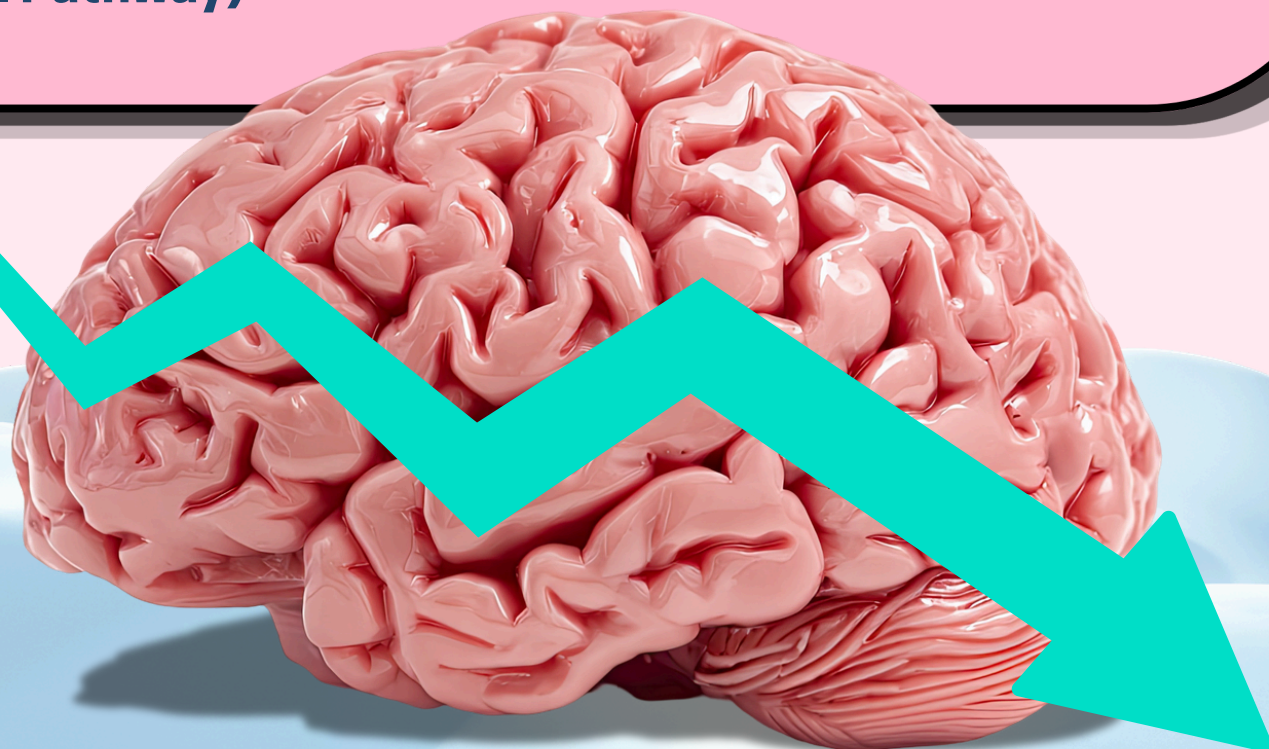




Therapeutic Hypothermia in Neonatal HIE

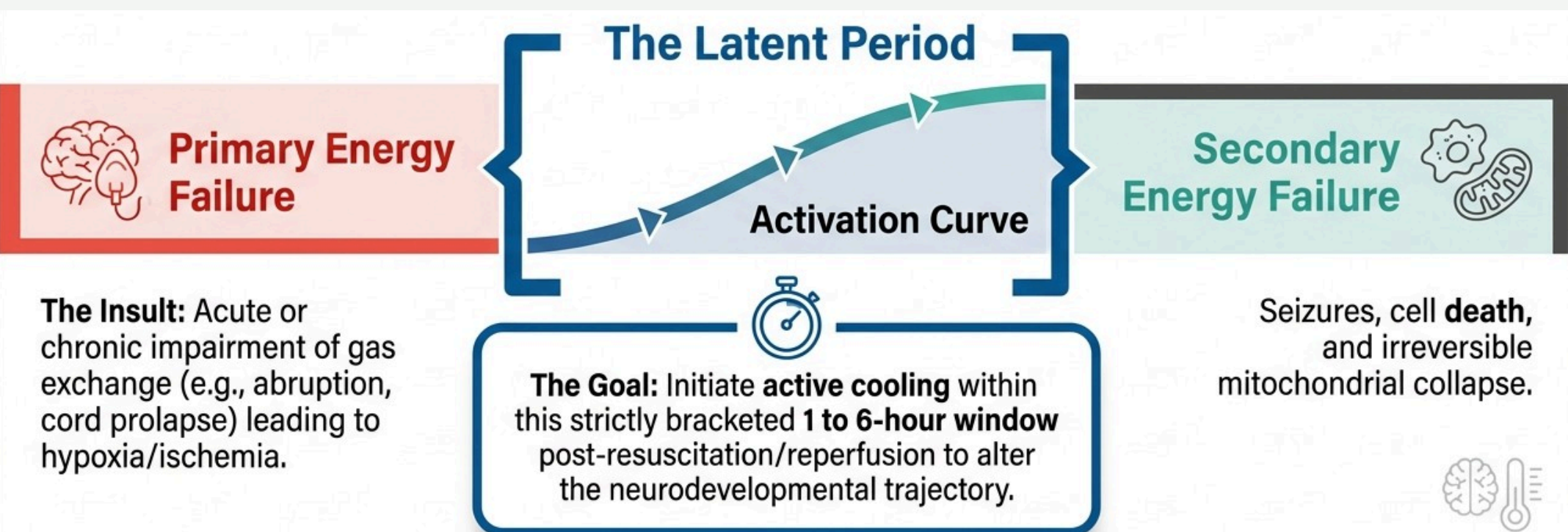
**Clinical Criteria, 72-Hour Protocol, and Systems
Management**

**An evidence-based visual reference based on the Toronto Resident's Handbook of
Neonatology (SickKids Clinical Pathway)**



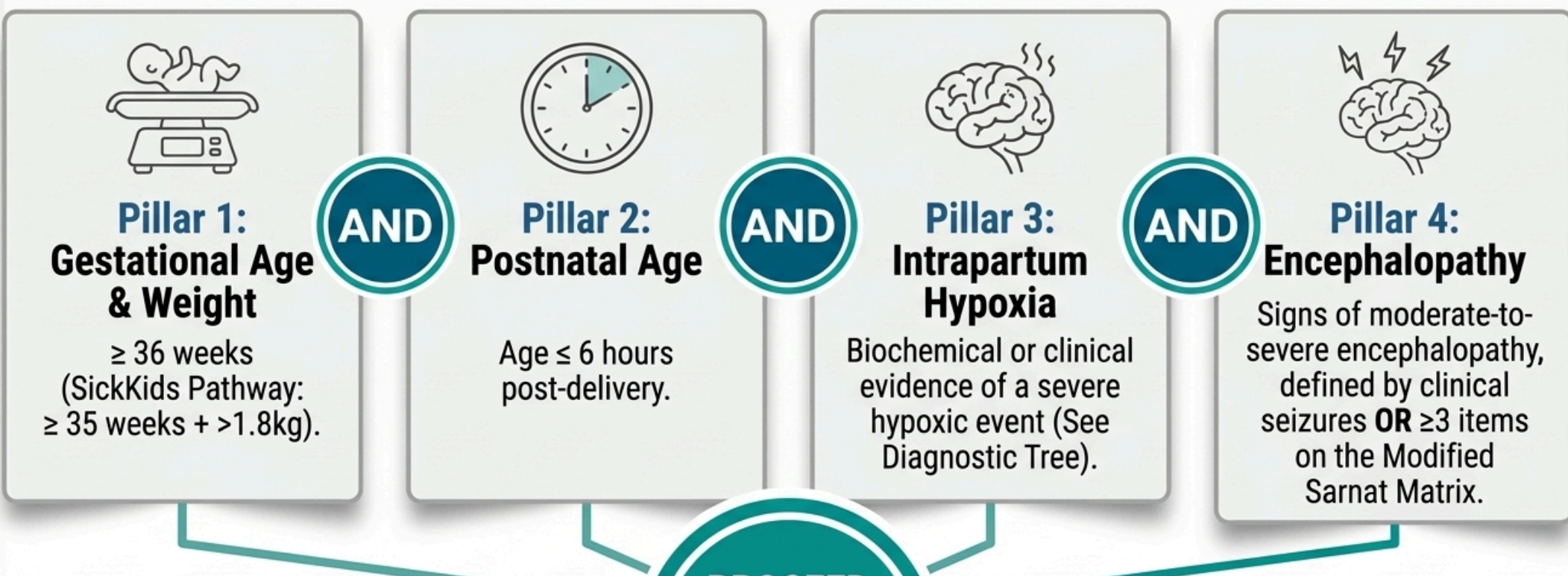
The Critical Window for Neuroprotection

Hypoxic-Ischemic Encephalopathy (HIE) initiates a cascade of cellular injury. Therapeutic hypothermia interrupts this cascade, but only if applied during the specific latent phase before irreversible mitochondrial failure occurs.



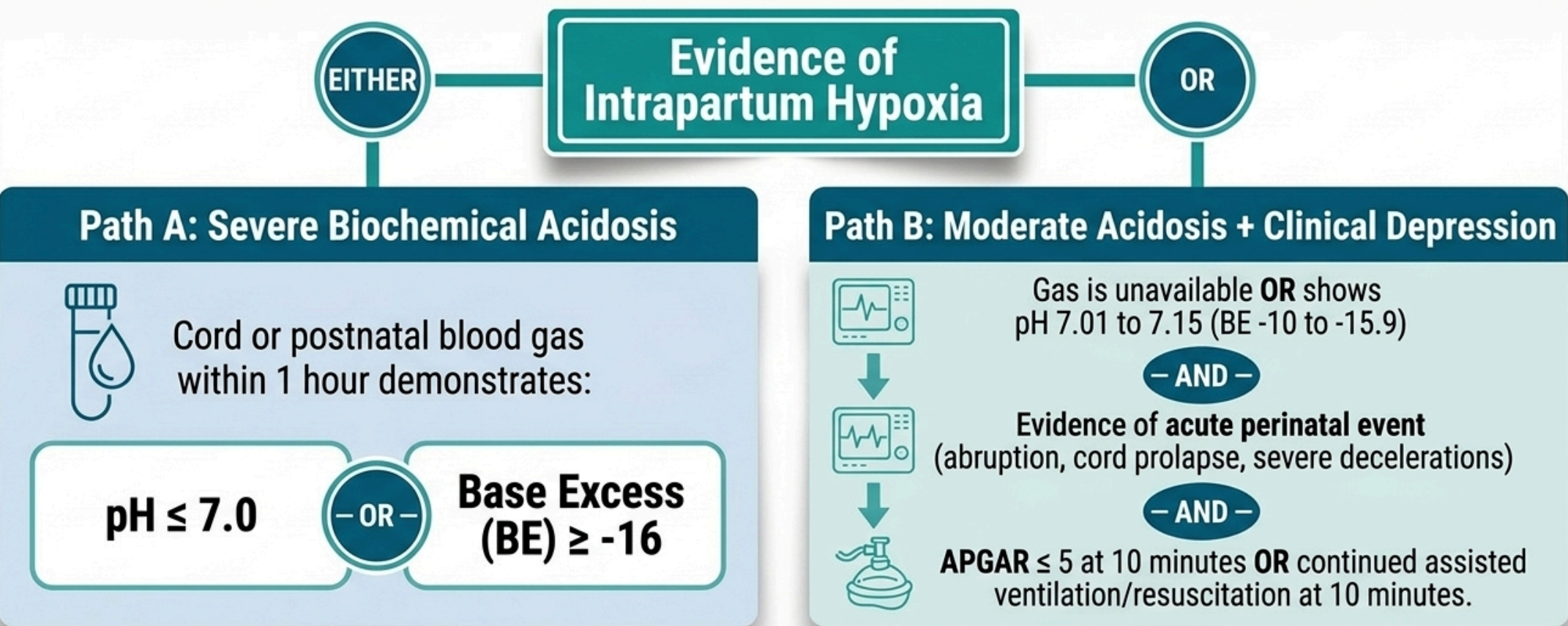
The Four Pillars of Inclusion

An infant must meet **ALL** four criteria to qualify for the therapeutic hypothermia protocol.



Defining Evidence of Intrapartum Hypoxia

To satisfy **Criterion 3**, the infant's presentation must match **EITHER Path A OR Path B**.



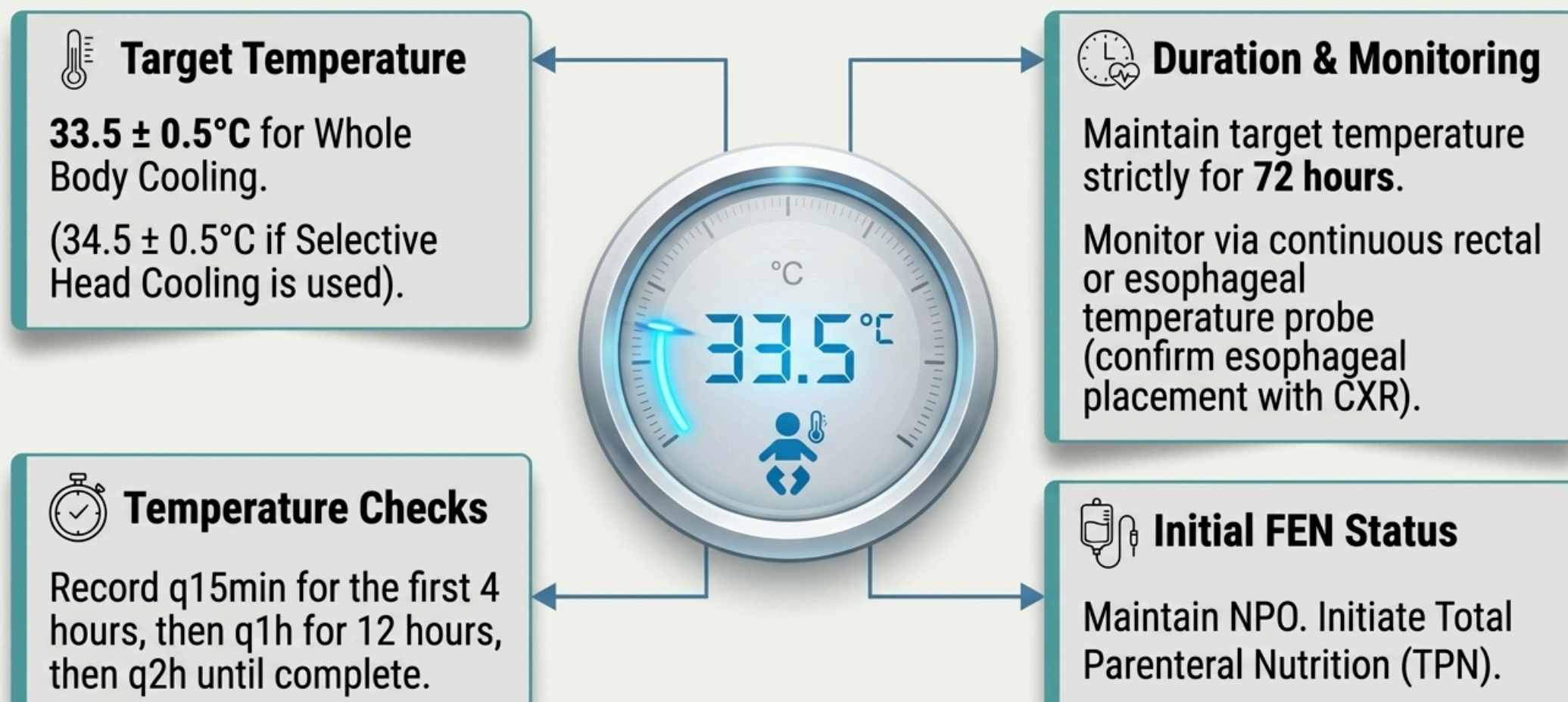
The Modified Sarnat Matrix

	Mild	Moderate	Severe
LOC	Hyper-alert	Lethargy	Stupor/coma
Posture	Mild distal flexion	Distal flexion, full extension	Decerebrate
Tone	Normal	Hypotonia	Flaccid
Reflexes	Suck weak, Moro strong	Suck weak, Moro incomplete	Absent
Autonomic: Pupils	Dilated	Constricted	Skew deviation / Dilated / Non-reactive
Autonomic: Vitals	Tachycardia, normal resp	Bradycardia, periodic resp	Variable HR, Apnea

Threshold for Cooling: Clinical seizures **OR** ≥3 of 6 items in the Moderate/Severe columns.

The 72-Hour Cooling Protocol Parameters

Initiate passive cooling immediately; transfer to tertiary care NICU for active management.



Systems Management Dashboard: Part I

Supportive care during hypothermia requires meticulous multi-organ monitoring.



Fluids, Electrolytes & Nutrition (FEN)

Maintain **NPO**; start TPN. Provide maintenance fluids but strictly avoid fluid overload.

Maintain **normoglycemia** (**2.6 - 8.0 mmol/L**; monitor q4-6h).

Actively correct **hypocalcemia**, **hypomagnesemia**, and **hyponatremia**.



Cardiovascular

Target Mean Arterial Pressure (MAP) **40-50 mmHg**.

Consider invasive BP monitoring.

Support hypotension with fluid resuscitation and inotropes; rule out primary cardiac dysfunction.



Respiratory

Ensure adequate **oxygenation**.

Strictly avoid hyperoxia and **hypocapnea** (worsens cerebral vasoconstriction).

Trend blood gases closely to monitor developing acidosis.

Systems Management Dashboard: Part II

Renal



Trend Creatinine, Urea, Electrolytes, and Urine Output. High vigilance for **fluid overload**, **Syndrome of Inappropriate Antidiuretic Hormone (SIADH)**, or **Acute Tubular Necrosis (ATN)**.

Hepatic & Metabolic



Monitor for **hyperbilirubinemia**. Trend liver enzymes (LFTs) for hepatic injury. Consider comprehensive metabolic screen including **lactate and ammonia**.

Neurological & Sedation



Arrange continuous aEEG +/- cEEG monitoring. Promptly treat **seizures**. Manage shivering and agitation with **Dexmedetomidine**. Treat pain with low-dose opioid infusions.

Hematologic



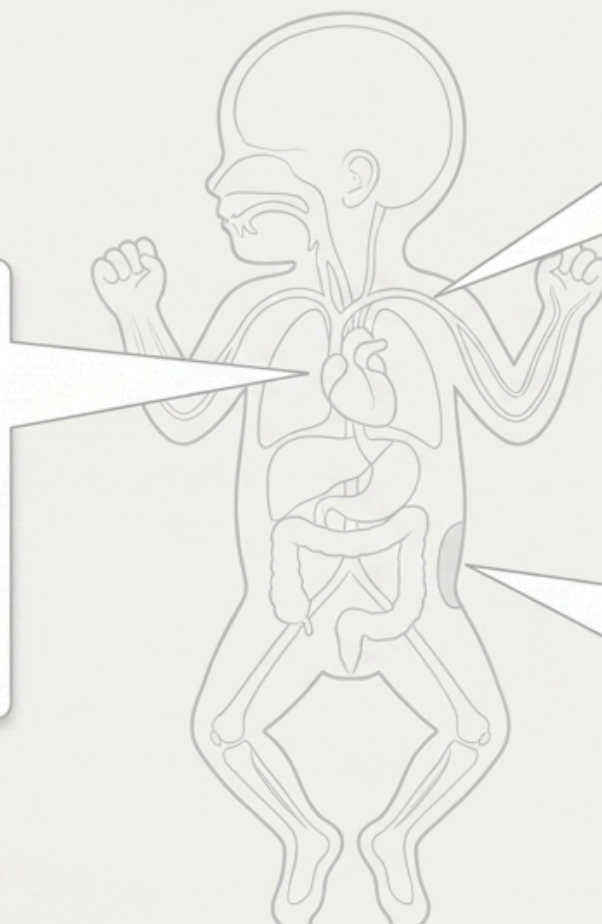
Monitor for **anemia** (transfuse pRBC if Hb is low; consider IVH if Hb is actively downtrending). Monitor for **coagulopathy** and **Disseminated Intravascular Coagulation (DIC)**.

Anticipated Complications of Hypothermia

Active cooling safely suppresses metabolism but predictably stresses certain physiologic systems. Expect and monitor for:

Cardiopulmonary

Sinus bradycardia (often physiological during cooling), hypotension, and Pulmonary Hypertension (PPHN) presenting as impaired oxygenation.



Hematologic

Mild thrombocytopenia and developing coagulopathies due to altered enzyme kinetics at lower temperatures.

Dermatologic

Subcutaneous fat necrosis (presents as firm, erythematous nodules, often on the back or buttocks, risking delayed hypercalcemia).

Emergency Cessation: Indications to Stop Cooling

Therapeutic hypothermia **must be abandoned** prior to the **72-hour mark** if the infant exhibits extreme physiological failure refractory to maximal medical therapy.

Abort Checklist



Cardiovascular Failure

Refractory hypotension that fails to respond despite escalating inotrope support.



Respiratory Failure

Persistent hypoxemia and pulmonary hypertension despite 100% O₂ and targeted pulmonary vasodilator treatment (e.g., iNO).

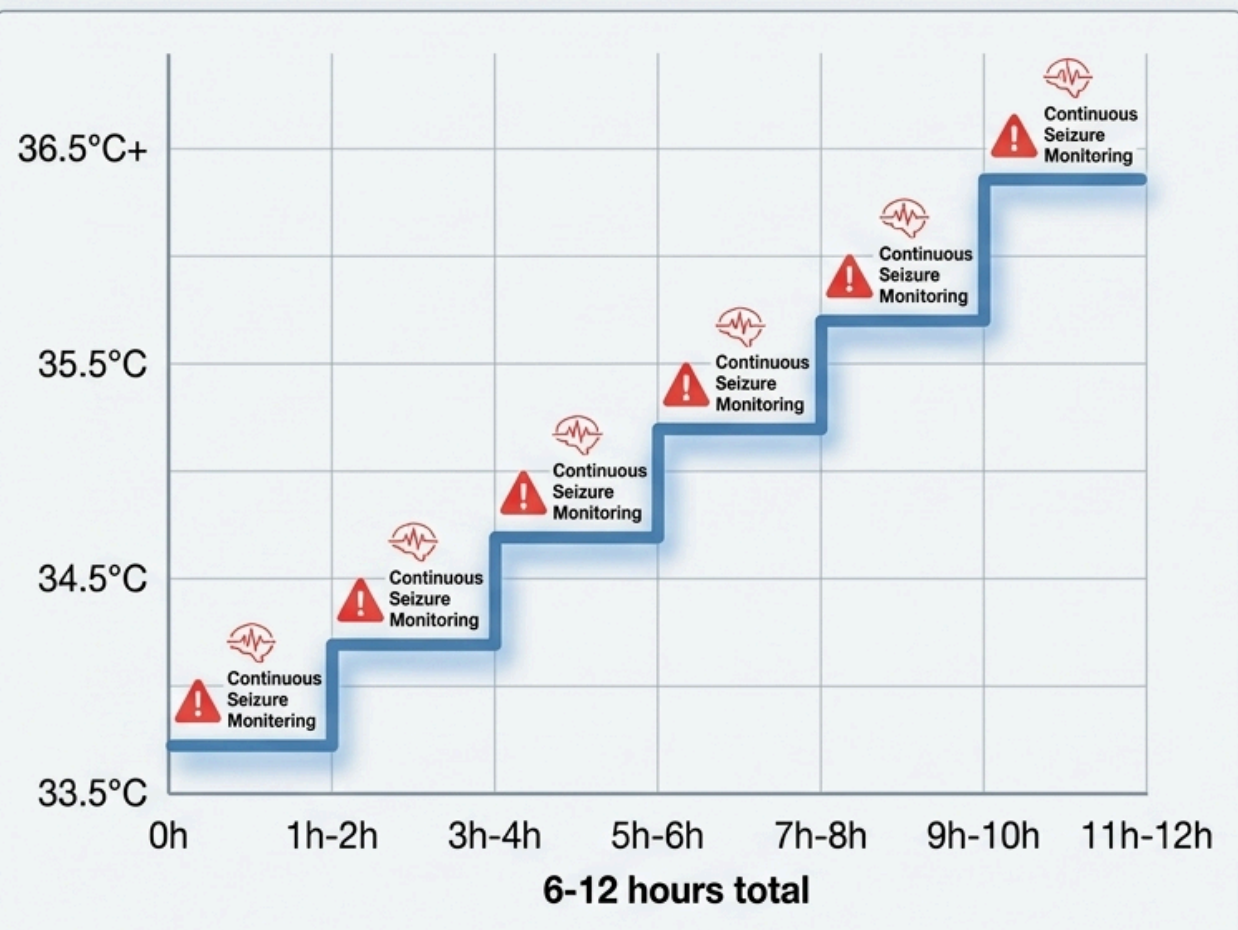


Hematologic Failure

Life-threatening, refractory coagulopathy that cannot be stabilized with blood products.

The Exit Strategy: Controlled Rewarming Protocol

Initiate **exactly after 72 hours of cooling**. Rapid rewarming causes severe vasodilation, hypotension, and lowers the seizure threshold.



The Rate of Ascent

Target an increase of no greater than 0.5°C per 1 to 2 hours. Total rewarming duration should span 6 to 12 hours.



Neurological Vigilance

Remain on high alert for increasing seizure frequency as cortical metabolism accelerates.



GI Considerations

Introduce enteral feeds extremely judiciously; the post-asphyxial, post-hypothermic gut is at a significantly elevated risk for Necrotizing Enterocolitis (NEC).

Post-Rewarming and Maintenance

Controlled Rewarming



Neuroimaging



Ensure successful completion of the rewarming phase.

Arrange for a brain MRI post-rewarming (typically between days 4-7 of life) to accurately assess the extent of white matter, basal ganglia, or cortical injury.

Seizure Management



If the infant required anti-seizure medication (e.g., phenobarbital loading) during cooling, re-evaluate the need for a maintenance dose prior to discharge.

System Normalization



Wean off respiratory and cardiovascular support as hemodynamics stabilize at normothermia.

Synthesis: The HIE Cooling Cheat Sheet

1. INCLUSION (ALL 4 REQUIRED)



• **GA** $\geq 36w$ (or $\geq 35w + >1.8kg$)



• **Age** ≤ 6 hrs



• **Hypoxia** ($pH \leq 7.0$ OR $BE \geq -16$ OR Acute Event + $APGAR \leq 5$ at 10m)



• **Mod/Severe Sarnat Score** (Seizures OR ≥ 3 signs)

2. PROTOCOL PARAMETERS



• **Temp:** $33.5 \pm 0.5^{\circ}C$



• **Duration:** 72 hours strict



• **NPO & TPN**



• **Dexmedetomidine** for shivering; low-dose opioids for pain

3. ABORT CRITERIA



• **Refractory hypotension** (max inotropes)



• **Persistent hypoxemia** (max O_2/iNO)



• **Life-threatening coagulopathy**

4. REWARMING



• **Rate:** $\leq 0.5^{\circ}C$ per 1-2 hours



• **Duration:** 6-12 hours total



• **High risk:** Seizures, hypotension, NEC



• **Action:** MRI post-rewarming

neofast

Neonatal Prescription



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