NSW Consensus Statement: Newborn Hypoxic Ischaemic Encephalopathy (HIE)

Version 1

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NSW GOVERNMENT

CLINICAL EXCELLENCE COMMISSION

Introduction

The NSW Hypoxic Ischaemic Encephalopathy (HIE) Expert Advisory Group (EAG) was established in March 2021, at the request of the Clinical Excellence Commission (CEC) to review the clinical management of HIE. The request came following a statewide recommendation as part of a review undertaken of a number of HIE incidents.

In line with this request, the CEC identified this work would additionally support the *NSW Health Policy Directive, Whole Body Cooling - Neonates Suspected Moderate or Severe Hypoxic Ischaemic Encephalopathy (HIE)* (PD2010_006)[1] policy update.

The EAG was chaired by an experienced neonatologist. It consisted of senior medical, nursing and midwifery clinicians with expertise in obstetrics, neonatology and paediatrics from New South Wales (NSW), together with observers from Victoria and the Australian Capital Territory (ACT). It was supported by executive sponsors and staff from the CEC and Agency for Clinical Innovation (ACI) (Appendix 4).

The initial function of the group was to help standardise the definition, clinical assessment, monitoring and reporting of neonates with neonatal encephalopathy, with an aim to reduce unwarranted clinical variation across NSW following identified opportunities for improvement.

Definition

The group agreed with a standard definition of hypoxic ischaemic encephalopathy as follows:

Hypoxic ischaemic encephalopathy (HIE) is a type of neonatal encephalopathy caused by systemic hypoxaemia and/or reduced cerebral blood flow resulting from an acute peripartum event. It can be the consequence of perinatal, birth and/or neonatal asphyxia. Hypoxic ischaemic encephalopathy is classified as mild, moderate, or severe based on the Sarnat criteria for encephalopathy.[2]

Assessment

The expert group met and reviewed current evidence, clinical assessment tools and clinical guidance resources, including statewide and interstate guidelines and policies.

The group concluded that the following be considered for recognition, monitoring and reporting of newborn hypoxic ischaemic encephalopathy:

Recognition

1. Intrapartum risk factors for encephalopathy should be identified during labour and managed appropriately.
2. Early recognition and management of hypoxic ischaemic encephalopathy has been shown to improve outcomes for neonates with moderate or severe encephalopathy.[3]
3. Neonates at high risk of encephalopathy should be identified soon after birth and commenced on a ‘Newborn Encephalopathy Pathway’ (Appendix 1).

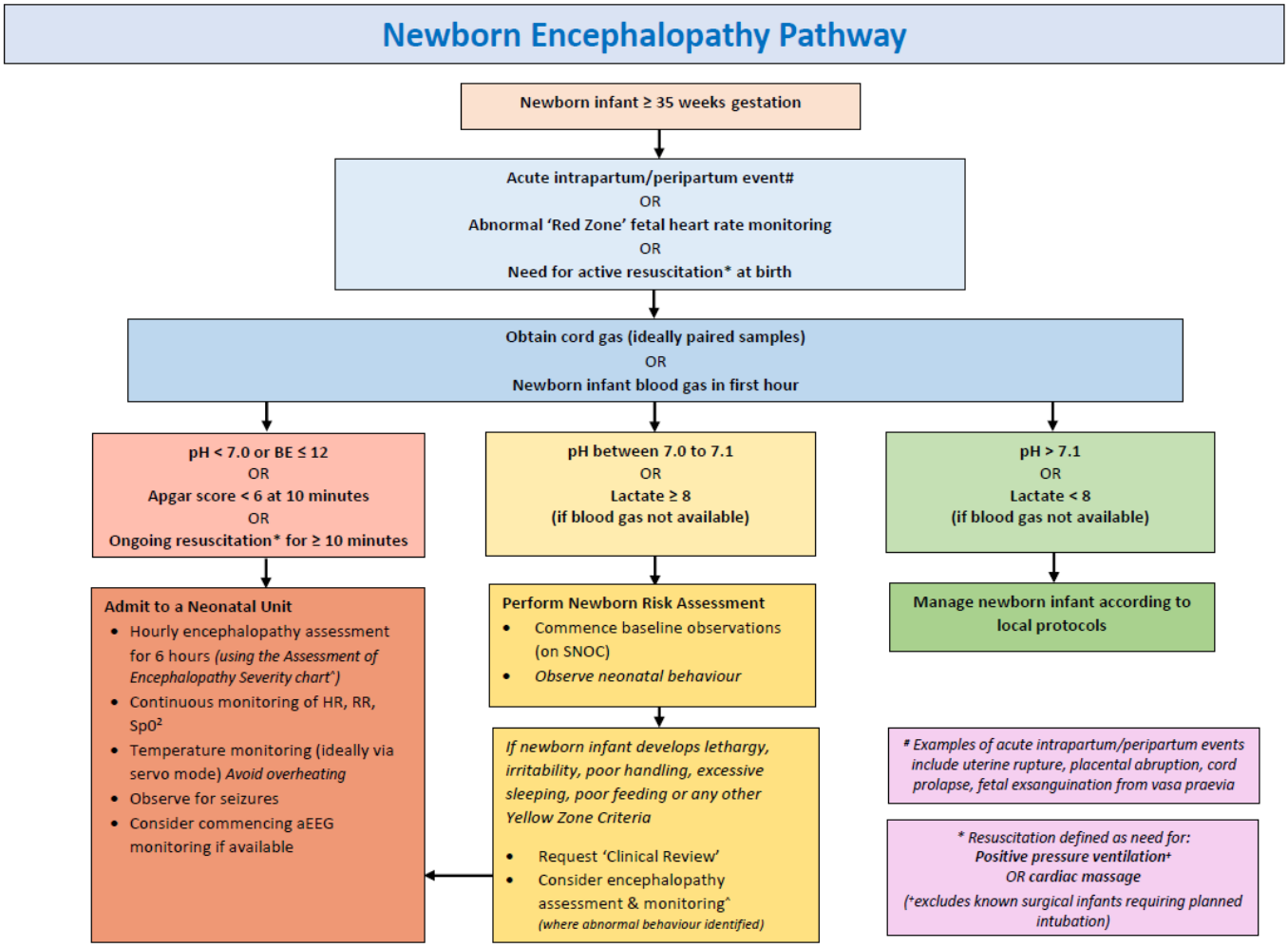
Monitoring

1. As neonatal encephalopathy may evolve over time, neonates at high risk of encephalopathy should be monitored closely after birth to assess for physiological stability and for signs of encephalopathy.
2. Monitoring using an 'Assessment of Encephalopathy Severity' tool (Appendix 2) is recommended for high-risk infants in the first six (6) hours after birth.[2]
3. The aim of early encephalopathy monitoring is to identify neonates with moderate or severe hypoxic ischaemic encephalopathy who fulfil the criteria for therapeutic hypothermia (Appendix 3). Evidence from high quality studies indicates that therapeutic hypothermia is a beneficial treatment for newborn infants ≥ 35 weeks with moderate or severe hypoxic ischaemic encephalopathy if commenced before six (6) hours of age.[3]
4. Neonates with mild hypoxic ischaemic encephalopathy may also benefit from additional monitoring and supportive treatment, although there is insufficient evidence for treatment with therapeutic hypothermia.[4]
5. Amplitude-integrated electroencephalography (aEEG) monitoring may have application as an additional method for identifying neonates with moderate encephalopathy in 'Neonatal Units' with capacity to provide aEEG monitoring.[5]

Reporting

1. Reporting processes should be in place to monitor incidence of neonates with moderate or severe encephalopathy, including:
    a. Birthing services to complete an incident management system (ims+) report for all neonates ≥ 35 weeks' gestation identified with high risk of neonatal encephalopathy following birth; including neonates with a cord pH < 7.0 mmHg or base excess (BE) ≤ -12, mmol/L OR an Apgar score < 6 at 10 minutes OR an ongoing need for resuscitation for ≥ 10 minutes.
    b. Neonatal services to complete an incident management system (ims+) report (or addition to a previously submitted ims+ report) for neonates who develop moderate or severe hypoxic ischaemic encephalopathy or who receive treatment with therapeutic hypothermia.
    c. Reporting for neonates born in a private hospital should occur through similar 'Clinical Governance' systems within the neonate's hospital of birth.
    d. Serious incidents, including term neonates diagnosed with Grade III (3) hypoxic ischaemic encephalopathy or therapeutically cooled, should be notified to the Ministry of Health via a Reportable Incident Brief (RIB) in accordance with NSW Health Policy Directive *Incident Management* (PD2020_047) for all neonates born in NSW.[6]

Appendix 1: Newborn encephalopathy pathway



Appendix 2: Assessment of encephalopathy severity

The advisory group met to consider which 'Assessment of Encephalopathy Severity' tool would be best recommended for universal use across NSW.

The group established that the current NSW encephalopathy assessment tool[1] (see Figure 1) is a limited assessment that only provides features of moderate or severe encephalopathy. It does not provide the option to record hourly assessments, or the ability to identify neonates with mild or no encephalopathy.

To increase identification of neonates with moderate and severe HIE through hourly assessment and provide an option for identification of neonates with mild HIE, the group recommended the use of a more comprehensive 'Assessment of Encephalopathy Severity' tool, currently used by Queensland Health Services[3] (see Figure 2).

Figure 1: Current NSW encephalopathy assessment tool

The existing encephalopathy assessment tool used in NSW Health services is based on a limited Sarnat score that focuses on identification of moderate and severe encephalopathy features only. It aligns with the NSW Health Policy Directive *Whole Body Cooling - Neonates Suspected Moderate or Severe Hypoxic Ischaemic Encephalopathy (HIE)* (PD2010_006)[1].

Category	Moderate encephalopathy	Severe encephalopathy
Level of consciousness	Lethargy	Stupor/coma
Spontaneous activity	Decreased activity	No activity
Posture	arms flexed, legs extended (decorticate)	arms and legs extended (decerebrate)
Tone	Hypotonia	Flaccid
Primitive reflexes	Weak suck, incomplete Moro	Absent suck, absent Moro
Autonomic system (any one of) Pupils Heart rate Respirations	Constricted Bradycardia Periodic breathing	Dilated/non - reactive Variable heart rate Apnoea

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Figure 2: Recommended 'Assessment of encephalopathy severity' tool

The recommended 'Assessment of Encephalopathy Severity' tool (using modified Sarnat criteria) is the encephalopathy assessment tool currently used in Queensland Health Services and aligns with the Queensland Clinical Guideline: *Hypoxic Ischaemic Encephalopathy (HIE) guideline MN16.11-V9-R21.* The assessment of encephalopathy severity tool allows the clinician to identify features of mild, moderate and severe HIE[2] and is assessed each hour during the first 6 hours of life.

Queensland Clinical Guideline: Hypoxic ischaemic encephalopathy

Assessment of encephalopathy severity

Assess baby's signs against each criterion and record the encephalopathy severity as normal **(n)**, mild **(mild)**, moderate **(mod)** or severe **(s)** each hour during the first 6 hours of life. If criterion is not assessable record as not applicable **(N/A)**.

Modified Sarnat Criteria

Assessment Criteria	**Encephalopathy severity** Record severity each hour				**Hours from birth** Record actual time of assessment and severity for each sign (**n/mild/mod/s or N/A**) each hour					
	Normal (N)	**Mild (Mild)**	**Moderate (Mod)**	**Severe (S)**	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**
Level of consciousness	Alert/arouses appropriately	Hyperalert	Lethargic	Stupor or coma						
Spontaneous activity	Normal	Normal or increased	Decreased activity	No activity						
Posture	Normal	Normal	Distal flexion, complete extension	Decerebrate						
Tone*	Normal	Normal or increased in trunk and extremities	Hypotonia (focal or general)	Flaccid						
Suck reflex	Normal	Normal or incomplete suck	Weak suck	Absent						
Moro reflex	Strong	Strong, low threshold	Incomplete Moro	Absent						
Autonomic system	Pupils equal and reacting to light; normal heart rate and respirations	Pupils equal and reacting to light; normal heart rate and respirations	Pupils constricted; bradycardia or periodic/irregular breathing	Pupils deviated/ dilated/ non-reactive; variable heart rate or apnoea						

*Assess tone in both limbs and trunk/neck. Presence of hypotonia in either meets the criteria.

Queensland Clinical Guidelines: *Hypoxic-ischaemic encephalopathy (HIE)*. Flowchart version: F16.11-1-V9-R21

Appendix 3: Criteria for therapeutic hypothermia

GA ≥35 weeks and <6 hours old

AND

Evidence of acidosis or depression at birth, with any ONE of:

- pH <7.0 mmHg or BE less than or equal to -12 mmol/L on any cord or baby blood gas in first hour
  OR
- Apgar Score <6 at 10 minutes
  OR
- Mechanical ventilation or ongoing resuscitation for ≥10 minutes
  OR
- pH 7.0 - 7.1 mmHg or lactate >8µmol/L in the first hour and abnormal neonatal behaviour

AND

Presence of moderate / severe encephalopathy defined as:

- 3 or more moderate or severe features of encephalopathy (Sarnat criteria) identified at any time from 1 to 6 hours
  OR
- Seizures (witnessed by a medical officer, nurse, midwife or seen on aEEG/EEG)
  OR
- 2 moderate or severe features of encephalopathy and abnormal aEEG (e.g., lower margin <5µV)

CONTRAINDICATIONS

There are no absolute contraindications to therapeutic hypothermia; however, relative contraindications include:

- uncontrolled bleeding
- uncontrolled severe hypoxia due to persistent pulmonary hypertension
- imminent withdrawal of life planned.

Appendix 4: Expert advisory group membership

COMMITTEE MEMBER	POSITION TITLE	DEPARTMENT / ORGANISATION
Dr Jennifer Bowen (Chair)	Senior Staff Specialist, Neonatology	Royal North Shore Hospital
Dr Robert Guaran	Senior Neonatology Advisor	Ministry of Health
Dr Daniel Challis	Senior Obstetric Advisor	Ministry of Health
Joanne Sheils	Project Officer, Maternity & Neonatal Network	Agency for Clinical Innovation
Dr Harvey Lander	Director Systems Improvement	Clinical Excellence Commission
Malcolm Green	Senior Manager, Patient Safety Improvement Programs	Clinical Excellence Commission
Alison Goodfellow	Patient Safety Analyst, Maternal & Perinatal	Clinical Excellence Commission
A/Prof Koert de Waal	Staff Specialist, Neonatology	Hunter New England LHD
Jo Davis	Clinical Nurse Consultant, Neonatology	Hunter New England LHD
Dr John Smyth	Staff Specialist, Neonatology	South Eastern Sydney LHD
Dr Rakesh Seth	Neonatologist and Paediatrician	Murrumbidgee LHD
Dr Melissa Luig	Staff Specialist, Neonatology	Western Sydney LHD
Jane Wardle	Nurse Manager, Special Care Unit	Central Coast LHD
Dr Adam Buckmaster	Staff Specialist, Paediatrics	Central Coast LHD
Dr Dharmintra Pasupathy	Professor of Maternal & Fetal Medicine	University of Sydney
Sue Downward	Clinical Midwifery Consultant	Nepean Blue Mountains LHD
Dr Mark Greenhalgh	Staff Specialist, Neonatology	Sydney LHD
Dr Hannah Dalrymple	Staff Specialist	NETS
Trish Grant	Clinical Nurse Specialist	NETS
External advisors		
Prof Rod Hunt	Staff Specialist, Neonatology	Monash Children's Hospital
Dr Amanda Dyson	Staff Specialist, Neonatology	Canberra Hospital

References

1. NSW Health Policy Directive (2010), *Whole Body Cooling - Neonates Suspected Moderate or Severe Hypoxic Ischaemic Encephalopathy (HIE).*
2. Queensland Clinical Guidelines (2016), *Hypoxic Ischaemic Encephalopathy (HIE) guideline.*
3. Cooling for newborns with hypoxic ischaemic encephalopathy (2013) Jacobs SE, Berg M, Hunt R, Tarnow-Mordi WO, Inder TE, Davis PG*. Cochrane Database Syst Rev 2013;1:CD003311.3.*
4. Kariholu U, Mondtaldo P, Markati T et al (2020) Therapeutic hypothermia for mild neonatal encephalopathy: a systematic review and meta-analysis. *Arch Dis Child Fetal Neonatal Ed 2020;105:225-228.*
5. Skranes JH, Lohaugen G, Schumacher EM (2017) Amplitude-Integrated Electroencephalopathy improves the identification of infants with encephalopathy for therapeutic hypothermia and predicts neurodevelopmental outcomes at 2 years of age. *J Pediatr 2017;187:34-42.*
6. NSW Health Policy Directive (2020), *Incident Management,* NSW Ministry of Health, Sydney, Australia.