# Prevention of hypothermia in newborns on delivery suite and postnatal ward

## Full Title of Guideline:
Prevention of hypothermia in newborns on delivery suite and postnatal ward

## Author (include email and role):
- Dr Aarti Mistry ST6 Neonatal Registrar ([aarti.mistry@nuh.nhs.uk](mailto:aarti.mistry@nuh.nhs.uk))
- Dr Anneli Wynn-Davies Consultant Neonatologist ([anneli.wynn-davies@nuh.nhs.uk](mailto:anneli.wynn-davies@nuh.nhs.uk))
- Dr Dulip Jayasinghe Consultant Neonatologist ([Dulip.jayasinghe@nuh.nhs.uk](mailto:Dulip.jayasinghe@nuh.nhs.uk))

## Division & Speciality:
- **Division:** Family Health – Children
- **Specialty:** Neonatology

## Version:
4

## Ratified by:
Neonatal Guideline Group 11.9.2018

## Scope (Target audience, state if Trust wide):
All neonatologist, midwives and obstetrians.

## Keywords
Hypothermia, re-warming

## Risks Managed
To prevent hypothermia in newborns on the postnatal wards.

## Review date (when this version goes out of date):
10.9.2023

## Explicit definition of patient group to which it applies (e.g. inclusion and exclusion criteria, diagnosis):
Neonatal patients of the Nottingham Neonatal Service and maternity service who fit the inclusion criteria of the guideline, stated below

## Changes from previous version (not applicable if this is a new guideline, enter below if extensive):
Previous v3 authored by Dr Dulip Jayasinghe May 2010
Main changes:
- Prevention of hypothermia guidance and flowchart
- Pathway for the management of hypothermia and escalation of care.
- Advice on the use of hats.

## Summary of evidence base this guideline has been created from:
The contemporary evidence base has been used to develop this guideline. References to studies utilised in the preparation of this guideline are given at its end. This guideline and evidence used has been peer reviewed.

___

*This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after the review date or outside of the Trust.*
1. INTRODUCTION

Body temperature is one of the primary vital signs. A fetus’ in-utero temperature is generally 0.5°C higher than mother’s temp [1] and rapid cooling occurs after delivery [2, 3]. Just over 1% of neonates on the postnatal ward have a temperature below 36°C at 2 hrs of age, although almost none do by 24 hours [[4, 5]]. Preterm neonates are especially susceptible to heat loss due to poor tone, reduced fat and thinner skin than term neonates [6]. Babies who have a traumatic birth process may be more vulnerable to temperature instability [7, 8]. Importantly, hypothermia and/or temperature instability is often a sign of delayed adaption following delivery and may be a sign of sepsis [9-12]. Hypothermia continues to be a reason for admission to the neonatal unit. On average, NUH admits two neonates above 34 weeks of gestation with hypothermia to its Neonatal Units each week. Many of these are potentially avoidable admissions and, therefore, early prevention of delayed adaption post-delivery is essential.[11, 13] This guideline helps provide a structured and systematic approach in the prevention and management of hypothermia on labour suite and postnatal wards.

1.2 MECHANISMS OF HEAT LOSS

Heat can be lost through 4 mechanisms: conduction (examples cold scales, cold blankets), evaporation (wet clothing, bathing), convection (near air vent, passing ward traffic), radiation (cold room air temperature): Figure 1.[11]

**Figure 1. Methods of heat loss [11].**

- **Evaporation** can occur during birth or bathing from moisture on skin, as a result of wet linens or clothes, and from insensible loss.
- **Conduction** occurs when the infant comes in contact with cold objects or surfaces such as a scale, circumcision restraint board, cold hands, or a stethoscope.
- **Convection** occurs when drafts come from open doors, air conditioning, or even air currents created by people moving about.
- **Radiation** heat loss occurs when the infant is near colder surfaces. Thus, heat is lost from the infant’s body to the side of the crib and to the outside walls and windows.
2.1 DEFINITION OF HYPOTHERMIA AND RESPONSE

Temperature has been categorised (normal (36.5-37.5°C), cold stress(36-36.4°C), moderate (32-35.9°C) and severe hypothermia (<32°C)) to aid comparison across studies [14]. Neonates who have a temperature less than 36.4°C are considered hypothermic. We should encourage the aim of normothermia (36.5-37.5°C) in all babies.

3. PATIENT POPULATION AT RISK OF HYPOTHERMIA [14]

- Preterm neonates (<36weeks + 6) [5]
- Growth restricted or small for gestational age (<10th centile for weight) or low birthweight neonates (<2.5kg) [5, 15]
- Neonates who have features of acute antenatal and perinatal hypoxia (cord ph<7.0, Apgar < 7 at 5 mins, hypotonia, need for IPPV at 10 minutes) [6, 7]
- Neonates at risk of an infection (Guideline C6) [16]
- Neonates with central nervous system malformations [15]
- Any baby with symptoms of respiratory distress
- Babies of substance abuse mothers [16]
- Babies born before arrival to hospital [16]

4. RECOGNITION

- Body cool to touch
- Poor feeding
- Mottling or pallor
- Acrocyanosis – bluish or purple colouring of hands and feet caused by slow circulation.
- Raised respiratory rate and/or Raised Heart Rate.
- Hypotonia
- Hypoglycaemia – as glucose stores being used to keep warm
- Lethargy – hypoxaemia restricting oxygen to brain
- Restlessness – behavioural thermoregulation, alteration of sleep patterns

Heat is generated by babies through movement, crying and the activation of brown adipose tissue. A cold environment causes a stress response and leads to the activation of this tissue to generate heat although this mechanism which is quickly used up especially in preterm infants. Figure 2 shows the potential physiological consequences of cold stress, giving us an understanding to how these neonates may present to us.

Figure 2 Physiological consequences of cold stress. [11]
5. MEASUREMENT
Temperature should be measured in the axilla using a thermometer that reads below 33°C. The electronic thermometers used within the NUH Trust record to a minimum temperature of 28.9°C, with an accuracy of 0.1°C.

6. INITIAL POST DELIVERY PREVENTION OF HYPOTHERMIA ON ALL BABIES ON LABOUR SUITE/THEATRES
Flow chart 1 describes the Management Pathway for Prevention of Hypothermia in infants on labour/theatres and when to inform the neonatal medical team.

6.1 PRE BIRTH
Before birth:
- Assess your environment
- Avoid drafts
- Ensure adequate room temperature (25°C) to reduce risk of delayed adaption
- Water bath birthing pool temperature (37°C)
- Check radiant heater is set to ‘manual’ at 75-100%
- Have warmed towels prepared.

6.2 AFTER BIRTH
After birth:
- Dry baby and wrap in warm dry towel/blanket preventing early heat loss.
- Minimise further loss by utilising an appropriate method such as:
  - Early skin to skin care can prevent early heat loss and is appropriate for well babies. In skin to skin care mothers are encouraged to cuddle their baby, placing their naked baby against the chest skin to skin and ensuring baby and mother are covered with warmed blankets. Skin to skin may be possible in mothers whom have had a caesarean section. For further guidance on skin to skin refer to NUH skin to skin care guideline [17-19].
  - clothing the infant e.g. if the mother has reduced level of consciousness, unwell post-delivery/caesarean section and when skin to skin is not possible, clothe baby in a vest, baby-grow, cardigan and apply 1 sheet and 2-3 double folded blankets [20]. This amount of clothing would provide about 4.6 Tog insulation [21] sufficient for air temperature between 20-22°C. The addition of extra bedding will add an extra 0.1 Tog per layer of blanket [21].
  - Placing a baby under a radiant warmer [2, 3]. Early use of a radiant warmer may be useful in those at particular risk of cold stress by 2 hours (<2.5 Kg at term or premature [5]) and those unwell requiring resuscitation.
  - If passage of urine needs to be confirmed place a piece of gauze in the nappy; ‘Terry nappies’ become wet and may contribute to heat loss and should not be used immediately after birth unless specifically requested by parents.

6.3 ADVICE ON HATS
Within NUH hats are not routinely be used indoors because of the risk of over-heating [22] and doing so may conflict with official advice against head covering, [13, 23-25] A hat may reduce heat loss in the first 2 hours after birth [20,31,32] and may ONLY be used initially after birth and during transfer from labour suite to postnatal wards [31,32]. Hats MUST be removed once arriving to the postnatal ward to promote the message to parents of safe sleeping, prevention of overheating and Sudden infants deaths (SIDS) [13, 23, 26]
6.4 AT RISK INFANTS

Neonates at elevated risk of hypothermia (see above) must have their temperature measured and documented within an hour of birth or prior to transfer to postnatal ward, whichever is sooner. Continue to measure the temperature every 4hrs and ensure it is documented on the NEWS chart. If risk factors for hypothermia are present, then ensure that the baby is fed within an hour of birth and every 3 hours thereafter. In less than <36wk and 1.8-2kg babies consider transfer from labour suite to postnatal in pre-warmed heated mattress (KANMED).

Neonates born less than 32 weeks place into a plastic bag without drying and wrapping, those less than 28 weeks consider transfer to neonatal unit in transport system. (refer to early care guidelines A5 and A8).
(FLOWCHART 1) PREVENTION OF POST DELIVERY HYPOTHERMIA FOR ALL BABIES BORN ON LABOUR SUITE/THEATRES

**PRE BIRTH:**
- Assess environment
- Ensure room temperature is adequate (25°C)
- Water bath birthing pool temperature (37°C)
- Avoid drafts
- Ensure warmed towels
- Ensure radiant heater is on manual

**UNWELL**
- Follow NLS Algorithm (Guideline A5)

**AT BIRTH**
- Place under thermocontrolled radiant heat warmer
- Assess HR, TONE, BREATHING, COLOUR
- Immediate place baby on mother
- Dry the baby
- Ensure adequate skin to skin
- Place warm towels over baby
- Place hat on head. (*)
- Early feed (particular babies with risk factors)

**WELL**
- Where unable to perform skin to skin effectively
- Dry and wrap baby and keep under thermo-controlled radiant heat warmer.
- Dress baby in vest, baby grow and cardigan and apply sheet and 2 doubled blankets
- Place hat on head (*)
- Early Feed (particularly babies with risk factors)
- In less than <36wk and 1.8-2kg babies consider transfer in pre-warmed KANMED.

**Check temperature within 1hour**
- If temperature < 36.5°C
- Follow the management of hypothermia (Flowchart 2) below

**If normothermic,** continue to normal care and transfer to postnatal ward with appropriate heat prevention methods as above.

*REMOVE HATS ONCE ON POSTNATAL WARD*
- Once off skin to skin
- Dress with vest, baby grow, cardigan, and apply sheet and 2 double blankets
- In less than <36wk and 1.8-2kg babies a KANMED may be required to help prevent hypothermia.
- Infants with risks factors continue 3-4hrly temperature checks and document.

*Hats are ONLY to be used after birth, and transfer through a cold environment. Hats MUST be removed once on postnatal wards, to promote the message of safe sleeping to families.*
7. TREATMENT OF HYPOTHERMIA

FLOWCHART 2: ‘Management of Hypothermia’ describes the pathway of management of normothermia, cold stress, moderate and severe hypothermia.

7.1 NORMOTHERMIA

Is defined as a temperature between 36.5-37.5°C. Babies with normal temperature follow the normal care pathway. Ensure they are dry, wrapped, dressed or having skin to skin care as per Flowchart 1. Babies with risk factors as discussed in section 3, will require their temperature rechecking every 4 hours thereafter.

7.2 COLD STRESS MANAGEMENT: Axillary temperature 36-36.4

If temperature less 36.4°C,
- skin to skin with warm blankets, or ensure adequately dressed in vest, baby grow, cardigan, and two blankets.
- Check temperature in 1 hour, if temperature above 36.4°C, continue to check temperature, heart rate, and respiratory rate every 4 hours for 12hrs and return to normal care (refer to section 7.1).
- If temperature remains <36.4°C and/or associated poor feeding, inform neonatal medical team, move to Moderate hypothermia pathway in the interim

7.3 MODERATE HYPOTHERMIA: axillary temperature: 32 - 35.9°C

If temperature between 32-35.9°C
- Inform neonatal medical team
- Recheck temperature
- Admit for medical review
- Sepsis should be considered and patients screened as per guideline C6
  In addition to cold stress management, rewarm using KANMED or Radiant heater. For babies at the lower end of scale and those who are likely to respond slower to rewarming, consider using incubator. Check temperature 1 hourly until normothermic (36.5-37.5). Aim to increase temperature by 0.5-1°C every hour.
- Document and observe feeding closely
- Check serum glucose levels every 3hrs
- Check and document observations of Heart Rate, Respiratory Rate and Oxygen saturations every 4 hours.
- If no improvement escalate management and follow the severe hypothermia pathway.

7.4 SEVERE HYPOTHERMIA: axillary temperature: <32°C

- Inform neonatal medical team IMMEDIATELY
- Recheck temperature and ADMIT
- Patient required URGENT Neonatal Medical assessment
- Place patient in an incubator for rewarming and also apply transwarmer inside incubator/
- Check temperature hourly until normothermic. Aim to increase temperature by 0.5-1°C every hour.
- Hold feeds and commence intravenous fluids.
- Sepsis should be considered and patients for infection as per guideline C6.
- Check serum glucose levels every 3hrs
- They should receive continuous monitoring of their Heart Rate, Respiratory Rate and Oxygen saturations.
- If you require further advice please seek senior support.
7.5 FEEDING IN HYPOTHERMIA

The feeding of cold stressed babies should continue as per feeding guidelines in postnatal wards. However, persistent failure to feed, alongside hypothermia, should be discussed with the neonatal medical team and necessitates a medical review and consideration of infection screening, close observation and neonatal admission.

In the case of severe/hypothermia (Temperature <32°C), attempts at feeding should be abandoned and babies should be brought to attention of the neonatal medical team immediately.

7.6 MONITORING IN HYPOTHERMIA

Hypothermic (<36.4°C) neonates should have a temperature monitored as guided by Flowchart 2 until >36.4°C and 3-4 hourly thereafter if risk factors persist or being actively warmed ie KANMED.

All babies with moderate hypothermia (32-35.9°C) should have regular observations recorded 4hourly which include temperature, respiratory rate, heart rate and oxygen saturations.

Babies with moderate and severe hypothermia (<32°C), should have serum glucose measured at least 3hourly and acted upon., as per NUH hypoglycaemia guideline D1. If a neonate is severely hypothermic they should have at least 6 hourly blood gases and have continuous monitoring of their heart rate, respiratory rate and oxygen saturations.
**FLOWCHART 2 MANAGEMENT OF HYPOTHERMIA**

**Check temperature within 1 hr from birth**

- **Normothermia**
  - Temperature 36.5-37.5°C
  - Normal care, dry, wrap, clothe, skin to skin
  - Babies with risk factors continue to check temperature 4hly

- **Cold stress**
  - Temperature 36-36.4°C
  - Skin to skin with extra warm blankets
  - Or
  - Ensure vest, baby grow, cardigans and two blankets on baby
  - Check temperature 1hrly until 36.5°C

- **Babies with risk factors continue to check temperature 4hly**

- **Moderate Hypothermia**
  - Temperature 32-35.9°C
  - Inform Neonatal Medical Team
  - Recheck temperature
  - Admit to NNU for medical review
  - Consider infection screen

- **Severe Hypothermia**
  - Temperature <32°C
  - Inform Neonatal Medical Team, Recheck temperature and ADMIT URGENT review by medical team
  - Perform infection screen

- **Kanmed or Radiant heater. Rewarming 0.5-1°C/hour**
  - Use heated mattress (gel or tecotherm)
  - Hold feeds.

- **Incubator care**
  - Rewarming 0.5-1°C/hour
  - Use heated mattress (gel or tecotherm)
  - Hold feeds.

- **Check temperature hourly until normothermia (36.5-37.5°C)**
  - Check serum glucose, HR, RR, SaO2 3-4 hourly

- **Check temperature hourly until normothermia is reached**
  - If moderate hypothermia and no response to intervention will require admission and follow severe hypothermia pathway.
  - Seek senior advice and support

*Refer to REWARMING section below for further details on methods of rewarming*
8 RE-WARMING

Re-warming of neonates can be performed by skin to skin, overhead radiant heating, water-filled warming mattress (Kanmed) or incubator. A rate of re-warming should be no more than 1°C/hr [27], between 0.4 to 0.8°C/hour maybe achieved using radiant heater [28] and Kanmed mattress [29].

8.1 OVERHEAD THERMO-CONTROLLED RADIANT HEAT WARMER

See Appendix 1 for instructions.

Babies to consider for a radiant warmer

- Prevent hypothermia in a baby following at birth to prevent delayed adaption. Particular those babies at risk of hypothermia (Refer to section 3).
- Maintaining normothermia during resuscitation following birth.
- Rewarming from a temperature of 35°C.

Radiant heaters can increase insensible water loss [30] so consideration should be given to monitoring fluid balance in preterm neonates. There is no randomised trial evidence to guide selection of neonates who would benefit from rewarming with a radiant warmer. A pragmatic choice may be to utilise a radiant warmer in those with cold stress though it has been used to rewarm preterm neonates from a temperature of 35°C.

8.2 KANMED WARMING MATTRESS

See Appendix 2 for instructions.

Babies to consider for a Kanmed mattress

- Prevent hypothermia in babies who are in the at-risk group of hypothermia ie 34-36-week gestation and/or are 1.8-2kg. (refer to section 3).
- Rewarming babies from a temperature of 34.5°C
- Maintaining thermoregulation in preterm babies with low birth weight, and those being transitioned from incubator care.

A Kanmed mattress warms a baby by conduction from the surface of a warm mattress. Heated water mattresses (HWM) have been used to both provide heat for preterm neonates (mean GA 29weeks (1.3Kg) [31]) and rearm hypothermic neonates [29]. Hypothermic (<36.4°C) preterm neonates of mean gestational age 32 weeks were rewarmed using HWM in a randomised trial compared with incubator care[32] and found to warm faster. There is no randomised trial evidence to guide selection of which neonates would benefit from rewarming with an HWM. A pragmatic choice may be to utilise an HWM in those with cold stress though in practice it has been used to rearm preterm neonates from a temperature of 34°C. In using HWM, it is important that infants are not laid on HWMs which are not in warming mode. Refer to Appendix 2 for detailed instructions on use of the KANMED.[33]

8.3 INCUBATOR

See Early Care A8 guideline
9. RELATED GUIDELINES

- Neonates with risk factors for sepsis C6
- Hypoglycaemia D1
- Resuscitation at birth A5
- Transitional care F10
- Early care A8
- Skin to skin NUH guideline

10. AUDIT POINTS

- Proportion of neonates with risk factors who have temperature measured within an hour of birth (Target 100%)
- Proportion of neonates with risk factors who become hypothermic (<36.0°C) (Target 0%)
- Proportion of neonates cold stressed (36.0-36.4°C) within 2 hours of age (Target 0-8%)
- Proportion of neonates made hyperthermic (target 0%).
- Proportion of term neonates admitted to the neonatal unit with hypothermia (Target 0%)

11. REFERENCES

33. KANMED Heated water mattress product information JUNE 2018]; Available from: http://kanmed.se/products/babywarmer/.
APPENDIX 1: USE OF OVERHEAD RADIANT WARMER

INTRODUCTION
Radiant warmers warm a neonate lying in a cot by radiant heat from an overhead element. Within the NUH Trust the devices are not used in servo-controlled mode. The use of a radiant warmer in combination with drying and wrapping can prevent heat loss after birth. Ensure warmer is not less than 80cm above the infant, not less than 50 cm between warmer and heat sensitive material such as Perspex [28].

CHOOSING SET TEMPERATURE
The Ceratherm 600-21 mobile radiant warmer has 4 output settings (25%, 50%, 75% and 99%) and produces a maximum of 600W of heat energy. Begin at 75% and observe response; if used with an incubator then do not increase beyond 75%. [34]

CLOTHING
Ensure that the neonate is in dry clothing. Place infant in a cot and clothe in a baby grow and vest but do not cover with a blanket to avoid insulating the infant from the heat source. A cot cover may be placed over the infant to act as a heat shield. If the infant requires close observation, consideration should be given to placing the infant unclothed in an incubator with a radiant warmer above.
APPENDIX 2: USE OF (KANMED) HEATED WATER MATTRESS

Preparation (available as video http://www.kanmed.se/download/video.html) [33]

- The mattress must be switched on and pre-heated up for at least 6 hours before use. The water in the mattress takes this length of time to come to 37°C
- Ensure the mattress is filled with 10 litres of ideally warm water (up to the line shown) with the heating pad placed with the writing on the pad up against the water mattress.
- Place a sheet on the foam mattress of the cot and put the Kanmed mattress onto the foam mattress and sheet.
- Hang the control box onto the cot and plug into a 15 amp plug and turn on at the back of the control box.
- Turn the mattress on with the relevant button at the front of the control box.
- Ensure the default temperature of the mattress is set at 37 degrees Celsius.
- DO NOT put the baby onto the Kanmed until 37°C is reached.
- Cover the mattress with a fleecy sheet and a blanket over the whole mattress to keep the heat contained.

How to use the Kanmed mattress

- Place the baby onto the warmed mattress at temperature of 37°C
- Cover the baby with appropriate bedding (one sheet and one blanket).
- He/she does NOT need a hat or piles of blankets whilst on a Kanmed. Dress baby in normal clothing, such as a vest, baby grow and possibly a cardigan.
- Check an axilla temperature when first putting the baby onto the mattress to create a base line observation. Monitor temperature again 1 hr later and subsequently 3-4 hourly recording all readings on an appropriate chart
- Place a ‘teddy bear’ environmental thermometer on the cot and record the room temperature at the same time as the baby’s temperature is taken. (If available)
- When the baby is taken off the mattress for feeding keep the mattress covered with a blanket/sheet to maintain the temperature inside cot.
- The baby does not need cardiac or saturation monitoring if his/her condition does not warrant it.

Key principles to consider when weaning the mattress down

- Each baby must be assessed individually when weaning the temperature down or up, of the mattress.
- Reduce the temperature of the Kanmed mattress when the baby shows a high temperature over a 2-hour period if a baby’s temperature shows a reading over 37.2°C. Take the temperature again 1 hr later and if the high temperature persists reduce the mattress temperature by 0.5°C and take baby’s temperature again in1hr. If the high temperature prevails reduce again by a further 0.5 degrees Celsius. Do this until the temperature is maintained within the normal range (36.5 – 37.2°C)
- If the baby is maintaining his/her temperature at normal levels (36.5-37.2°C) and putting on weight for a 48hr period the temperature of the Kanmed can be reduced by 0.5°C. Check the baby’s temperature again in 1 hour and if temp normal leave the temperature of the Kanmed mattress at this adjusted temperature. When the temperature of the Kanmed mattress is at t35.5 Celsius and the baby is maintaining his/her temperature for 24hrs they are ready to come off the Kanmed mattress. At this stage the baby’s normal temperature is higher than the mattress so the baby may be using more energy keeping warm and therefore a good time to get the baby off the mattress.
- When taking baby off mattress place onto a warmed sheet to avoid heat loss. The sheet can be warmed by being placed under the mattress prior to baby being taken off the Kanmed mattress.
- **ONLY** turn off KANMED once baby has been transferred into cot, babies should not be left in a switched off or non-heated KANMED.
- Check baby's temp when taken off mattress and take again in 1 hour and subsequently every 4 hours as transitional care guidelines.
- Once the baby is off the mattress adjust bed clothing and the baby's clothing to maintain temperature at normal levels.
- Only put the baby back onto a Kanmed mattress if adjustment of clothing fails over a period of 6 hours.
- Once maintaining temperature outside of Kanmed in a normal open cot for 24hrs the baby can be considered for discharge.

**When to increase the mattress temperature**

If the baby shows a lower than normal temp (< 36.5°C) check temp again in 1 hour and if still low increase the temperature of the Kanmed mattress by 0.5°C. Continue until the temp reaches normal values. If the baby does not maintain its temperature and is still cold with the Kanmed at its highest setting after a period of 3 hours the baby will need to go into an incubator. The Kanmed maximum temperature is 38°C.

**Figure 3. Illustrations of heated water mattress (Kanmed)**