

# Neonatal Hypoxic Ischemic Encephalopathy Clinical Pathway: NICU Management

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Newborn meeting **inclusion criteria**<sup>1</sup> within the 1<sup>st</sup> hour of life (HOL) with either:

Sentinel birth event<sup>2</sup> **and** arterial cord gas<sup>3</sup> (or infant blood gas) pH  $\leq 7.15$  or base deficit (BD)  $\geq -10$

OR

Arterial cord gas<sup>3</sup> (or infant blood gas) pH  $\leq 7.00$  or base deficit (BD)  $\geq -16$

Perform & document **Modified Sarnat Exam** (Page 3) at delivery.

Initial modified Sarnat exam abnormal?

YES

NO

**NO ENCEPHALOPATHY**

Proceed with routine care and monitoring.

Repeat exam at 1 HOL.

Infant has  $\geq 3$  domains classified as moderate or severe on modified Sarnat exam or seizures?

YES

NO

Infant has  $> 1$  abnormal domain of any classification on modified Sarnat exam?

YES

## MODERATE OR SEVERE ENCEPHALOPATHY

Admit to NICU and evaluate eligibility for therapeutic hypothermia (Page 2).

Infant eligible for therapeutic hypothermia?

YES

NO

### ELIGIBLE

- Call urgently for transport if needed.
  - Ideally between 1-2 HOL
- Start therapeutic hypothermia ASAP using a servo-controlled device.
  - Standard of care within 6 HOL
  - If not available at hospital start on transport if possible
- Start empiric cEEG monitoring.
  - Monitor through re-warming. Minimum 24 hours.
- Consider cranial US.
  - Do NOT delay cEEG
- Consult neurology if inpatient consult available.
- Recommend brain MRI without contrast at 3-5 days of life.
  - If clinically unstable, after day 10 of life
- Refer for neurodevelopmental follow-up.

### INELIGIBLE

- Do not proceed with therapeutic hypothermia.
- Evaluate for other causes of encephalopathy, such as:
- Genetic or chromosomal abnormality
  - Stroke
  - Infection

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## <sup>1</sup>Inclusion Criteria

- Diagnosis of, or concern for Neonatal Encephalopathy or Hypoxic Ischemic Encephalopathy (HIE).
- Infants Less than 24 hours old
- Gestational age  $\geq 36$  weeks

## <sup>2</sup>Sentinel Birth Events

Presence of sentinel event defined as:

- Maternal trauma, hemorrhage, or cardiorespiratory arrest
- Placental abruption or uterine rupture
- Vasa previa or fetal-maternal hemorrhage
- Shoulder dystocia or head entrapment
- Cord accident such as cord prolapse, rupture, knot, or tight nuchal cord
- Fetal bradycardia or other non-reassuring fetal heart tones

## <sup>3</sup>Cord Gas

Arterial Cord gas is the preferred screening lab. If an arterial cord gas cannot be obtained, infant blood gas collected in the first hour of life (HOL) can be used.

## MILD ENCEPHALOPATHY

Consider admission to NICU for 6 hours of observation.

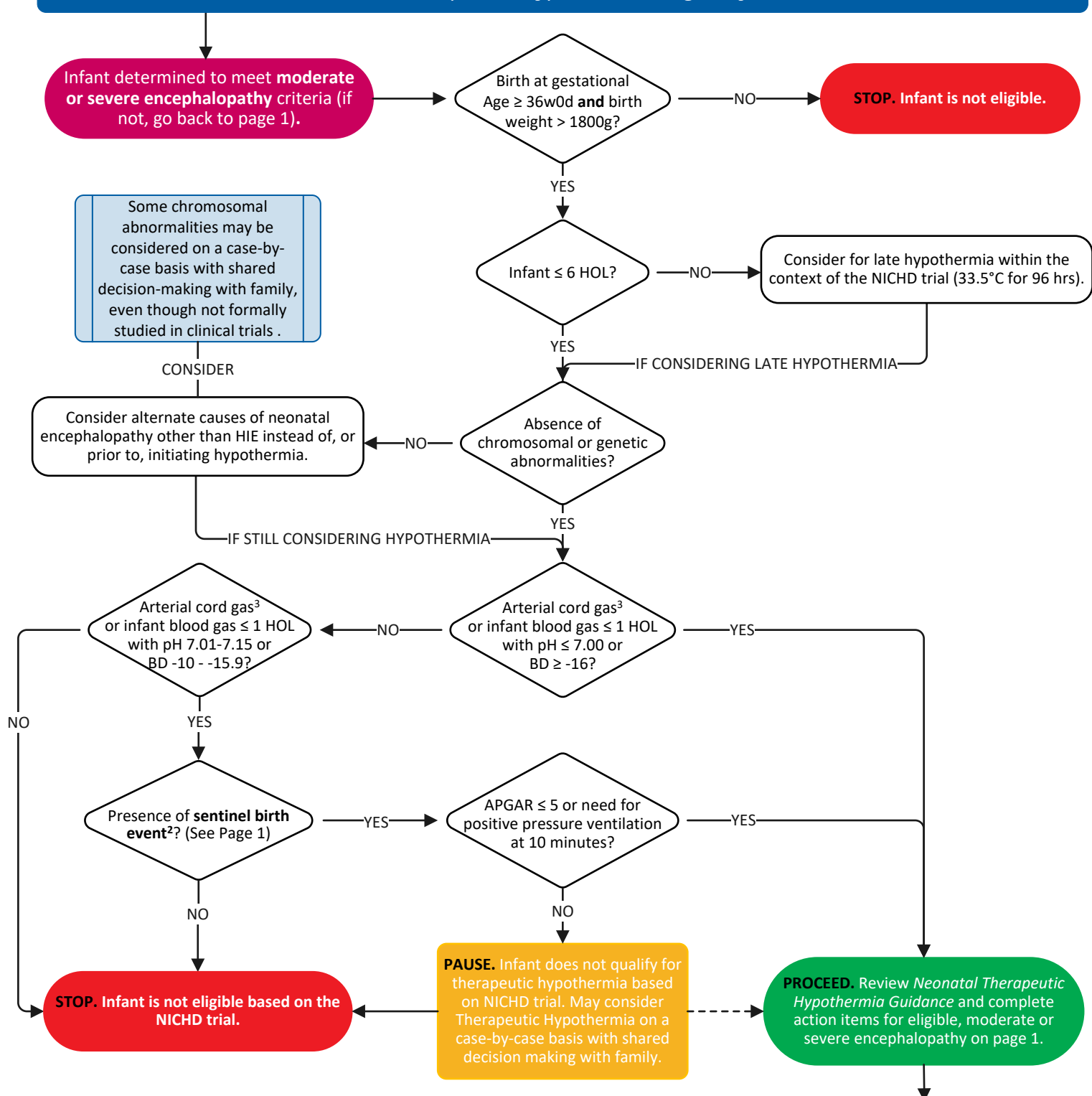
Repeat modified Sarnat exams at 3 and 5 HOL.

Infant develops seizure or  $\geq 3$  domains classified as moderate or severe on subsequent exam within 6 HOL?

NO

- Current evidence shows no benefit of therapeutic hypothermia at this stage.
- Consider: cEEG, and brain MRI prior to discharge and ideally within 2-3 days of life.
  - Refer for neurodevelopmental follow-up.

## Neonatal Therapeutic Hypothermia Eligibility Criteria



## Neonatal Therapeutic Hypothermia Guidance

Standard therapeutic hypothermia is using a servo-controlled device for 72 hours at 33.5°C. It is important to monitor temperature closely, as hyperthermia and severe hypothermia have been associated with adverse outcomes. Passive cooling should only be undertaken with caution (rectal temperature q15 minutes with goal temp 33.5-36°C and consideration for external heat if temperature <33.5°C).

## Modified Sarnat Exam

Domain		Normal	Abnormal Domains		
			Mild	Moderate	Severe
Level of Consciousness		Alert, responsive to external stimuli	Irritable, hyperalert, excess crying alternating with sleep	Lethargic	Stupor or coma
Spontaneous Activity		Active, vigorous (doesn't stay in one position)	Increased or exaggerated movements, jittery	Decreased activity	No activity
Posture		Extremities flexed in toward the trunk	Mild distal arm or leg flexion with leg abduction or slight extension	Distal flexion, complete extension	Decerebrate
Tone		Strong flexor tone in all extremities	Slightly increased	Hypotonia (focal or general)	Flaccid
Reflexes	Suck	Vigorous suck	Uncoordinated suck	Weak, incomplete or biting suck	Absent suck
	Moro	Complete normal moro	Exaggerated moro	Incomplete (Partial abduction at shoulder and extensions of arms)	Absent moro
Autonomic function	Pupils	PERRL	Dilated but reactive pupils	Constricted but reactive pupils.	Deviated, dilated, or nonreactive to light.
	Heart Rate	Normal HR (100-160)	Tachycardia	Bradycardia	Variable or irregular HR
	Breathing	Regular spontaneous breathing	Irregular respirations or tachypnea	Periodic breathing	Apnea requiring non-invasive or invasive ventilation

Time	# Abnormal Domains	HIE Severity <sup>4</sup>
Birth	Mild: Moderate: Severe:	
1 HOL	Mild: Moderate: Severe:	
3 HOL	Mild: Moderate: Severe:	
5 HOL	Mild: Moderate: Severe:	

### 4Modified Sarnat Exam Staging Guidance

- **Normal** = ≤1 abnormal domain
- **Mild HIE** = ≥ 2 abnormal domains of any severity, but with **no more than 2** classified as moderate or severe
- **Moderate or Severe HIE** = ≥ 3 moderate or severe domains
  - For **moderate** and **severe**, severity is determined by the stage that has more abnormal domains.
  - If an **equal** number of domains are classified as **moderate** and **severe**, the level of encephalopathy is determined by the **severity** of the **Level of Consciousness** domain.

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