



CLINICAL GUIDELINE	
Cooling Guideline: Systemic Cooling for Neuroprotection in Neonates > 35 Weeks Gestational Age with HIE	
Scope (Staff):	Nursing and Medical Staff
Scope (Area):	NICU KEMH, NICU PCH, NETS WA
Child Safe Organisation Statement of Commitment	
CAHS commits to being a child safe organisation by applying the National Principles for Child Safe Organisations. This is a commitment to a strong culture supported by robust policies and procedures to reduce the likelihood of harm to children and young people.	

This document should be read in conjunction with this [DISCLAIMER](#)

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Background

This guideline is only for neonates > 35 weeks gestation at birth.

Hypothermia is not advisable for preterm neonates < 35 weeks gestation.

Hypoxic Ischaemic Encephalopathy (HIE) following perinatal asphyxia contributes significantly to neonatal mortality and morbidity including long-term neurodevelopmental sequelae in up to 25%-60% of survivors. Evidence from high quality RCTs indicates that cooling of neonates with moderate to severe HIE is safe and reduces the risk of death or disability at 18 to 22 months of age. Therefore, cooling is the first intervention which has been proven in rigorously conducted scientific studies to be beneficial in term and near term neonates with HIE. Target rectal temperatures during the period of cooling: 33.5°C (acceptable range 33-34).

Guideline for Management in NICU

Essential: the following four inclusion criteria should be met to be eligible for cooling.

Inclusion Criteria

1. > 35 weeks gestational age.
2. < 6 hours post birth.
3. Evidence of asphyxia as defined by the presence of at least two of the following four criteria:
 - Apgar < 6 at 10 minutes or continued need for resuscitation with positive pressure ventilation +/- chest compressions at 10 minutes.
 - Any acute perinatal event that may result in HIE (i.e. abruption of placenta, cord prolapse, severe FHR abnormality etc).
 - Cord pH < 7.0 or base deficit of 12 or more.
 - If cord pH is not available, arterial pH < 7.0 or BE > 12 mmol/L within 60 minutes of birth (if able to do gas).
4. Moderate or severe HIE based on modified Sarnat Classification (see [table below](#)).

If a neonate meets eligibility criteria 1, 3, and 4 but is 6-12 hours of age, delayed initiation of cooling may be considered at the discretion of the attending neonatologists.

The presences of moderate / severe HIE according to the modified Sarnat Classification is defined as seizures **OR** presence of signs in at least three of the six categories given below:

Category	Moderate encephalopathy	Severe encephalopathy
Level of consciousness	Lethargic	Stupor/coma
Spontaneous activity	Decreased activity	No activity
Posture	Distal flexion, full extension	Decerebrate
Tone	Hypotonia	Flaccid
Primitive reflexes	Weak suck, incomplete Moro	Absent suck, absent Moro
Autonomic system: Pupils Heart rate Respirations	Constricted Bradycardia Periodic breathing	Dilated /non - reactive Variable heart rate Apnoea

When screening a neonate for eligibility of cooling, please tick/fill in below list in the medical notes. Use the dedicated stamp.

This documentation applies to all neonates with HIE screened for eligibility of cooling, not just the ones who actually meet inclusion criteria and/or receive cooling.

Individual eligibility criteria checklist (please use stamp and put in medical notes):

- GA > 35 weeks Yes/no
- Apgar < 6 at 10 minutes Yes/no
- Need for assisted ventilation at 10 mins Yes/no
- Cord pH/postnatal pH < 7 Yes/no
- Cord or postnatal base deficit > 12 Yes/no
- Level of consciousness Awake/ lethargy/ stupor/ coma
- Spontaneous activity Normal/ reduced/ no activity
- Posture Normal/ decerebrate/ decorticate
- Tone Normal/ hypotonia/ hypertonia
- Suck reflex Normal/ weak/ absent
- Moro's reflex Normal/ weak/ absent
- Pupils Normal/ constricted/ dilated/NR
- Heart rate Normal/ bradycardia/ variable
- Respirations Normal/ periodic/ apnoea
- Seizures Yes/no
- Congenital anomaly Yes/no
- Chromosomal anomaly Yes/no
- Severe IUGR (BW < 1800 grams) Yes/no
- In extremis Yes/no
- Ano-rectal anomaly Yes/no
- Suspected head trauma or ICH Yes/no

If the infant meets eligibility criteria for cooling please follow the guidelines below.

Considered relative contraindications to Cooling in HIE

- Suspected coagulopathy (Mosalli 2012, Jacobs, Berg et al. 2013)
- Passive partial cooling might be considered (to keep axillary or rectal temperatures at 34.5°C) prior to receiving result of the coagulation profile (O'Reilly, Labrecque et al. 2013)
- Persistent pulmonary hypertension (PPHN)
 - Pulmonary hypertension itself is NOT a contraindication (Thoresen 2008, Jacobs, Berg et al. 2013)
 - Refractory hypoxaemia despite maximal medical therapy (due to the shift in the oxyhaemoglobin dissociation curve to the left with hypothermia), e.g. Oxygen requirement greater than 80% (Dyson 2017, Yum, Seo et al. 2018)
 - Cooling might worsen PPHN and meconium aspiration syndrome (need to be guided by clinical condition and echo)

Management

- The decision to cool a neonate with HIE is made by the attending neonatologist or senior registrar.
- In order to be effective, cooling should commence as soon as possible, i.e., within 6 hours of birth.
- Aim is to achieve target temperature range within 1 hour:
 - **Active cooling** - for 72 hours from the initiation of cooling.
 - **Rewarming** - 12 hours of active gradual re-warming time after completion of 72 hours of cooling.

Note: The 84 hour period of cooling and re-warming commences from the time cooling begins and not from the time of birth.

Active Cooling Phase - Cincinnati 3 and Meditherm III

Maintenance of Target Rectal Temperature for 72 Hours using the Cincinnati 3 or Meditherm III Servo Controlled Cooling And Warming Machine

- Infant Cooling and rewarming are preferably done using the Cincinnati 3 (PCH) or the Meditherm III (KEMH).
- Manual cooling with cool packs is to be used in the NICU only if all the Cincinnati Meditherm machines are in use for other babies. Cooling should never be withheld or delayed because of unavailability of these machines.
- Place the gel neonatal mattress underneath the baby. A single sheet can be used over the mattress if required.
- Nurse the infant on a radiant warmer with warmer off.
- Do not nurse on a sheepskin.
- Do not dress.
- Leave nappy unfastened.
- Insert rectal probe and tape the 10 cm mark to the upper inner aspect of the thigh. This depth will give an accurate core temperature. The probe remains in situ for the duration of the cooling period.
- Full cardiopulmonary monitoring including invasive blood pressure if possible.
- If infant is ventilated, leave ventilation humidity at normal temperature.
- When hypothermia has been achieved and temperature range is stable, apply BRAINZ Monitor.
- Cooling should not be stopped earlier than the 72 hour period. If the attending neonatal consultant decides to stop cooling earlier the reason must be documented in the medical records.
- All other documentation/care/treatment should be as per NICU routine care of infant requiring intensive care.
- Advise/reassure parents re: appearance, cool to touch.

Cooling Guideline: Systemic Cooling for Neuroprotection in Neonates > 35 Weeks Gestational Age with HIE

CINCINNATI 3	MEDITHERM III
Connect the tubes to the black insulated hose from the machine.	Connect the tubes to the grey insulated hose from the machine.
Make sure the hoses and gel roll are not kinked. Check the water level at the back of the machine. Water level must be visible at the bottom of the water fill opening.	Make sure all clamps are in the open position, both on the grey hose and on the neonatal mattress. Press the on switch, located at the front lower left of the Meditherm III machine. Select the centre square button, THE AUTOMATIC MODE. Tab to select the speed - choose the middle speed.
Press the on switch, located at the front lower left of the machine.	Set the target temperature of the patient with the far lower right hand side square button. To cool below 36°C, keep the button depressed to confirm and set the new patient cooling set temperature to 33.5°C.
Press TEMP SET and use the UP & DOWN buttons to select desired temperature to 33.5°C.	Cooling will now commence. When the infant temperature is approaching the target temp the machine will slow down automatically to prevent significant undershooting and will maintain the target temperature.
Select the GRADIENT 10°C and the select SMART MODE.	
Ensure that paddle wheel is turning. If paddle is not turning check for obstruction such as kinked hose.	
Cooling will now commence.	
When the infant temperature is approaching the target temp the machine will slow down automatically to prevent significant undershooting and will maintain the target temperature.	
REWARMING PHASE - THIS PHASE WILL TAKE UP TO 12 HRS.	
After the period of cooling, to rewarm the infant, press the TEMP SET button.	After the period of cooling, to rewarm the infant, set the target temperature to the desired temperature 37°C (Core).
Use the ↑ button to increase the set temperature by 0.3°C every hour until the infants temperature is 36.5°C over 12 hours.	Continue with the MODERATE rate setting which will rewarm the patient at 0.33°C per hour, i.e. from 33.5 to 36.5°C over 12 hours.
Every time the TEMP SET is adjusted the GRADIENT 10°C/GRADIENT VARIABLE & SMART button must be pressed to accept the change and to start the unit again.	Once the infants core temperature reaches 36.5°C at 12 hours the mattress is removed and the machine is turned off. The rectal probe is removed.
Once the infants core temperature	

reaches 36.5°C at 12 hours the mattress is removed and the machine is turned off. The rectal probe is removed.	
Monitor neurological status closely during the rewarming phase	

Active Cooling Phase with cool packs

Maintenance of Rectal Temperature between 33.0 and 34.0 for 72 Hours using **cool packs**.

Cooling using cool packs should be done only if all the Meditherm cooling machines are already in use. Cooling should not be delayed or withheld because of unavailability of Meditherm cooling machine. Cool gel packs are also a good method of cooling babies.

Nursing care is as above under [Active cooling phase](#)

- Set alarm limits for rectal temp at 33.0-34.0°C.
- Use cold packs from the fridge, **never** frozen.
- Always put cold packs in cotton bags.

Temperature algorithm	Number of cool packs to be applied	Areas to apply
> 37.0	4	Head, shoulders, neck, trunk
36.1 - 37.0	3	Shoulders, neck, trunk
35.1 - 36.0	2	Shoulders, trunk
34.1 - 35.0	1	Trunk
33.0 - 34.0	0	Nil

- When rectal temp < 33.0, set radiant warmer on manual and gradually adjust heater output to maintain rectal temp at 33.0-34.0°C. Turn off the heater once temperature reaches 33.5.
- Caution: watch temperature range more closely in infants treated with anticonvulsants or muscle relaxants as they may cool much quicker.

Rewarming Phase after use of cool packs - This Phase Will Take up to 12 Hours

- Takes place after the completion of 72 hours of cooling and **not** 72 hours after birth.
- Rewarming process should be gradual and occur over a period of 10-12 hours; rapid rewarming may be harmful.
- Apply skin temperature probe and turn radiant warmer on if switched off.
- Set servo at 34.0°C.
- Increase servo temp by 0.5 every 2 hours until rectal temperature is 36.5°C.
- Adjust alarm limits accordingly on rectal temp range as temp increases.
- Record both skin and rectal temp hourly.
- When normothermia has been achieved, **pay particular attention to avoid overheating the infant above 37°C.**

Investigations

Please ensure below investigations are done and recorded in the medical notes.

Investigations	Day 1	Day 2	Day 3	Day 4
Full blood picture	Y	Y	Y	Y
U & E's, Creatinine, Calcium, Magnesium	Y	Y	Y	Y
Lactate	Y	Y	Y	N
PT, PTT	Y	Y	Y	Y
Glucose	Y	Y	Y	Y
Neuro assessment/Modified Sarnat staging*	Y	Y	Y	Y
ABG/CBG	Y	Y	Y	Y
LFT's	Y	Y	Y	N
12 ECG (only if concerns)	-	-	-	-
Brainz Monitor	Y	Y	Y	-
EEG (usually at 72hr)	-	-	Y	-
MRI (before day 8, ideally on day 4)	-	-	-	Y

*Modified Sarnat staging:

Mild: Hyperalertness, hyper-reflexia, dilated pupils, tachycardia, absence of seizures.

Moderate: Lethargy, hyper-reflexia, miosis, bradycardia, seizures, hypotonia with weak suck and Moro.


Severe: Stupor, flaccidity, small to midposition pupils which react poorly to light, decreased stretch reflexes, hypothermia, absent Moro.

Follow-up: Please inform the discharge coordinator to ensure appropriate follow up including developmental assessments are arranged.

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1. Booth D, Evans DJ. Anticonvulsants for neonates with seizures. <i>The Cochrane Database of Systematic Reviews</i> 2004, Issue 3.
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6. Kecskes Z, Healy G, Jensen A. Fluid restriction for term infants with hypoxic-ischaemic encephalopathy following perinatal asphyxia. <i>The Cochrane Database of Systematic Reviews</i> 2005, Issue 3.
7. Merchant N, Azzopardi D. Hypoxic-ischaemic encephalopathy in newborn infants. <i>Fetal and Maternal Medicine Review</i> 2010; 21 :3 242-262. Cambridge University Press 2010, doi:10.1017/S0965539510000069

Useful resources (including related forms)
Neonatal Neurological Observations MR

This document can be made available in alternative formats on request for a person with a disability.

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Healthy kids, healthy communities

Compassion
Excellence
Collaboration
Accountability
Equity
Respect

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Appendix 1: Quick Reference Guide

