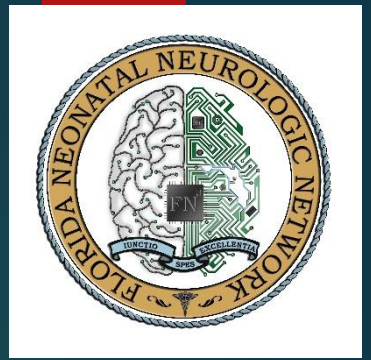


Hypothermia in Neonates with HIE

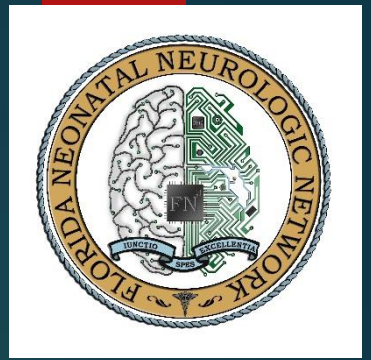
TARA JENDZIO, DNP(C), RN, RNC-NIC

Objectives



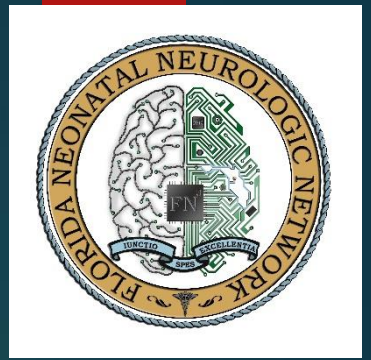
1. Define Hypoxic-Ischemic Encephalopathy (HIE)
2. Identify the criteria used to determine if an infant qualifies for therapeutic hypothermia
3. Recognize the steps of the modified Sarnat exam
4. Interpret typical HIE order sets

Disclosure



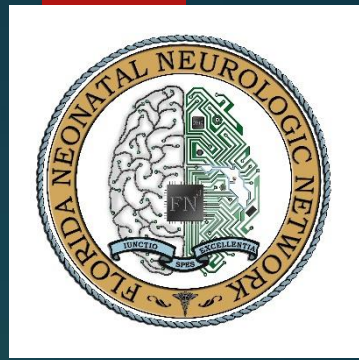
- ▶ I have no actual or potential conflict of interest in relation to this presentation

What is Hypoxic-Ischemic Encephalopathy (HIE)?

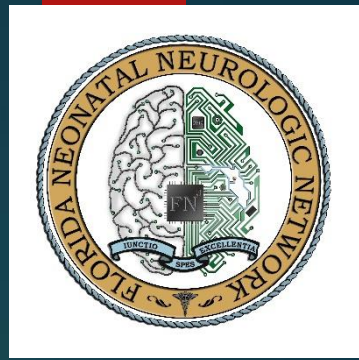


- ▶ **Hypoxia** = a reduction in the supply of oxygen to organs including the brain.
- ▶ **Ischemia** = an inadequate supply of blood to the organs.
- ▶ **Encephalopathy** = any form of generalized brain dysfunction.
- ▶ **Hypoxic-Ischemic Encephalopathy (or HIE)** = a non-specific term for brain dysfunction caused by a lack of blood flow and oxygen to the brain.
- ▶ Sometimes, HIE is also referred to as **birth asphyxia**, but this term only pertains to a very strict criteria of infants with brain injury.

How and when does HIE occur?



How do we know if a baby has HIE?



- ▶ HIE can be classified as mild, moderate or severe based on the infant's neurological exam.
- ▶ **Sarnat Classification** and can be helpful in predicting long-term neurological risk.
 - ▶ Sarnat score of 2 = moderate HIE
 - ▶ Sarnat score of 3 = severe HIE
 - ▶ Done by the Neonatologist at birth/admission and every 24 hours
 - ▶ Final Sarnat Exam is done when the infant is warmed

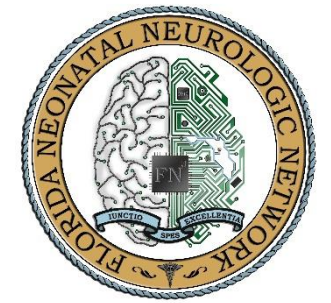
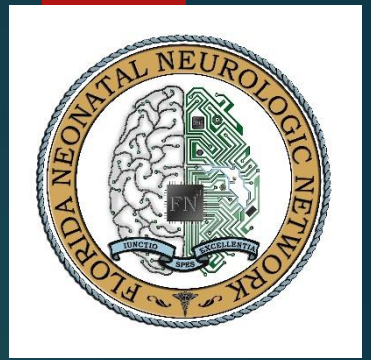


Table 1. Modified Sarnat Classification Scale for Neonatal HIE

Category	Mild	Moderate (2)	Severe (3)
Level of consciousness	Hyperalert	Lethargy	Stupor/Coma
Spontaneous activity	Spontaneous	Decreased activity	No activity
Posture	Mild distal flexion	Distal flexion, complete extension, frog leg posture	Decerebrate
Tone	Normal	Hypotonia or hypertonia	Flaccid or rigid
Primitive reflexes			
Suck	Weak	Weak or bite	Absent
Moro	Strong	Incomplete	Absent
Autonomic System			
Pupils		Constricted	Skew deviation/dilated/non-reactive to light
Heart rate	Tachycardia	Bradycardia	Variable HR
Respirations		Periodic breathing	Apnea or intubated

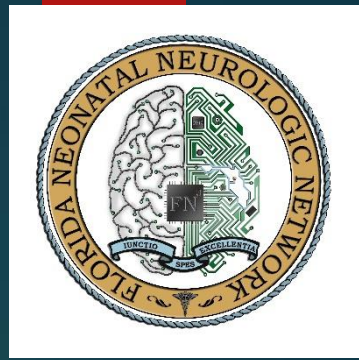
Score is determined by which column has the most checks!

How is HIE treated?



- ▶ Unfortunately, there is **no definitive treatment** for infants with HIE. Most therapies are directed at supporting the infant's affected organs including:
 1. Supporting the heart and blood pressure
 2. Sustaining kidney and liver function
 3. Mechanical ventilation may be required if the infant can not breath completely on their own
 4. If the baby has seizure, they must be controlled with medications
- ▶ **Currently, the only brain-specific therapy that has been proven to reduce the risk of long-term neurodevelopmental handicaps is **brain or whole body hypothermia****
 - ▶ Cooling the infant's body temperature to approximately **33.5 degrees Celsius or 92 degrees Fahrenheit for 3 days**

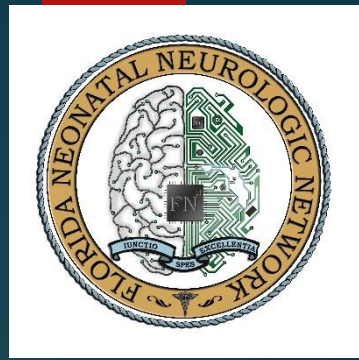
Who qualifies for cooling?



- ▶ Moderate to severe HIE, not mild cases
 - ▶ GA greater than or equal to 35 weeks
 - ▶ Birth weight greater than or equal to 2kg
 - ▶ Less than or equal to 6 hours since insult occurred
 - ▶ Cannot have another cause of brain dysfunction such as a brain malformation or bleeding into the brain.
- ▶ Two or more abnormal Neurological findings:
 - ▶ Abnormal tone
 - ▶ Decreased activity
 - ▶ Abnormal reflexes
 - ▶ Seizures
 - ▶ Posturing
 - ▶ Greater than 3 beat clonus

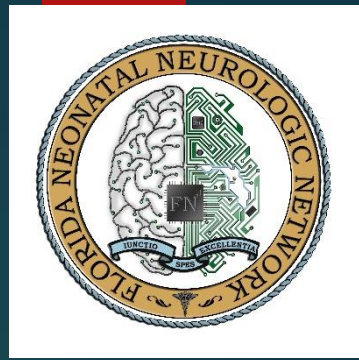


Who qualifies for cooling? Continued...



- ▶ One or more of the following predictors of severe HIE:
 - ▶ pH less than or equal to 7.0 with base deficit of greater than or equal to 16 on arterial blood gas or cord gas determination (base excess more negative than -16)
 - ▶ pH 7.01 - 7.15, base deficit 10 - 15.9 or no blood gas available and acute perinatal event (cord prolapse, heart rate decelerations, uterine rupture) and APGAR less than or equal to 5 at 10 min.
 - ▶ Assisted ventilation at birth required for greater than or equal to 10 min.
 - ▶ PaO₂ less than 35 for greater than or equal to 20 minutes with evidence of ischemia (poor perfusion, hypotension).
 - ▶ Fetal heart rate less than 80 bpm for greater than or equal to 15 minutes

Your baby qualifies for cooling...Now what?!?

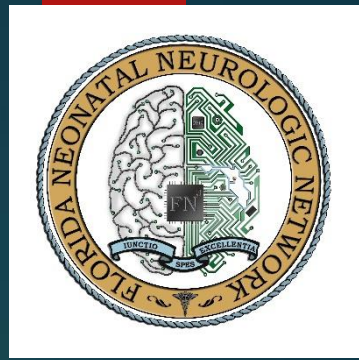


Let's set up the cooling device!

<https://www.youtube.com/watch?v=AegRDBY7rTo>

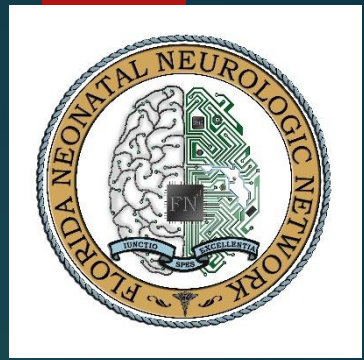


Next come the HIE admission orders...



- ▶ Apply cooling blanket (YAY! We already did this!)
 - ▶ Set temp between 33.0 and 34.0°C with a target of 33.5°C using servo-control
- ▶ **Vital signs** q15min x 4, then q30min x 2, then q1hr
 - ▶ *Note: Blood pressure might initially increase secondary to vasoconstriction but subsequently fall as a result of cardiovascular effects of hypothermia*
- ▶ **Temperature:** Rectal temperature q1hr
 - ▶ *Note: Place indwelling rectal temperature probe, 4cm insertion*
- ▶ **Notify provider** if:
 - ▶ Temperature greater than 33.5°C
 - ▶ Temperature less than 32.5°C
 - ▶ Heart rate less than 70 bmp
 - ▶ Blood glucose less than 60 mg/dL
 - ▶ Mean arterial pressure less than 35 mmHg
 - ▶ pH less than 7.35 arterial (7.3 venous) or PCO2 less than 30 mmHg
 - ▶ Sodium less than 120
 - ▶ Potassium less than 3
 - ▶ Calcium less than 7 or ionized calcium less than 0.9
 - ▶ Platelet count less than 50,000
 - ▶ Coagulation profile is abnormal

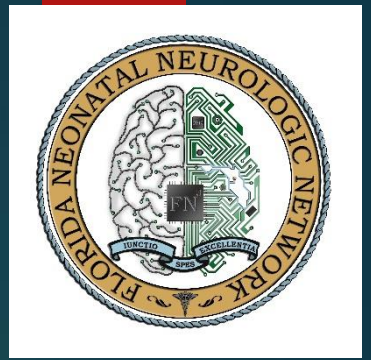
HIE admission orders continued...



▶ Nursing orders:

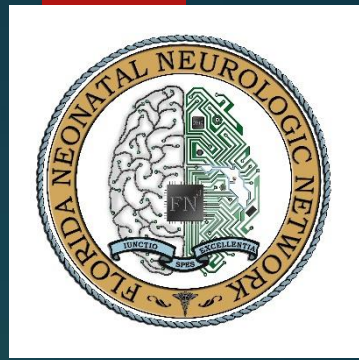
- ▶ Diet **NPO** (may consider low volume feeds (trophic) depending on the clinical condition of the neonate)
- ▶ Daily **weight**
- ▶ Strict **I&O**
- ▶ If low urine output, insert a **Foley catheter**
- ▶ **Assess skin** and reposition every hour
- ▶ **Lower heart rate at 70**
 - ▶ *Note: Cooled babies may have bradycardia around 100 bpm. Heart rates above 110 bpm may indicate distress or volume loss or the infant may need more sedation. However, a heart rate below 70 bpm may lead to decreased cardiac output. Clinician may consider increased set temp up by 0.3°C increments to a max of 35°C*

HIE admission orders continued...



- ▶ Nursing orders continued...
 - ▶ Place **alpha EEG**
 - ▶ <http://hopefn3.org/members/aeeg-step-by-step-video/>
 - ▶ Perform **near infrared spectroscopy**: Cerebral sat
 - ▶ **Glucose** q1hr until 3 consecutive results are WNL, then q2hrs for 4hrs, then q4hrs for 24hrs, then q8hrs for 24hrs
 - ▶ Start **Fentanyl** at 0.5 mcg/kg/hr IV

HIE admission orders continued...



▶ Diagnostic Tests

▶ EEG

- ▶ *Note: Ordered to rule out other causes of encephalopathy and as an indicator of severity of hypoxic-ischemic injury.*

▶ Pediatric echocardiogram

- ▶ *Note: Usually ordered if evidence of pulmonary hypertension and/or cardiac dysfunction is present.*

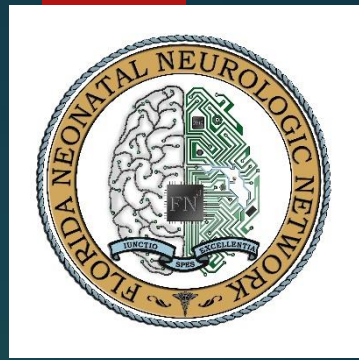
▶ Cranial ultrasound

- ▶ *Note: HUS with Doppler flow ordered to rule out causes of encephalopathy and as an indicator of severity of injury (may need to call EEG techs to remove leads for HUS)*

▶ Renal ultrasound

- ▶ *Note: Consider ordering with Doppler if patient has anuria or severe oliguria less than 1 mL/kg/hr*

HIE admission orders continued...



▶ Labs

- ▶ **ABG with lactic acid** stat and q6hrs while undergoing hypothermia
- ▶ **CK total and CKMB** upon initiation of hypothermia
- ▶ **Troponin I** upon initiation of hypothermia
- ▶ **Basic metabolic panel with magnesium, phosphorus and ionized calcium** stat then q12hrs for 4 days
- ▶ **CBC with differential** stat then q12hrs for 4 days
- ▶ **PT/INR, aPTT, Fibrinogen, D-dimer** stat then q12hrs for 4 days
 - ▶ *Note: Consider therapy to maintain PT less than 19, Fibrinogen greater than 100, platelets greater than 50,000 as hypothermia might increase the risk of coagulopathy or bleeding. If coagulation profile is abnormal requiring correction, follow-up in 6 hours after treatment. If normal X 2 without replacement, discontinue coagulation profile monitoring. Hold re-warming for abnormal labs, heart rate greater than 160, MAP greater than or equal to 35, or any signs of seizures.*
- ▶ **Hepatic function panel** stat then q24hrs for 2 days
- ▶ At 72hrs of cooling, nurse to confirm physician has ordered "Re-warming Order Set" if lab results are WNL

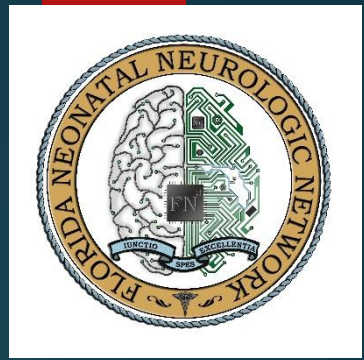


It's not over till it's over...Now we have Re-warming orders...



- ▶ Before rewarming, **call the BMP results to the provider** who will ensure results are normal in order to proceed with rewarming
- ▶ **Vital signs** q1 hr during rewarming
- ▶ **Notify physician and stop rewarming** if:
 - ▶ Heart rate greater than 160 bpm
 - ▶ MAP less than 35
 - ▶ Any signs of seizures
- ▶ Re-warm infant by **increasing set temp 0.2°C every 30 minutes** until temperature reaches 36.5. Then discontinue the servo-controlled cooling unit.
- ▶ After re-warming complete, manage radiant warmer per protocol

Re-warming orders continued...



▶ Labs

- ▶ PT/INR, Fibrinogen, D-dimer, CBC with differential, Magnesium and Phosphorus 24 hours after rewarming complete

- ▶ *Note: Electrolyte abnormalities may predispose infant to arrhythmias during rewarming.*

▶ Imaging

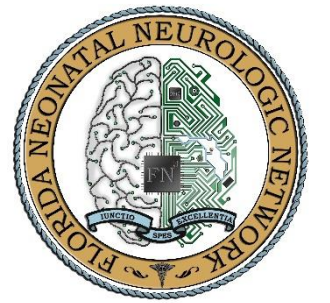
- ▶ Diffusion weighted MRI with spectroscopy at 3-7 days after hypoxic-ischemic event

▶ Social work consult

- ▶ Refer to Early Steps Program

- ▶ *Note: Early intervention is vital for best possible long-term outcome*

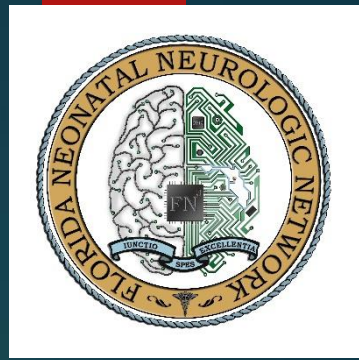
Now it's really over!



Can we start
the weekend
over again?
I wasn't ready...



References



- ▶ <https://fn3.sites.medinfo.ufl.edu/parent-info-2/parent-info/#definition>
- ▶ <https://fn3.sites.medinfo.ufl.edu/members/protocols-and-guidelines/>

