

***Early Identification and Screening
of Neonates At-Risk for
Neonatal Encephalopathy***

A Statewide Guideline



Early Identification and Screening of Neonates At-Risk for Neonatal Encephalopathy

- Aim of the task force was to create a state-wide guideline:
 - Decrease “missed” infants and improve newborn outcomes across the state
 - Common guidelines for NICUs providing therapeutic hypothermia
 - Provide guidance to birthing hospitals and NICUS not providing therapeutic hypothermia on admission criteria



Hypoxic Ischemic Encephalopathy (HIE)

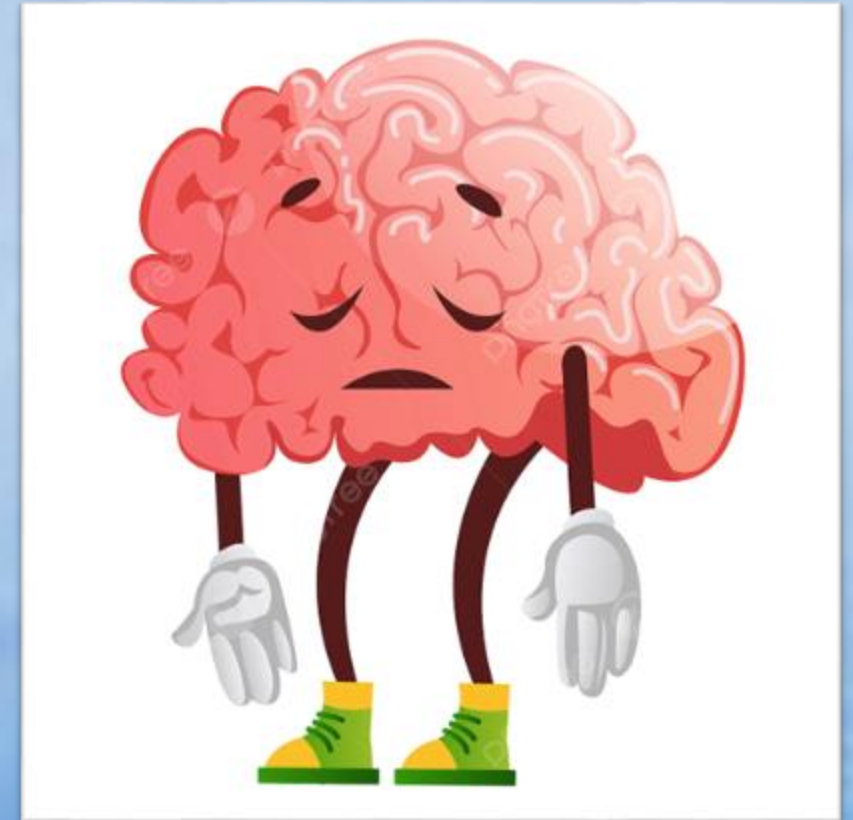
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OBJECTIVES

- › Define HIE
- › Incidence of HIE
- › Review underlying pathophysiology of HIE
- › Review outcomes for infants with HIE
- › Outline diagnostic considerations, including MRI and EEG

Definitions

- › Neonatal Encephalopathy
 - Clinically defined syndrome
 - Neurologic dysfunction in infants in early days of life at or beyond 35 weeks gestation
 - Spectrum of neurologic dysfunction
- › Hypoxic ischemic encephalopathy (HIE)
 - “Birth asphyxia” – an outdated term
 - Most common type of neonatal encephalopathy
 - › Accounts for 15-35% of encephalopathy in late preterm and term infants
 - Represents global hypoxic insult to the brain



HIE Incidence

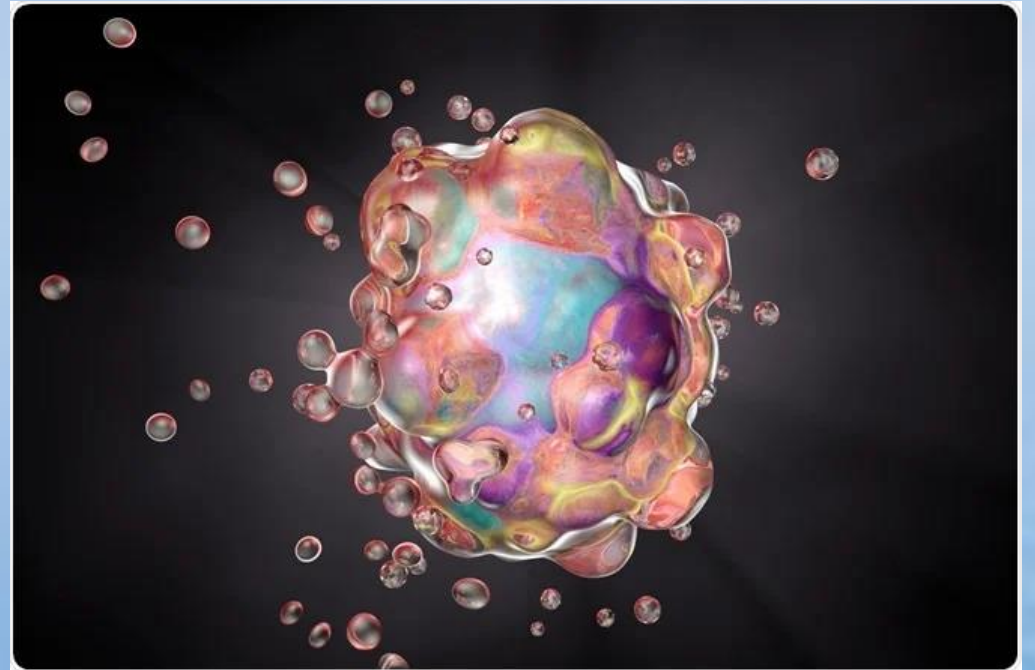
- › 1 to 8 per 1000 live births in developed countries
- › As high as 26 per 1000 live births in underdeveloped countries
 - Variation occurs based on variability of resources

Pathophysiology – Key Points

- › Brain is dependent on appropriate delivery of oxygen and glucose to function
- › Adequate cerebral blood flow is essential for oxygen and glucose delivery
 - Maintenance of homeostasis
 - Meeting of cellular energy demands
- › Variety of conditions compromise appropriate placental perfusion and disrupt oxygen and glucose delivery to the umbilical cord

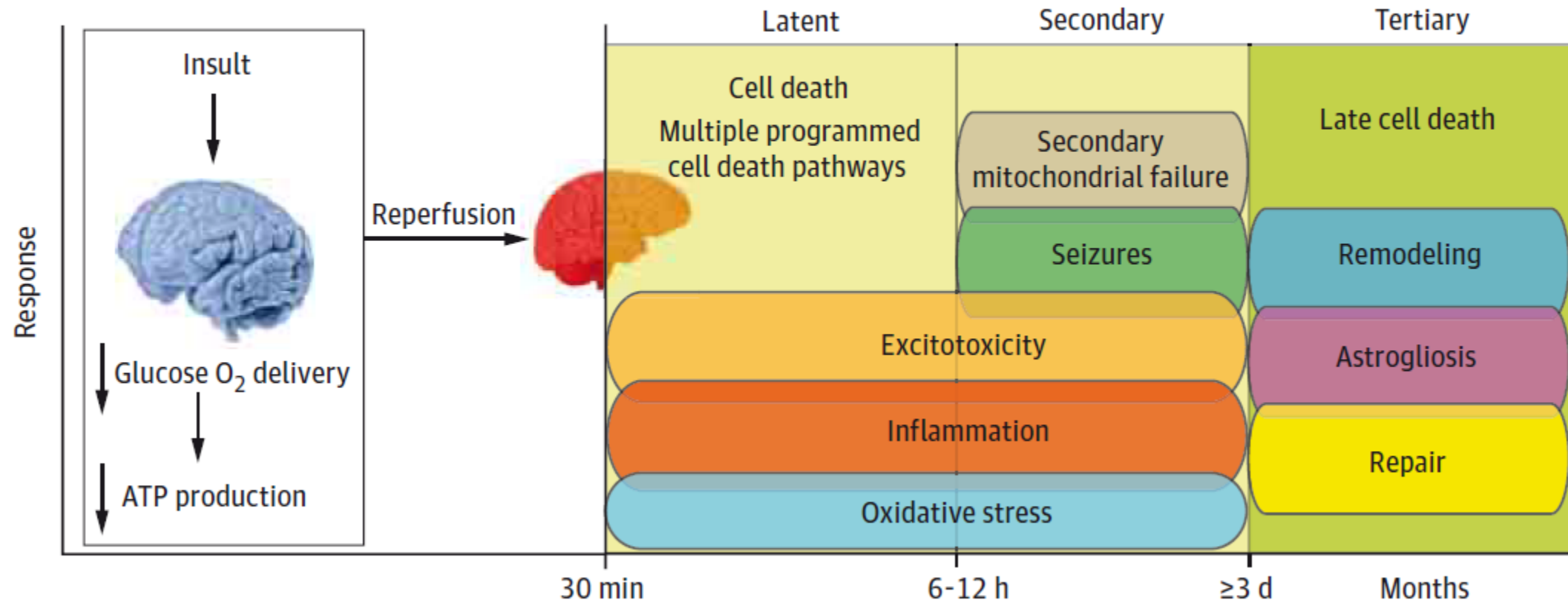
HIE – 3 Main Phases of Injury

- › Initial hypoxic-ischemic insult
- › Secondary effects of oxidative stress, mitochondrial deficiency, excitotoxicity, inflammation, and early stages of neuronal necrosis and apoptosis
- › Long-term cell death, inflammation, cell turnover/repair, and gliosis



HIE – Timeline of Injury

Figure 1. Schematic Overview of the Pathophysiological Features of Hypoxic-Ischemic Encephalopathy



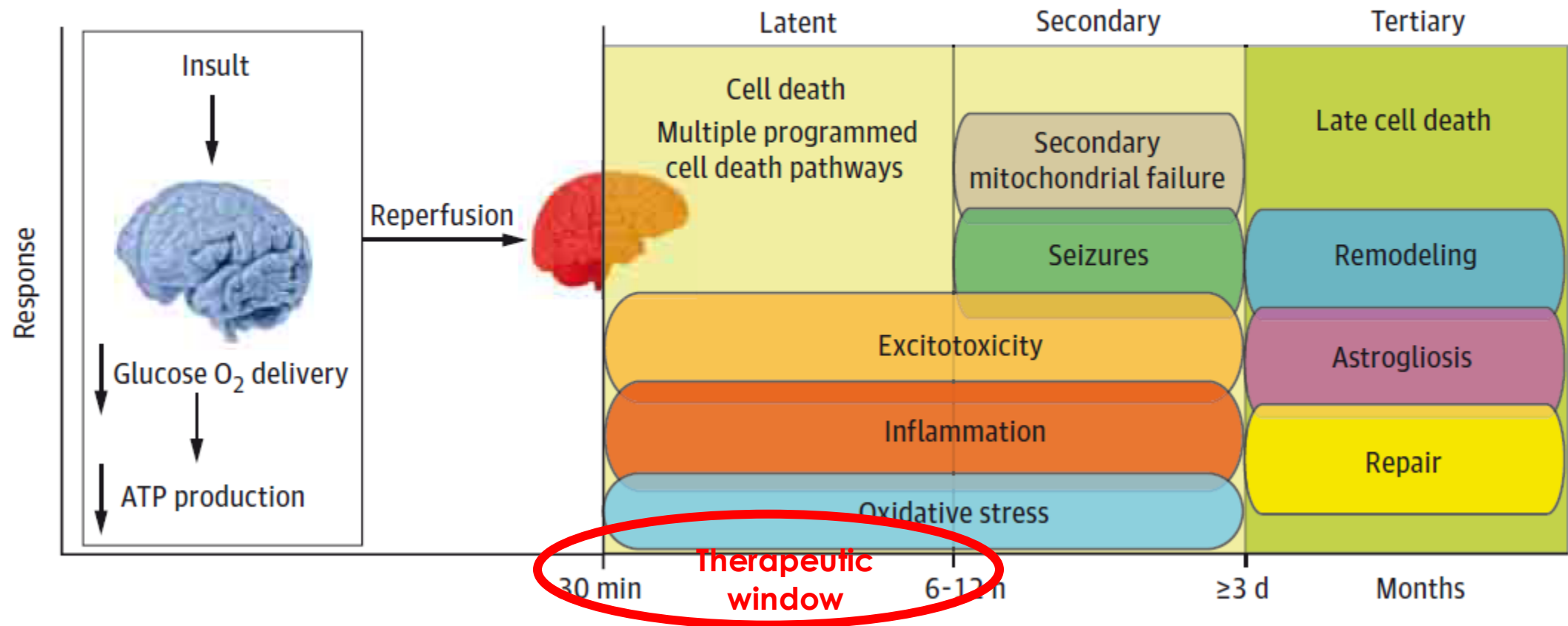
HIE – TIMELINE OF INJURY

- › Primary energy failure
 - Occurs early, around hypoxic event
 - May resolve based on timing and effectiveness of resuscitative efforts
 - Neuronal injury - **necrotic**

- › Secondary energy failure
 - Occurs 6-12 hours later, may be progressive
 - Leads to tissue damage – brain and other organs
 - Neuronal injury - **apoptotic**

HIE – Timeline of Injury

Figure 1. Schematic Overview of the Pathophysiological Features of Hypoxic-Ischemic Encephalopathy



Therapeutic Hypothermia

- › The only approved treatment for HIE
- › Works within the “therapeutic window” to decrease brain injury during the phase of secondary energy failure
- › Two types:
 - Selective head cooling
 - **Whole body hypothermia**
 - › Easier to use and less expensive

Therapeutic Hypothermia

SELECTIVE HEAD COOLING



WHOLE BODY



So, Why Cool?

- › Multiple trials to date showing benefits of cooling on outcomes for babies with moderate to severe HIE
- › 2 largest multi-center trials showed:
 - 18-22 months of age:
 - › Lower mortality and moderate/severe disability
 - › Decreased rate of cerebral palsy
 - › Decrease in hearing and visual impairments
 - At 6-7 years of age:
 - › Benefits seen at 18-22 months persisted at school age
 - › Lower rate of mortality and moderate/severe disability
 - › Lower rate of cerebral palsy
 - Reduction in death DID NOT result in increase in survivors with disability

Imaging - MRI

› Preferred modality

- Need conventional sequences (T1 and T2) and diffusion weighted imaging (DWI)

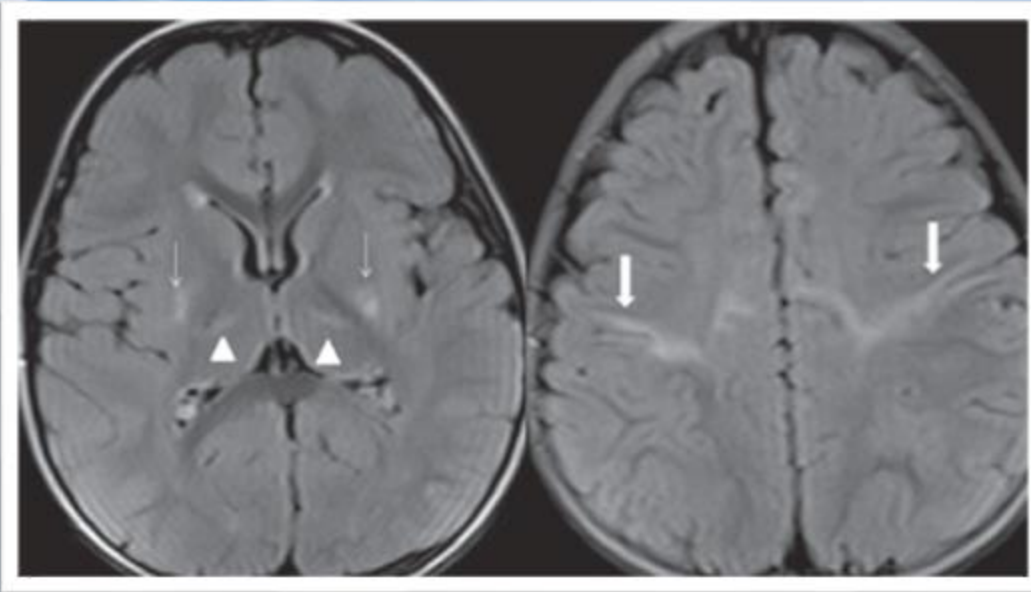
› When to get it

- **3-5 days ideally**
- Prior to 2 days – too early, may only show subtle changes
- After 7 days – can have some “pseudo-normalization” and can miss injury

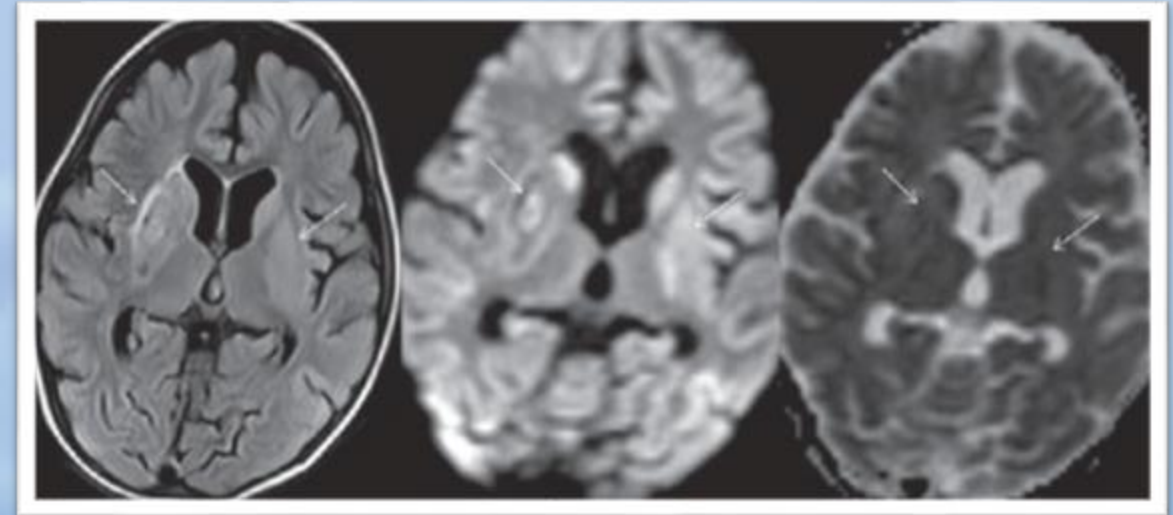
› Patterns of injury

- Watershed infarcts involving cortical gray matter and subcortical white matter
- Involvement of basal ganglia, thalami, brainstem, hippocampus – more reflective of global hypoxic injury

MRI Findings



1 year-old with severe HIE: injury in thalami (arrow head), posterior putamen (thin arrow), and cortex (thick arrow)



2.5 yo male with severe HIE: basal ganglia infarcts

Seizures

- › Common sign of CNS injury, thus common in neonatal encephalopathy
- › In neonatal period, HIE is the most common cause
- › **EEG**
 - Identifies and characterizes seizures
 - 2011 guidelines by the American Clinical Neurophysiology Society recommend 24 hour continuous EEG monitoring – great idea but not always feasible
- › **aEEG**
 - Amplitude-integrated EEG
 - Continuously monitors cerebral activity and helpful in detecting seizures
 - More readily available than continuous EEG

References

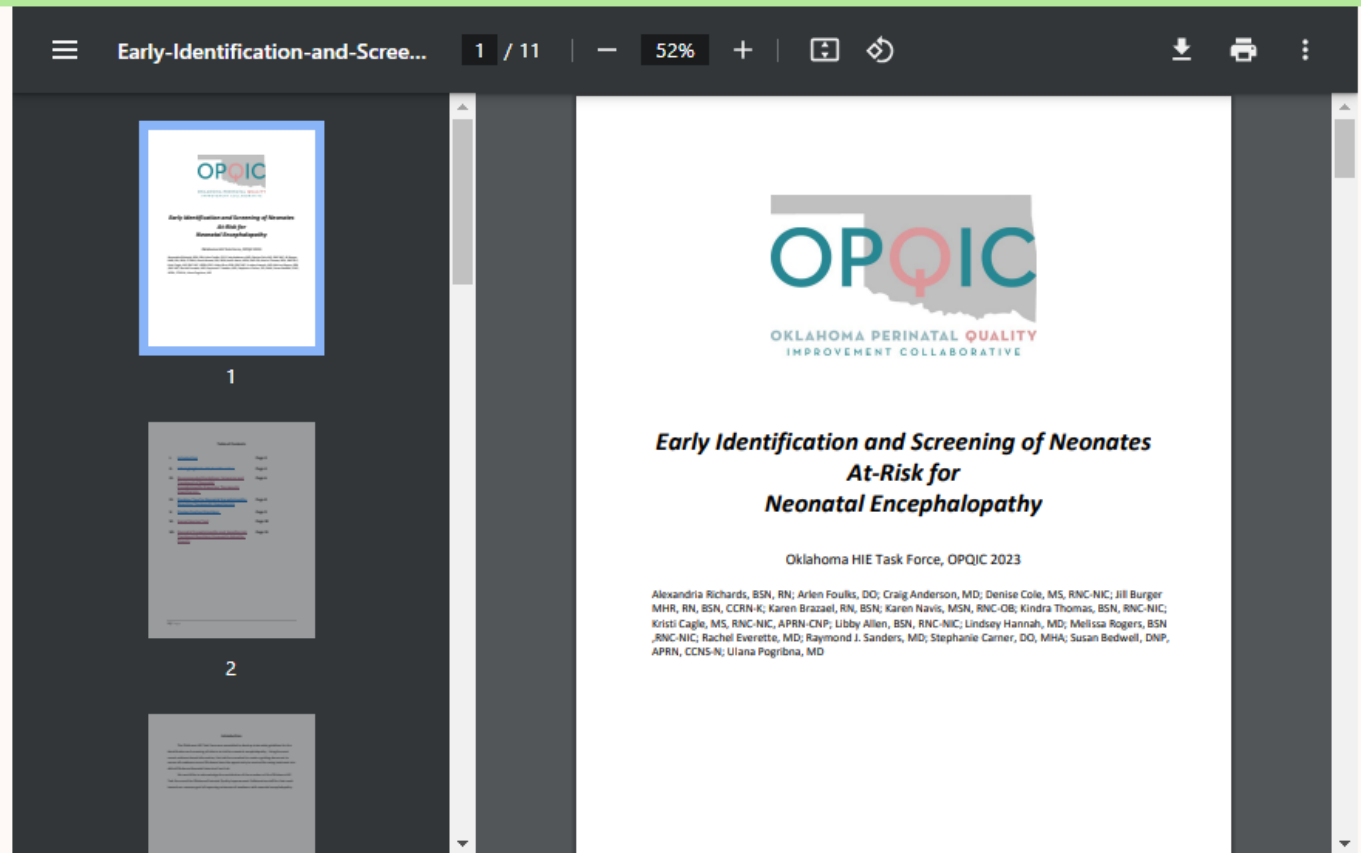
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***Early Identification and Screening of
Neonates At-Risk for
Neonatal Encephalopathy Guidelines***

Dr. Arlen Foulks, Dr. Susan Bedwell

Oklahoma HIE Task Force

The Oklahoma HIE (Hypoxic Ischemic Encephalopathy) Task Force was assembled to develop state-wide guidelines for the identification and screening of infants at-risk for neonatal encephalopathy. Using the most recent evidence-based information, the task force worked to create a guiding document to ensure all newborns across Oklahoma have the opportunity to receive life-saving treatment at a skilled Oklahoma Neonatal Intensive Care Unit.





Early Identification and Screening of Neonates At-Risk for Neonatal Encephalopathy

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Birthing Hospital Screening Criteria

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- › Because the window for treatment for hypoxic ischemic encephalopathy is short (6 hours), any infant equal to or greater than 35 weeks gestation with a **history of an acute perinatal event with the potential for hypoxia** accompanied by any one of the following should be immediately referred to a neonatal intensive care unit that provides therapeutic hypothermia:
 - **APGAR less than or equal to 5 at 10 minutes of life**
 - **Assisted ventilation required at 10 minutes of life**

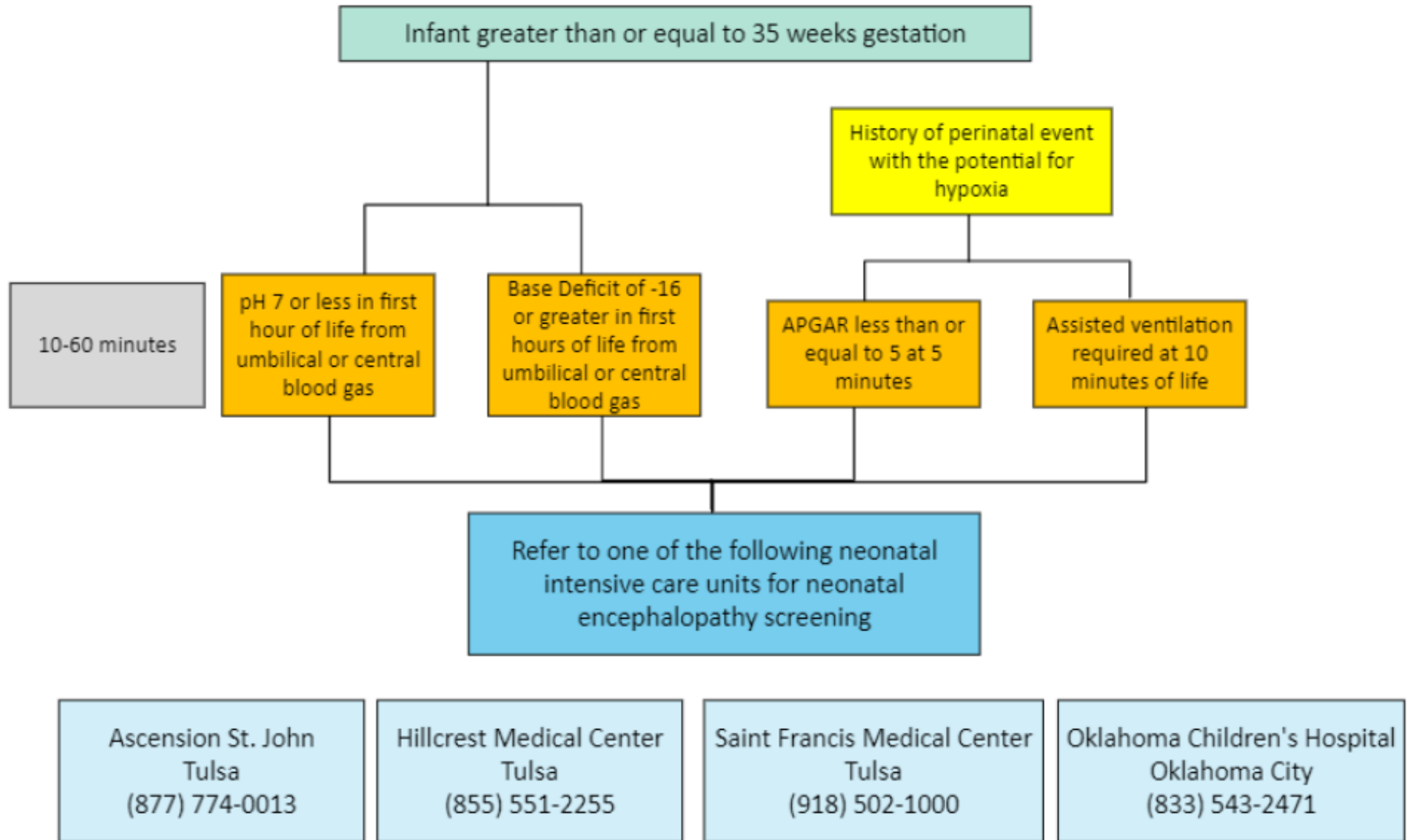
Birthing Hospital Screening Criteria

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- › **Infants regardless of perinatal history** with an umbilical cord or central blood gas obtained within 1 hour of life with one of the following should be immediately referred to a neonatal intensive care unit that provides therapeutic hypothermia:
 - **pH of 7 or less**
 - **Base Deficit of negative 16 mEq or greater**
- › Infants with severe IUGR, severe chromosomal or congenital anomalies or who are unlikely to benefit from or respond to aggressive life support are not eligible for therapeutic hypothermia.

Referral Decision Tree for Neonatal Encephalopathy Requiring Therapeutic Hypothermia

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Neonatal Intensive Care Confirming Criteria

Page 6

The presence of seizure activity or presence of moderate to severe neonatal encephalopathy qualifies the infant for treatment with therapeutic hypothermia.

Neonatal Intensive Care Confirming Criteria

A Neonatologist, or a clinician should examine the infant for signs of encephalopathy using the Modified Sarnat Scoring Tool.

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The presence of abnormal neurologic signs affecting 3 of the 6 categories indicates moderate to severe encephalopathy and the infant should receive treatment with therapeutic hypothermia.

Neonatal Intensive Care Confirming Criteria

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Category	Sarnat Level	
	Moderate	Severe
Level of consciousness	Lethargic	Stupor/coma
Spontaneous activity	Decreased activity	No activity
Posture	Distal flexion, full extension	Decerebrate
Tone	Hypotonia (focal, general)	Flaccid
Primitive reflexes: Suck Moro	Weak Incomplete	Absent Absent
Autonomic system: Pupils Heart rate Respirations	Constricted Bradycardia Periodic breathing	Skewed deviation/dilated/nonreactive Variable heart rate Apnea

Passive Cooling

- › Modest hypothermia (core temperature of 33 to 35 degrees C [91.4 to 95 degrees F]) may be indicated for some infants with moderate to severe hypoxic ischemic encephalopathy.
- › Passive cooling may be advantageous for some infants with signs of perinatal depression prior to and during transport when eligibility for hypothermia therapy is being considered.
- › During passive cooling, no external sources of cooling are applied. Care must be taken to avoid over-cooling because passive cooling is unregulated and, depending on patient-specific and environmental circumstances, the infant's temperature may fall too low.
- › **CAUTION: Passive cooling should ONLY be initiated under the direction of a neonatologist/clinician from a NICU providing therapeutic hypothermia.**

Confirming Criteria Not Met

If the infant is not having seizure activity or the neurological exam using the Modified Sarnat Scoring Tool does not indicate moderate to severe encephalopathy:

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- › Keep the infant normothermic
- › Transfer to a neonatal intensive care unit that provides therapeutic hypothermia for continued observation.

The Modified Sarnat Scoring Tool is repeated hourly until the scoring tool indicates moderate to severe encephalopathy or the infant reaches 6-hours post birth

Therapeutic Hypothermia (Cooling)

What is cooling?

- Cooling is a treatment for suspected hypoxic ischemic encephalopathy (HIE). Within 6 hours of birth, your baby's temperature is cooled below normal body temperature and is kept in this low range of 33°C to 34°C (91.4°F to 93.2°F) for 72 hours. Cooling may stop further injury to your baby's brain and may reduce or prevent physical or mental conditions that limit movement, senses and activities.

What to expect/side effects

- Sleepy/sedated
- Pale, patchy, slightly blue skin coloring
- Possible shivering
- Slowing of the heart rate (will return to normal rate after cooling)
- Monitors to track heart rate, oxygen levels and breathing, lines into the umbilical cord, tubes in the mouth
- Medication administration - While the cooling process has not been shown to cause pain, measures to comfort your baby, including pain medication, may be provided

What can I do?

- Allow your baby to rest
- Gently whisper to your baby
- Provide a calm and quiet environment
- Ask the health care team when hands-on time will occur
- Pump and store your breast milk
- Ask questions when you have them

Feel free to reach out to your baby's health care team

For more information about HIE, visit the
www.hopeforhie.org



THANK YOU!

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