <120 mg/dL) vs. poor glucose control (mean plasma glucose level >140 mg/dL):
  > hyperglycemic group had more preeclampsia, maternal urinary tract infections, premature deliveries, cesarean deliveries, macrosomia, respiratory distress, neonatal hypoglycemia, congenital malformations, and perinatal mortality

Hemoglobin $A_{1C}$

- Direct measure of glucose control
- Measure at 14 weeks to predict risk for congenital anomalies:
  - > <7 % no increase
  - > 5 % with levels 7- 8.5%
  - > 22 % with levels > 10%



Many pregnancies are unplanned;
the need for *preconception*
glycemic control in diabetic women cannot be overstated



IDM Risks

- Equal frequency male: female
- Stillbirth
- Preterm labor
- Respiratory distress
- Macrosomia
- Hyperviscosity
- Polycythemia
- Hypoglycemia
- Hypocalcemia
- Hypomagnesemia
- Iron deficiency
- Neonatal death
- Birth injury
- Perinatal asphyxia
- Congenital malformations



Birth defects in infants of diabetic mothers have risen from 1-2% to 8-15% as a consequence of increased perinatal survival

5-9% major congenital malformations

200 times increased risk of caudal regression



Hypothesis of fuel-mediated teratogenesis

- Reduced arachidonic acid (precursor of prostaglandins) and myoinositol (component of Vitamin B complex) levels
- Role of excess glucose-induced free radicals of oxygen and hydroperoxides in the mitochondria of susceptible fetal tissues
- Prostacyclin inhibitors may cause disruption in the vascularization of developing tissues



Major causes of morbidity

- Large or small for gestational age
- Hypoglycemia
- Prematurity
- Respiratory distress syndrome
- Intrapartum asphyxia

Macrosomia = excessive growth

- Insulin is a growth hormone
  - > Fat stores increase after 32 weeks
  - > All organ systems, except kidney and brain, are sensitive
  - > Head size is typically not affected
    - Check the growth chart for this pattern



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NAS, NOWS, IUDE, ESC

Opioid exposed infants



Eat, Sleep, Console (ESC) Model for

Neonatal Abstinence Syndrome (NAS)

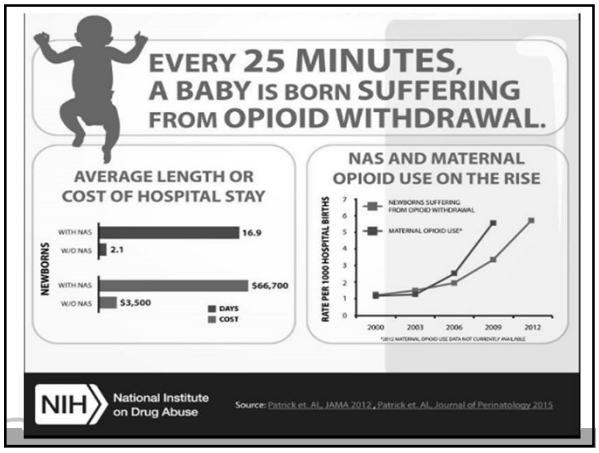
aka

Neonatal Opioid Withdrawal Syndrome (NOWS)



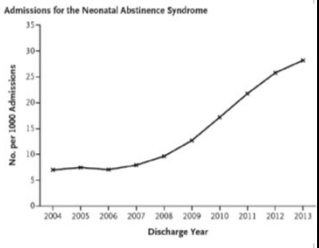
- Neonatal abstinence syndrome (NAS) = global term for withdrawal from in-utero exposure to substances
- Neonatal opioid withdrawal syndrome (NOWS) = specific name for withdrawal syndrome due to in-utero exposure to opioids (heroin, methadone, buprenorphine (Subutex), oxycodone, hydrocodone,etc) or iatrogenic analgesia and/or sedation therapy
- *KEY POINT*: NOWS is due to physiologic dependence not addiction as there is no psychological component






A big problem getting bigger…
from 2000 → 2009

- NAS tripled: more in some places
- LOS increased: 13 days to 19 days
- NICU days increased: 0.6% to 4%




Spitzer et al, 2015




## NAS/NOWS affects normal baby functioning…

55-94% develop signs of withdrawal → Opioid receptors are concentrated in CNS & GI tract → CNS irritability & GI tract dysfunction → Excess stimuli & hunger exacerbate severity → Impacts ability to: → EAT, SLEEP & BE CONSOLED



## Timing and frequency of NAS/NOWS

| Drug | Onset (hours) | Duration (days) | Frequency (%) |
|---|---|---|---|
| Heroin | 24-48 | 8-10 | 40-80 |
| Methadone | 48-72 | Up to 30 or more | 13-94 |
| Buprenorphine | 36-60 | Up to 28 or more | 22-67 |
| Rx opioids | 36-72 | 10-30 | 5-20 |

Kocherlakota, 2014



## A new approach from Yale

EAT SLEEP CONSOLE



## An Initiative to Improve the Quality of Care of Infants With Neonatal Abstinence Syndrome

Matthew R. Grossman, MD,[a] Adam K. Berkwitt, MD,[a] Rachel R. Osborn, MD,[a] Yaqing Xu, MS,[b] Denise A. Esserman, PhD,[b] Eugene D. Shapiro, MD,[a,c] Matthew J. Bizzarro, MD[a]

Population: Infants ≥ 35 weeks gestation whose mothers took methadone daily for at least 1 month before delivery
421 infants with NAS → 287 inclusion criteria (55 baseline, 188 intervention, 44 in post-implementation period)
**Results:**
- Average LOS decreased from 22.4 days to 5.9 days (74% reduction)
- Proportion of infants treated with morphine decreased from 98% to 14%
- Proportion of infants that took majority of their feeds from breastmilk increased from 20% to 45%
- Infants admitted directly to NICU decreased from 100% to 20%.

No patient admitted to inpatient unit required transfer to NICU. No seizures reported. No readmissions within 30 days of discharge related to withdrawal.

*Pediatrics*, 2017; 139 (6)

Decreased LOS: 22.5 days → 5.9 days

Treated with morphine: 98% → 14%

Total average cost: $44,824 → $9,572

HOW did they do this?

- With a "common sense" approach called the Eat, Sleep, Console (ESC) model based on functional well-being of NOWS babies
- ESC simplifies withdrawal assessment to how well babies eat, sleep and console

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Advantages

- No more Finnegan scores – no longer treating based on sneezing, yawning, etc
- Treat based on ability to function normally
- Decreased LOS, morphine/pharmacologic management, cost of care
- Less transfer to NICU
- Keep moms and babies together
- Improve family bond and breastfeeding
- Build skills for parenting

Does the Finnegan score help us with this?

| Finnegan Score | Baby Goals |
|---|---|
| • Purpose of treatment is to get scores below threshold<br>• Long lengths of stay & lots of meds<br>• Must disturb/exacerbate to assess signs of withdrawal<br>• Powerful and potentially harmful meds given to treat a few sneezes/yawns<br>**So, no, it doesn't** | • Gain weight consistently<br>• Sleep adequately<br>• Integrate into family and environment by communicating with caregivers and managing stimuli<br>**Basically, act like a BABY (eat, sleep, some socializing)** |

| Currently | With ESC |
|---|---|
| ▪ Goal: suppress symptoms<br>▪ Treat by number (Finnegan)<br>▪ Morphine and lots of it<br>▪ Staff cares for baby | ▪ Goal: function like a baby<br>▪ Keep mom & baby together<br>▪ SUPPORTIVE CARE<br>▪ No feeding schedule<br>▪ Staff coaches/supports family |

Eat, Sleep, Console Functional Assessments every 3-4 hours and PRN WHEN AWAKE

| Can baby... | If not... |
|---|---|
| 1) Eat appropriate amounts (meet feeding goal)?<br>2) Sleep undisturbed for ≥ 1 hour?<br>3) Console within 10 minutes? | ➢ Lactation, OT/PT, gavage<br>➢ Assess environment, increase skin to skin<br>➢ Maximize non-pharmacologic care<br>**LASTLY:**<br>➢ PRN dose of morphine (NOT scheduled) |

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Non-pharmacologic interventions

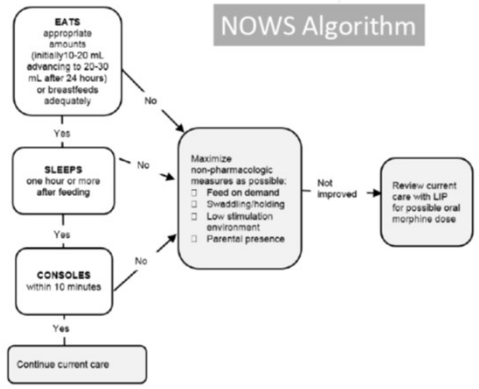
- ❑ Low stim environment (dimmed lights, noise)
- ❑ Parents strongly encouraged to room-in, feed on demand, consoling techniques
- ❑ Breastfeeding (barring contraindications)
- ❑ Non-pharm interventions = medication: must maximize before adding morphine

## Non-pharmacologic interventions

- Reduce environmental stimuli:
  - Turn out overhead lights
  - Limit loud sounds and voices
  - Consider private room
- Avoid bouncing or swinging back and forth
- Hold infant curling the body in a "C" position
- Use slow, rhythmic swaying with head to toe movement, swaddled and held in "C"
- Organize care around awake time; avoid waking from deep sleep
- Respond early to cues to maintain calm state
- Use kangaroo care
- Prepare baby by talking before touching
- Use slow, smooth movements
- Apply barriers to prevent damage
- Use transparent dressing as needed to rub sites
- Clean skin regularly
- Keep clothing and bedding dry
- Ensure adequate hydration and reduce environmental temperature
- Avoid heavy bedding/tight swaddling
- Keep hands available and centered near mouth, and provide for non-nutritive sucking
- Feed on demand
- Provide frequent feedings and/or hypercaloric feedings
- Reduce environmental stimuli during feeding- use a therapeutic hold swaddled in "C" position.
- Do not overfeed
- Give medication at beginning of feeding
- Frequent diaper changes
- Use skin barrier creams liberally and preventively- do not wipe entirely off- leave film to prevent rubbing skin



## NOWS Algorithm




## "Eat" definition

- ✓ Choose "Yes" if able to coordinate feeding within 10 minutes of showing hunger and/or is able to sustain feeding for 10 minutes at breast or feed appropriate/goal amounts by bottle.
- ✓ Do not choose "NO" if poor feeding is due to non-NOWS factors such as prematurity, transitional sleepiness, or spittiness in the first 24 hours of life, or inability to latch due to maternal or infant anatomy.



## "Sleep" definition

- ✓ Choose "Yes" if able to sleep for more than a one-hour stretch after feeding (baby is not displaying excessive fussiness, restlessness, increased startle, tremors).
- ✓ Do not choose "NO" if poor sleeping is due to non-NOWS factors such as physiologic cluster feeding, interruptions in sleep for routine newborn testing, symptoms in the first day likely due to nicotine or SSRI exposure.



## "Console" definition

- ✓ Choose "Yes" if able to console within 10 minutes with caregiver effectively providing calming/consoling care.
- ✓ Do not choose "NO" if poor consoling is due to hunger, difficulty feeding, or non NOWS source of discomfort (e.g. circumcision).



***KEY POINT:*** **If it is not clear whether poor eating, sleeping or consoling is due to NOWS, choose "Yes" and continue to monitor closely while maximizing non-pharmacologic interventions.**

Helpful video

https://www.youtube.com/watch?v=zbgQAe7FKjc




https://reneweddesign.files.wordpress.com/2014/10/screen-shot-2014-10-04-at-1-54-20-am.png



LEGACY HEALTH

Thank you!

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