1.0 Aim of Guideline

- To ensure that babies with suspected HIE are appropriately assessed to see whether therapeutic hypothermia (cooling) is appropriate
- To ensure that cooling is initiated in a safe and timely manner
- To outline the care pathway for ongoing cooling treatment

2.0 Scope of Guideline

The guideline applies to all neonates who fulfil the criteria for cooling set out in the guidance below, who are born in neonatal units and maternity units covered by South Central North Neonatal Network. This includes the following hospitals:

**North Network**
- Milton Keynes General Hospital, MK
- John Radcliffe Hospital, Oxford
- Horton General Hospital, Banbury
- Stoke Mandeville Hospital, Aylesbury
- Royal Berkshire Hospital, Reading
- Wexham Park Hospital, Slough
3.0 Guideline

Introduction

- Neonatal encephalopathy has an incidence of approximately 3/1000 births, with hypoxic-ischaemic encephalopathy occurring in approximately 1.5-2/1000.¹
- South Central has approximately 61,000 live births and therefore we can anticipate approximately 90-120 cases of moderate to severe HIE will need cooling per year.
- The risk of death or severe handicap in survivors of moderate or severe HIE is approximately 25 and 75% respectively, and children without motor impairments have lower cognitive scores on longterm follow-up, poorer scholastic attainment in independent National Attainment Tests, and often need educational support.²³
- Results of three randomised controlled trials, including the UK total body cooling trial (TOBY) confirm that 72 hours of cooling to a core temperature of 33-34 °C started within six hours of birth reduces death and disability at 18 months of age and improves a range of neurodevelopmental outcomes in survivors.⁴⁻⁶
- Meta analysis of these trials showed that the number needed to treat for survival without impairment at 18 months is 8 (95% confidence interval 5-17).⁷
- NICE and BAPM support the use of this treatment in selected neonates with HIE.⁸⁹
- Clinically significant adverse events attributed to cooling are uncommon; however, as a new therapy, data collection on all babies undergoing therapeutic hypothermia should continue to be sent to the TOBY Cooling Registry (www.npeu.ox.ac.uk/tobyregister)

Criteria for Cooling

- Cooling should be considered in all infants that meet criteria A and B (outlined below) and are within 6 hours of delivery
- Infants who meet these criteria but where cooling is NOT offered should have the reasons for this clearly documented in the notes so this decision can be justified, if necessary, in the future.
- Where an infant meets criteria A but it is not possible to assess criteria B (eg. paralyzing agents have been used prior to clinical neurological assessment), cooling should be commenced and the aEEG should be used to assess ongoing need for cooling. Initiation of cooling should not be delayed if aEEG is not readily available.

A. Infants ≥36 completed weeks gestation admitted to NNU with at least one of the following:

- Apgar score of ≤5 at 10 minutes after birth
- Continued need for resuscitation, including endotracheal or mask ventilation, at 10 minutes after birth
- Acidosis within 60 minutes of birth (defined as any occurrence of umbilical cord, arterial or capillary pH <7.00)
- Base Deficit ≥16 mmol/L in umbilical cord or any blood sample (arterial, venous or capillary) within 60 minutes of birth

B. Seizures (clinical or subclinical*) or moderate to severe encephalopathy, consisting of:

- Altered state of consciousness (reduced or absent response to stimulation) AND
- Abnormal tone (focal or general hypotonia, or flaccid) AND
- Abnormal primitive reflexes (weak or absent suck or Moro response)

*Subclinical seizures are those which are detected on amplitude integrated EEG (aEEG) but there are no clinical signs apparent.
Cooling Outside Trial Guidelines

Evidence for cooling outside the above guidelines is weak or unavailable. However, there are circumstances where there may be theoretical benefits for cooling certain patients. Cooling in these circumstances should only be instigating following discussion with the cooling centre.

Examples would include

- Infants who fulfill criteria A+B but are between 6-12 hours old
- Preterm infants, 33+weeks or more, who have suffered an acute asphyxial event and fulfill criteria A+B above
- Acute postnatal collapse with a neurological examination consistent with a diagnosis of acute encephalopathy
- Early prolonged or recurrent seizures (within 12 hours of birth)
- Infants who fulfill criteria A but only partially fulfill criteria B

Prior to commencement of cooling treatment in these circumstances (outside trial guidelines) parents must be fully informed that this treatment is not proven.

Hypoxic ischaemia may co-exist or mimic other metabolic/neurological conditions and investigations to elucidate other causes of encephalopathy/seizures should be carried out where necessary.

Contraindications to Cooling

There are no absolute contraindications to cooling infants who meet the criteria above except where there are other life-threatening congenital abnormalities present.

Relative contra-indications include

- Suspected significant haemorrhage or thrombosis (NB although hypothermia prolongs bleeding time, the 3 trials did not demonstrate differences in complications related to abnormal clotting)
- Surgical conditions likely to be associated with significant blood loss
- Severe PPHN - Cooling may produce adverse respiratory or cardiovascular effects. However, the 3 cooling trials found no difference in the prevalence of PPHN between cooled patients and control groups

Where Infants should be Treated with Cooling

- All units are expected to identify babies in need of cooling and initiate cooling treatment (either passive or active cooling).
- Cooling is part of a range of intensive care treatments which babies with HIE may require and in accordance with BAPM guidelines and South Central Neonatal Network Guidelines, ongoing care should normally be delivered in a NICU.
- The designated cooling centre for South Central North is Oxford; babies should be transferred there for ongoing care.
Assessment of Babies at High Risk

- All infants that require significant resuscitative measures should have the resuscitaire heater switched off whilst undergoing further evaluation and neurological assessment.
- Ongoing cooling (either passive or active cooling) should be undertaken for infants that meet the clinical criteria above.
- Infants who fulfilled criteria A but not criteria B should undergo further neurological assessment within the first 6 hours to ensure there is no deterioration.
- Where there is doubt regarding eligibility for ongoing cooling, advice should be sought from the local cooling centre.

Additional Assessments

**Clinical Assessment**

The severity of encephalopathy should be assessed using the Hypoxic Ischaemic Encephalopathy Score below. There is no specific score threshold that indicates treatment with cooling (this should be done using neurological criteria in box B) but the score should be recorded **prior to commencing cooling** and subsequently for the next four days. All fields should be completed – allocate the highest score unless a lower score can be elicited. The HIE score is included on the UK TOBY Register Data Collection Form (appendix 1).

<table>
<thead>
<tr>
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<th>2</th>
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<td>Irritable</td>
<td>Poorly Responsive</td>
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<td>Hypotonia</td>
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<td>Respiratory status</td>
<td>Normal</td>
<td>Respiratory distress (apnoea/needling oxygen)</td>
<td>CPAP or mechanical ventilation</td>
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<td>Reflexes</td>
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<tr>
<td>Feeding</td>
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<td>Not tolerating feeding</td>
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</tr>
</tbody>
</table>

**Amplitude Integrated EEG (aEEG) Assessment**

The aEEG (also known as Cerebral Function Monitor –CFM) is a single or dual channel time compressed and filtered EEG providing information on overall electrical activity in the brain

- The amplitude integrated EEG (aEEG or CFM) must be recorded in all infants treated with cooling **but cooling should not be delayed until the aEEG is initiated**.
- It is not essential for LNUs to undertake aEEG recording; however, it provides additional information on the severity of encephalopathy and assessment of seizure activity and is particularly helpful where an infant has been paralysed.
- Follow manufacturers instructions for application of EEG electrodes and machine setup. Further information on application and training in interpretation may be found at [http://neoweb.org.uk](http://neoweb.org.uk).
- A normal aEEG record indicates a high probability of normal outcome, and clinicians may consider that treatment with cooling is not required.
- Rewarming following active cooling may be considered if the clinical examination is normal and the CFM normalizes within the first 6 hours. However, ongoing neurological examination and CFM recording should occur during rewarming and if any signs of deterioration occur the patient should be recooled for the full 72 hours. Early rewarming will generally not occur outside treatment centres.
- **Apparent improvement of the aEEG AFTER 6 hours of age is NOT an indication for discontinuing cooling.**
- A copy of CFM traces should be sent with the baby to the cooling centre and provided with other data to the UK TOBY Register
- IV anticonvulsant therapy may cause transient suppression of EEG activity. Ideally the aEEG should be performed before administering anticonvulsant therapy.
Initiation of Cooling Treatment Outside Cooling Centres

- Cooling should be started as soon as possible after resuscitation is completed. Current evidence suggests that earlier cooling is more likely to be beneficial\textsuperscript{12}.
- Cooling to the desired temperature (33-34°C) should occur as rapidly as possible.
- Cooling treatment whilst awaiting the arrival of the transport team can be either passive or active, depending on the equipment available.
- Continuous monitoring of HR, Respiration, BP, is advisable during cooling.
- \textit{Monitoring of rectal temperature is essential.} The rectal probe should be inserted 3-6 cm and secured to the thigh.
- Neonatal units using passive cooling should follow “Passive cooling – how to do it” in Appendix 2.
- Neonatal units using active cooling should follow manufacturers equipment instructions to cool infants to between 33-34°C.
- If a baby becomes overcooled (<33°C)– rewarming to 33-34°C should take place slowly – ideally no more than 0.5°C every hour.
- The “UK TOBY Cooling Register data collection form” (Appendix 1) should be downloaded from www.npeu.ox.ac.uk/tobyregister, if none are available on the neonatal unit. The first page should be \textbf{completed by the referring hospital including the HIE score PRIOR TO COOLING}. The baby’s age at the time heating equipment is turned off should be entered as the time cooling started on the data collection form. Copies of the UK TOBY Cooling Register Data Collection Form should be retained in the patients notes and be sent with the patient on transfer to the cooling centre.

Process of Referral for Ongoing Cooling Treatment

- The ORH attending consultant should be contacted where clinical advice regarding suitability for cooling or ongoing management is required.
- ORH should confirm bed availability and arrange transport with the local neonatal transport service. In the event that a bed is unavailable, the transport service will find an appropriate cot and liaise with referring and receiving units on the timing of transfer (until a receiving unit has been identified, ongoing advice will be provided by Oxford).
- CONSENT - Verbal parental assent should be sought for cooling treatment which requires transfer to the cooling centre and parents may be given a copy of \textit{“UK TOBY Cooling Register Parent Information Leaflet”} (Appendix 3).
- Details of all discussion with parents about their infant’s treatment with cooling should be documented in the infant’s notes. Local Trust clinical governance procedures and policy for consent for treatment should be followed.
Management of Cooled Infants Whilst Awaiting Transfer

Ventilation
- Most infants treated with cooling will initially require mechanical ventilation as a consequence of their encephalopathy/anticonvulsant medication.
- Ventilatory care should be managed according to local protocol.
- Bolus doses of paralysis should be used if required rather than infusions to prevent drug accumulation.
- Blood gases will guide ventilatory requirements; particular care should be taken to ensure normocapnia. The infant’s temperature should be inputted into the blood gas machine so that the appropriate adjustment is performed.
- Ventilator gases should be warmed and humidified in the normal way, according to local policy.
- More frequent suctioning may be necessary as secretions tend to be more viscous when cold. Vary positioning 6 hourly, Chest physio as indicated.

Cardiovascular support
- Most infants with a rectal temperature of 33-34°C will have a heart rate around 100 bpm and a mean blood pressure greater than 40 mmHg.
- Treatment with volume replacement and inotropes should be considered if the mean arterial blood pressure is less than 40 mmHg.

Analgesic and Sedative Therapy
- Stress may have adverse effects in asphyxiated infants and may influence the therapeutic effect of hypothermia. Signs of distress include tachycardia, facial grimacing and irritability. A heart rate consistently above 110 bpm in cooled infants suggests that the infant is distressed (exclude hypotension/hypovolaemia and other causes of pain).
- Ventilated infants should be sedated with intravenous morphine as per local unit guidelines.
- Non-ventilated infants will also require sedative therapy, which may include chloral hydrate or morphine. Respiratory function must be monitored in these infants. There should be a low threshold for commencing ventilation in order to give adequate sedation/pain relief.

Fluid & Electrolyte Management
- Renal function is commonly impaired following severe perinatal asphyxia and fluids should be restricted according to local protocol in infants who have renal failure.

Coagulation
- Send platelet count and clotting at the start of cooling. If there are clinical signs of increased bleeding tendency, treat babies with FFP without waiting for lab results. Bleeding times did not increase during cooling in the TOBY trial but hypothermia can affect coagulatory function.

Sepsis
- Antibiotic therapy may be given if clinically indicated

Seizures
- The management of seizures should be guided by local protocols.
- In general, symptomatic seizures or frequent subclinical (>3/hr) seizures seen on aEEG/CFM should be treated with anticonvulsants.
- Cooling may affect the metabolism of several drugs, including anticonvulsants and sedatives, and toxic drug levels may occur even with normal doses.
4.0 References


8. NICE Interventional Procedure Guidance 347. Therapeutic Hypothermia with intracorporeal temperature monitoring for hypoxic Perinatal brain injury. May 2010


11. South Central Neonatal Networks Briefing Paper – Therapeutic Cooling for Hypoxic Ischaemic Encephalopathy

Appendix 1 TOBY Cooling Register Data Collection Form

The image contains a detailed form for recording patient data with specific sections for patient identification, cooling treatment details, birth details, and patient status. The form includes fields for patient identification number (PIN), patient hospital number, cooling treatment details, clinical details of the baby at birth, hypoxic ischaemic encephalopathy score prior to cooling, baby’s age, alertness, tone, respiratory status, reflexes, seizure, and feeding. There are also sections for birth hospital, during transport, and cooling centre with details like age when target temperature first achieved, pregnancy complications, mode of delivery, congenital abnormalities, and initial CMF findings and age recorded.

The form includes a table with columns for sign, alertness, tone, respiratory status, reflexes, seizure, and feeding. There are also sections for passive cooling, active cooling, aids used for cooling, and age when target temperature first achieved.

The form is comprehensive and designed to collect detailed data for the purpose of monitoring and evaluating cooling treatments, with specific emphasis on the patient's health status before and during the cooling process.
**Day 1: Cooling hours 0-23**

<table>
<thead>
<tr>
<th>Hours from start of cooling</th>
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<td>11</td>
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**During this 24 hours were these conditions noted or treated? (Please tick all that apply)**

- Seizures
- Respiratory support
- Hypoxia
- Hypotension
- Coagulopathy
- Sepsis
- Hypoglycaemia
- Arrhythmia

**Hypoxic Ischaemic Encephalopathy Score**

**Day 1 (Please circle clearly as appropriate)**

<table>
<thead>
<tr>
<th>Baby's age</th>
<th>Sign</th>
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<tr>
<td>Alertness</td>
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<td>Respiratory Status</td>
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<td>Respiratory distress (Apnoea/ needing oxygen)</td>
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**Day 2: Cooling hours 24-47**

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**During this 24 hours were these conditions noted or treated? (Please tick all that apply)**

- Seizures
- Respiratory support
- Hypoxia
- Hypotension
- Coagulopathy
- Sepsis
- Hypoglycaemia
- Arrhythmia

**Hypoxic Ischaemic Encephalopathy Score**

**Day 2 (Please circle clearly as appropriate)**

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**During this 24 hours were these conditions noted or treated? (Please tick all that apply)**

- **Seizures**
- **Respiratory support**
  - Mechanical ventilation, CPAP or supplementary O₂
- **Hypotension**
  - Persistent mean blood pressure of < 40 mmHg
- **Sepsis**
  - Evidence of infection requiring antibiotic therapy which is confirmed on culture
- **Coagulopathy**
  - Any disorder requiring treatment in order to maintain or recover normal haemostasis
- **Hypoglycaemia**
  - Blood glucose < 2.6 mmol/litre
  - Arrhythmia: Sinus bradycardia < 80 bpm
  - Arrhythmias identified on ECG

**Hypoxic Ischaemic Encephalopathy Score**

**Day 3 (Please circle clearly as appropriate)**

**Baby’s age**

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Please score EVERY sign (allocate highest score unless lower score can be elicited on examination)

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<td>95</td>
</tr>
</tbody>
</table>

**During this 24 hours were these conditions noted or treated? (Please tick all that apply)**

- **Seizures**
- **Respiratory support**
  - Mechanical ventilation, CPAP or supplementary O₂
- **Hypotension**
  - Persistent mean blood pressure of < 40 mmHg
- **Sepsis**
  - Evidence of infection requiring antibiotic therapy which is confirmed on culture
- **Coagulopathy**
  - Any disorder requiring treatment in order to maintain or recover normal haemostasis
- **Hypoglycaemia**
  - Blood glucose < 2.6 mmol/litre
  - Arrhythmia: Sinus bradycardia < 80 bpm
  - Arrhythmias identified on ECG

**Hypoxic Ischaemic Encephalopathy Score**

**Day 4 (Please circle clearly as appropriate)**

**Baby’s age**

<table>
<thead>
<tr>
<th>Sign</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alertness</td>
<td>Alert</td>
<td>Irritable</td>
<td>Poorly responsive</td>
<td>Comatose</td>
</tr>
<tr>
<td>Tone</td>
<td>Normal</td>
<td>Hypertonia</td>
<td>Hypotonia</td>
<td></td>
</tr>
<tr>
<td>Respiratory Status</td>
<td>Normal</td>
<td>Respiratory distress (Apnoea/needling oxygen)</td>
<td>CPAP or mechanical ventilation</td>
<td></td>
</tr>
<tr>
<td>Reflexes</td>
<td>Normal</td>
<td>Hyperreflexia</td>
<td>Hyporeflexia</td>
<td>Absent reflexes</td>
</tr>
<tr>
<td>Seizure</td>
<td>None</td>
<td>Suspected</td>
<td>Confirmed clinical seizure</td>
<td></td>
</tr>
<tr>
<td>Feeding</td>
<td>Normal</td>
<td>Not tolerating feeding</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please score EVERY sign (allocate highest score unless lower score can be elicited on examination)

---

* Definitions for all items on this form marked with an asterisk may be found in the Clinician’s Handbook and in the appendix to this form.

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## End of cooling information and outcome

**Equipment used to maintain cooling**: 
- Servo control [ ]  
- Manual control [ ]

**Outcome (please tick all that apply):**
- Discharged home [ ]  
- Age [ ] days  
- Transferred* to another hospital [ ]  
- Age [ ] days  
- Please give name of hospital if transferred: _____________________________

*(Please send a photocopy of this completed form to the receiving hospital with the baby)*

- Died [ ]  
- Age [ ] days [ ] hrs  
- Post Mortem planned? [ ] Yes [ ] No  
- Post Mortem performed? [ ] Yes [ ] No

**MRI scan performed or booked**:  
- Yes [ ] No [ ]

**MRI results (if available):**  
- Attach separate sheet if necessary

**Cranial Ultrasound report**:  
- Yes [ ] No [ ]

**Summary**:  
- Attach separate sheet if necessary

**Diagnoses during admission (please tick all that apply):**
- None [ ]
- Cerebral imaging abnormality* [ ] If yes, please explain in comment field below
- Thrombosis* [ ]
- Necrotising enterocolitis* [ ]
- Late onset sepsis* (>72 hours after birth) confirmed by blood or CSF culture [ ]
- SFN* at age [ ] days [ ]
- SFN treated [ ] Yes [ ] No
- Pneumonia* [ ]
- Pulmonary airleak* [ ]
- Pulmonary haemorrhage* [ ]
- Pulmonary hypertension* [ ]
- Renal failure treated with dialysis [ ]

**Other comments, including any relevant diagnosis (e.g. metabolic, congenital abnormality or infection)**:

________________________________________________________________________

Please report any condition or event likely to be due to cooling treatment or rewarming

________________________________________________________________________

**Full sucking feeds achieved before discharge?**  
- Yes [ ] No [ ]
- If Yes, please give age [ ] days

**If cooling was stopped earlier than 72 hours please explain why**:  
________________________________________________________________________

**Form completed by (please print clearly)**: ____________________________

**What to do now**

- If necessary information may be provided on extra page(s) clearly numbered with the PIN.
- Inform parents that a developmental assessment will be completed at about 24 months of age.
- Keep a copy of the completed form for your records, and identify YOUR copy clearly with patient details. Ensure that the PIN and baby details are added to your local record of all Registered babies.
- If the baby is transferred to another hospital please send a copy of this completed form with the notes and a Register transfer letter ([https://www.npeu.ox.ac.uk/downloads/tobyregister/TOBY-Register-Transfer-Form.pdf](https://www.npeu.ox.ac.uk/downloads/tobyregister/TOBY-Register-Transfer-Form.pdf)) so that they are aware of the Register PIN for this baby.

**The copy that is sent to the Register must not contain any patient identifiers.**

**Return completed form to:**

UK TOBY Cooling Register, National Perinatal Epidemiology Unit,  
FREEPPOST (OF 2279), Oxford, OX3 7LF  
Tel: 01865 617919 / 289735  
email: tobyregister@npeu.ox.ac.uk

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* Definitions for all items on this form marked with an asterisk may be found in the Clinician’s Handbook and in the appendix to this form

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Appendix

Definitions Of Terms In Data Collection Form
(version 7, November 2010)

Arrhythmia
Sinus bradycardia below 80 bpm and other arrhythmias identified on ECG

Cerebral imaging abnormality
Including evidence of parenchymal haemorrhage as determined by ultrasound, ventricular dilatation
(defined as >97th centile for gestational age) or the presence of porencephalic cysts or cystic leukomalacia

CFM grade
1: Upper margin of trace >10 μV, lower margin >5 μV.
2: Upper margin of trace >10 μV, lower margin <5 μV.
3: Upper margin of trace <10 μV.

Clinical Seizures
Seizures observed without aEEG or EEG diagnosis

Coagulopathy
Any disorder requiring treatment in order to maintain or recover normal haemostasis

Delivery complications
This can include prolapsed cord, abruption, shoulder dystocia, ruptured uterus, head entrapment etc

EDD – Estimated Date of Delivery
Use the best estimate (dates or ultrasound) based on a 40 week gestation

Hypoglycaemia (infant)
Blood glucose below 2.6 mmol/litre

Hypotension (infant)
Persistent mean blood pressure of < 40 mmHg

Late onset sepsis (>72 hours after birth) confirmed by blood or CSF culture
Any evidence of infection requiring antibiotic therapy which is confirmed on culture

Meconium aspiration syndrome
The presence of meconium stained liquor at birth and severe respiratory distress within 1 hour of birth and
compatible X-ray changes

Necrotising enterocolitis
Infants with abdominal distension, gastric aspirate and/or blood in stools together with abdominal X-ray
showing bowel oedema, pneumatisos or pneumoperitoneum, i.e. Bell’s staging 2 or 3

Pregnancy complications
This can include pre-eclampsia, maternal seizure, thyroid disorder, diabetes, placenta praevia, known illicit
drug use etc.

Pulmonary airleak
Any radiologically confirmed airleak serious enough to affect management (including pneumothorax,
pulmonary interstitial emphysema, pneumopericardium, pneumoperitoneum and pneumomediastinum)

Pulmonary haemorrhage
Copious bloody secretions with clinical deterioration requiring change(s) in ventilatory management

Pulmonary hypertension
Severe hypoxaemia disproportionate to the severity of lung disease and evidence of a right to left shunt

Respiratory support
Use of mechanical ventilation, CPAP or supplementary oxygen

Seizures
Clinical or subclinical, identified on CFM / EEG

Sepsis
Any evidence of infection requiring antibiotic therapy which is confirmed on culture

SNF
Sub-cutaneous fat necrosis

Thrombosis
Thrombosis or thrombo-embolism not related to an infusion line
Appendix 2

PASSIVE COOLING PROTOCOL

Commence continuous rectal temperature monitoring Document initial temperature (axilla if rectal thermometer not available)

Turn incubator off, open portholes, document rectal/axilla temperature every 15 minutes

Wait 30 minutes

Temperature falling?

YES

Baby temperature > 33°C

NO

Add 1 blanket

Baby temperature > 34°C

YES

Remove any blanket if present. Consider using a fan, contact transport consultant for advice*

TARGET TEMPERATURE 33.0 - 34.0 °C

*Ice packs should not be used for cooling as these can result in severe hypothermia, active cooling (e.g. fan) should not be used unless rectal temperature is monitored.

Dr Denis Azzopardi
Dr Giles Kendall
Dr Nikki Robertson

UK TOBY Cooling Register
www.npeu.ox.ac.uk/tobyregister
01865 289735
tobyregister@npeu.ox.ac.uk
Appendix 3 Toby Cooling Register Parent Information Leaflet

Treatment of babies who have perinatal asphyxia (lack of oxygen before birth).
We know that your baby has been very unwell. Your doctor will already have spoken to you about what has happened to your baby and discussed the treatment needed.

You have been given this leaflet because your baby has been born with perinatal asphyxia and is being offered cooling treatment, and this information will help you to understand more about what this means.

What is cooling?
Cooling means that a baby is cooled from the normal body temperature of 37°C (98.6°F) down to a temperature of 33.5°C (92.3°F). The baby is kept cool for about three days (72 hours). Cooling is started as early as possible after birth, and after 72 hours of cooling the baby’s temperature is slowly returned to normal.

What is perinatal asphyxia?
We do not always know what causes perinatal asphyxia but we do know that lack of oxygen to the baby’s brain can lead to brain injury. This injury may be severe and some babies will not survive. If a baby with perinatal asphyxia does survive, there is a chance that the baby will be disabled. Disability can be severe or it can be very mild but some degree of disability occurs in about half of all babies born with perinatal asphyxia.

The only standard treatment we have for perinatal asphyxia is intensive care treatment. There are no specific treatments that definitely help this condition. However, researchers continually try to find ways to improve the health of babies such as yours. There has been much research over recent years into the use of cooling as a possible treatment that could limit the amount of brain injury caused by perinatal asphyxia.

The TOBY Study
One of the largest of these published studies of newborn babies with perinatal asphyxia was the TOBY Study, funded by the United Kingdom Medical Research Council. Recruitment of 325 babies to the TOBY Study ended in November 2006. Information was collected about TOBY babies at 18 months of age so that the longer-term effects of cooling could be studied. The results were published in the New England Journal of Medicine in October 2009. Cooling was shown to be beneficial for some babies with perinatal asphyxia.

How will my baby be treated with cooling?
Your baby will receive standard intensive care and in addition your baby will be cooled. This means that your baby will be nursed on a special cooling mattress that cools the whole body to the desired temperature. The mattress is filled with fluid that can be cooled or warmed. You will still be able to touch your baby just as you would if they were not on a cooling mattress.
Another way of cooling babies is to use a cooling cap, which is placed on the baby’s head, but this is less common.

We will aim to cool your baby for three days (72 hours). After this time the cooling will be stopped and your baby’s temperature will slowly return to normal. The mattress can be used to help re-warm your baby.

Your baby’s temperature will be measured closely to make sure that this stays at around 33.5°C (92.3°F). It is important to know exactly what your baby’s temperature is during cooling and re-warming, and we usually do this by measuring the temperature from a small probe placed in the baby’s bottom (which measures rectal temperature).

What are the possible side effects of cooling?
From studies which have been performed in animals or adults and from the existing studies of newborn babies we know that cooling may lead to problems with blood pressure control, abnormal heart rhythm, bleeding and clotting problems, and chemical and sugar imbalances in the blood.

The doctors and nurses looking after your baby are aware of this and your baby will be closely monitored for signs of these unusual complications.

Your baby’s doctors can decide to stop the cooling early if they consider this to be best for your baby.

What happens now?
Thank you for reading this information leaflet. If you wish to discuss anything about the treatment your baby is receiving please speak to the doctor and nurse in the neonatal unit.

Local contact details:

npeu
National Perinatal Epidemiology Unit

November 2009
Appendix 4
Flowchart for Assessment and Initiation of Cooling in Referring Hospitals

Significant Resuscitation or fetal/neonatal acidosis

Switch off Heater on Resuscitaire
Assessment for Encephalopathy (within first hour)

A. Infants ≥36 completed weeks gestation admitted to NNU with at least one of the following:
   - Apgar score of ≤5 at 10 minutes after birth
   - Continued need for resuscitation, including endotracheal or mask ventilation, at 10 minutes after birth
   - Acidosis within 60 minutes of birth (defined as any occurrence of umbilical cord arterial or capillary pH <7.00)
   - Base Deficit ≥16 mmol/L in umbilical cord or any blood sample (arterial, venous or capillary) within 60 minutes of birth

B. Seizures (clinical or subclinical*) or moderate to severe encephalopathy, consisting of:
   - Altered state of consciousness (reduced or absent response to stimulation) AND
   - Abnormal tone (focal or general hypotonia, or flaccid) AND
   - Abnormal primitive reflexes (weak or absent suck or Moro response)

*Subclinical seizures are those which are detected on amplitude integrated EEG (aEEG) but there are no clinical signs apparent.

Fulfills A+B
Insert Rectal Probe
Monitor HR, BP and RR
Commence active or passive cooling using Appendix 2) to 33-34°C
Contact Nearest Treatment Centre
Inform Parents about cooling (information leaflet in appendix 3) and potential need for transfer

Uncertain about eligibility or meets possible criteria for cooling outside trial criteria (see p3 network guideline)

Discuss with Oxford Neonatal Attending Consultant
Await ETA from transfer team
Continue active or passive cooling and follow network guideline on management of cooled infant whilst awaiting transfer p6
If infant temperature falls to <33°C, rewarm slowly, 0.5°C/hr if significant cooling has already occurred) but repeat neurological examination again within 4 hours if criteria A are met to ensure no deterioration occurs

Does not fulfil A+B
Revert to normothermia (rewarm slowly, 0.5°C/hr if significant cooling has already occurred) but repeat neurological examination again within 4 hours if criteria A are met to ensure no deterioration occurs

Contact local treatment centre for advice if required