

## Thermoregulation of Infants in Newborn Intensive Care Unit (NICU)

### Procedure Responsibilities and Authorisation

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### Procedure Review History

Version	Updated by	Date Updated	Summary of Changes
02	Joan O'Sullivan	Oct 2012	Review
03	Joan O'Sullivan	Oct 2014	3-yearly review
04	Narika Mcdowall, Laura Thorpe	Oct 2021	3-yearly review

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## Thermoregulation of Infants in Newborn Intensive Care Unit (NICU)

### 1 Overview

#### 1.1 Purpose

To provide infants with an appropriate thermal environment for gestation and weight.

#### 1.2 Scope:

Waikato Staff working in NICU

#### 1.3 Patient / client group:

Neonates & infants in NICU

#### 1.4 Exceptions:

Babies receiving cooling therapy

#### 1.5 Definitions

<b>Air mode</b>	This mode monitors the air temperature inside the incubator and keeps it at a steady level, compensating for fluctuations caused by opening and closing of incubator doors.
<b>Cold stress</b>	When the infant's temperature drops below 36.5°C the baby is considered to be in cold stress. The extremities will feel cold and the body will feel warm because the baby will draw heat from the extremities to the centre of the body to protect the vital organs. If the temperature continues to decrease the baby will become hypothermic.
<b>Comfort Zone</b>	Use <b>Comfort Zone</b> if you are anticipating the admission of a preterm infant. This programme considers the infants <b>gestational age, days of life</b> and <b>estimated weight</b> when calculating the most appropriate incubator air temperature.
<b>Hyperthermia</b>	When the infant's body absorbs or produces more heat than it can dissipate (> 37.2°C).
<b>Hypothermia</b>	When the infants' temperature drops below that required for normal metabolic and body function (< 36.5°C), it is said to be hypothermic.
<b>Kangaroo care</b>	In skin-to-skin contact, also known as <i>kangaroo care</i> , a neonate is placed against a parent's bare chest and covered by a warmed blanket. Skin-to-skin contact provides emotional and physiological benefits to neonates and parents.
<b>Neohelp™</b>	A polyethylene wrap designed to reduce insensible water and heat loss in infants weighing < 1000g or whose gestation is <29 weeks. When preparing for admission, note that there is two sizes of neohelp, small and medium.
<b>Neutral Thermal Environment (NTE)</b>	This is the environmental temperature at which the infant is able to maintain a normal temperature with a minimal metabolic rate and

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	therefore reduce both energy and oxygen consumption. For each baby, this will vary with the gestational age.
<b>Normal axilla temperature</b>	In NICU, the normal range is 36.6°C – 37.2°C
<b>Servo control or Baby mode</b>	A mode of operation whereby the incubator monitors the baby's skin temperature via a probe attached to the abdominal wall and adjusts the incubator temperature to maintain the temperature at a pre-set level.
<b>Thermoregulation</b>	The ability to balance heat loss and heat production through normal thermoregulatory mechanisms in order to maintain body temperature within the normal range.

### 1.6 Indications

- 1) Small for gestational age (SGA) infants
- 2) Extreme low birth weight (ELBW) infants
- 3) Premature infants <37 weeks gestation
- 4) Infants with neurological problems
- 5) Infants with cardiorespiratory problems
- 6) Low birthweight infants <2500 grams
- 7) Infants with low blood sugars
- 8) Infants with endocrine problems
- 9) Sedated infants
- 10) Infants with congenital abnormalities e.g. gastroschisis, myelomeningocele

## 2 Clinical Management

### 2.1 Competency required

- Registered Nurses who have completed Level II orientation.
- Enrolled Nurses who have completed Level II orientation, and under the direction and delegation of a RN.

### 2.2 Equipment

- Radiant heater with Servo temperature probe
- Incubator – Giraffe Omnibed
- Servo temperature probe
- Reflective probe cover
- Silicon tape for babies <1000g
- Nesting
- Thermometer

## Thermoregulation of Infants in Newborn Intensive Care Unit (NICU)

### 2.3 Procedure

#### 2.3.1 Assessing infant

- Assess infant's condition: respiratory and cardiovascular status, axilla temperature. Normal axilla temperature is 36.6- 37.2°C.
- Determine the appropriate method of controlling the infant's temperature:

#### Types of beds:

- Infants <1500g or preterm infants requiring level 3 care in Omnibed.
- Stable infants ≥1500g who are able to maintain own temperature e.g. growing infant able to maintain normal temperature may be considered for transfer into a cot or cosy therm.

#### Method of control

- Infants <1500g on servo control.
- Infants should be nursed on servo control until regularly being removed from incubator for feeding etc. Approximately 32 weeks gestation.

#### 2.3.2 Checking temperature

- Use digital thermometer.
- Use individual plastic shield for each baby.
- Clean the thermometer with chlorhexidine-alcohol swab before and after each use.

#### 2.3.3 Nursing infant on radiant heater

- Ensure radiant heater is pre-warmed to minimise heat loss by conduction.
- Inspect the servo thermometer probe, especially the tip of the probe to ensure the device is free from defect.
- Attach servo probe to abdomen with reflective probe cover.
- Once infant has a normothermic axilla temp, set servo mode to what the skin temperature probe is recording at the time of the normothermic axilla temp.
- Ensure that servo probe is securely attached to the infant, and the infant is not lying on the probe.
- Avoid phototherapy lights shining directly on the probe to prevent inadvertent heating from the phototherapy as this will give false readings, which can lead to a decrease or increase in supplied radiant heat. Also, overheating of the probe can lead to cooling down of infant.
- Check skin condition and change site at least 6-8 hourly to detect any pressure areas /bruising due to placement of probe.

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- Check probe site hourly to ensure it is secure and correctly attached, and baby not lying on probe.
- Record hourly and observe trends of skin and set temperatures.
- Record axilla temperature 4 hourly/PRN.
- Place baby in flexed position and provide nesting to minimise draughts.
- Using individual baby's behaviour cues to determine timing of nursing care.

### 2.3.4 Nursing infant in incubator

- Pre-warm incubator to 34°C in the nursery. Once admission is expected, switch incubator to comfort zone with correct gestation and days of life. Once infant has arrived, place infant on mattress to minimise heat loss by conduction.
- Infants <1500g should be nursed in Giraffe Omnibed/incubator.
- ELBW infants may remain in the Neowhelp/plastic wrap during admission procedure and remove once normothermic.
- Use silicone tape for babies < 1000g to minimise skin stripping with probe changes.
- In anticipation of a preterm admission use the 'Comfort Zone' mode, by inputting the infants gestational age, postnatal age and estimated weight.
- Normal incubator temperature range may vary. The smaller the baby, generally the higher the incubator temperature.
- On admission, place incubator temperature probe on the infant and allow it time to assess skin temperature. Attach probe to abdomen or back if prone.
- Following admission, once the axilla temp is normothermic the infant should be placed on 'Servo Mode'. For 'Servo Mode' the **set temp** is set according to the **current skin temp probe**. \*NB ensure you do not use the axilla temp as your set temp for servo mode\*
- Avoid opening main incubator doors and use portholes for access to baby to prevent heat loss from incubator
- Incubator must always be turned on to ensure continuous air flow.
  - Fan does not work when the incubator is switched off resulting in no air circulation and therefore levels of carbon monoxide and carbon dioxide level increased.
- Record air and axilla temperature 4 hourly/PRN.
- Do not bathe babies <1500g as bathing causes rapid loss of heat.
- Lie infant in a flexed position and use nesting to provide a comfortable position, which makes the infant more settled and leads to energy conservation.
- For babies <1500g or babies frequently out of the incubator, once thermostable and growing, air mode may be considered in place of servo mode.
- To switch over to air mode, use the observation chart to determine the most appropriate air temperature based on recordings over the previous 24hrs.

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### 2.3.5 Skin servo control

#### 2.3.5.1 Contraindication for skin servo control

- Infants with circulatory compromise – severe hypothermia, sepsis: rapid warming may cause vasodilation and hypovolaemic shock.
- Severe skin compromise – burns, collodion infants: avoid use of tapes/probes on skin to prevent further skin/tissue compromise, which increases the risk of infection.
- Cerebral damage – asphyxia, hydrocephalus: thermo-regulation centre in brain may be permanently damaged, thus mask signs of temperature instability.

#### 2.3.5.2 Iatrogenic hazards relating to servo control

a) Hypo/hyperthermia may result from:

- Improper probe placement
- Infant lying on probe
- Tight clothing/blankets/nappies over probe
- Radiant heat absorbed by probe (when reflective cover is not on properly)
- Inappropriate set control mode: air or infant/skin.
- Inappropriate temperature setting – too high/too low.

b) Temperature instability related to sepsis or cerebral damage may be overlooked as skin temperature will remain stable, therefore observe for:

**Swings in incubator air temperature** that are unrelated to events such as handling or open incubator doors

**Inappropriate air temperature** for infant's size, gestation or post-natal age.

**NOTE:**

If in doubt, check with ACNM/Coordinator/Nurse Practitioner Neonatology/Clinical Nurse Specialist and use air control mode.

### 2.3.6 Nursing infant in incubator on servo control

- Pre-warm incubator using comfort zone to set incubator temperature using gestation, weight and age.
- Place infant in incubator.
- Attach servo skin probe to abdomen or back if prone.
- **Ensure probe is securely and appropriately located** to minimise risks of iatrogenic hazards.
- Base tapes may be used to preserve skin integrity, must ensure good **probe-to-skin**

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contact. Use silicone tape for babies < 1000g to minimise skin stripping with probe changes.

- Check site hourly to ensure it is securely attached.
- Change probe site 6-8 hourly.
- Cover probe with a reflective cover.
- Ensure infant not lying on probe. When infant is lying on probe, the probe may sense added heat thus decreasing incubator heat output and result in cooling infant.
- Connect probe cable end into incubator probe socket 1.
- Select heating mode option – Baby or Air mode.
- Record hourly:
  - Incubator air temperature
  - Infant skin temperature
  - Incubator set temperature
- Record axilla temperature 4 hourly/PRN, preferably during cares time.
- If necessary adjust incubator set skin temperature gradually and with caution (maximum 0.5°C at a time) to maintain axilla temperature 36.7° – 37°C. Pay close attention to what the air temperature trend has been, your incubator will already be making adjustments to correct the skin temp. Too rapid change may compromise infant's cardiovascular system (CVS).
- Infants on servo control should not be given a full bath as bathing may result in dramatic decrease in skin temperature. Only stable infants >1500g are bathed.

### 2.3.7 Moving infant in/out of incubator on servo control

- Wrap infant warmly and prevent environmental draught before moving baby, who is on servo control, in/out of incubator for procedures, e.g. weighing, intubation, kangaroo care, breast-feeding etc.,
- Set incubator air temperature within 0.5°C of current incubator air temperature to prevent incubator alarming.
- Select **AIR** control mode to maintain stable air temperature while infant is out of incubator.
- When infant is placed back into incubator, reselect skin/baby servo control mode and use original skin temperature setting previously suited to infant. Modify set temperature as necessary if infant has become hyper/hypothermic whilst out of incubator.
- Ensure probe is securely and appropriately located.

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### 2.3.8 Weaning incubator temperature

Weaning of the incubator temperature may be considered by the bedside nurse when an infant is being nursed with the Manual Control setting.

- Assess all possible environmental and physiological factors including maturity.
- Assess appropriate temperature range for gestation and current age (Comfort Zone on Giraffe incubators and Omnibeds)
- Wean the incubator temperature by 0.3 to 0.5°C hourly
- Check axillary temperature hourly for four hours with each temperature change until temperature is stable and within normal range.

### 2.3.9 Transfer to an open cot

Preterm infants may be transferred to an open cot once they have met the following criteria:

- Weight  $\geq 1500$  grams
- Consistent weight gain
- Tolerating all feeds
- Medically stable
- No longer requiring invasive mechanical ventilation
- Wean incubator temperature by 0.5°C hourly (as a maximum) until the temperature is at 28.5°C
- Dress infant in pre-warmed clothing and wrap
- Ensure the infant maintains their temperature within the normal range at this set temperature for 4 hours (hourly axilla temperatures)
- Place in cot
- Assess temperature
- If the axillary temperature drops between 36.2°C and 36.5°C, increase clothing layers if possible and add a pre-warmed wrap/blanket.
- Check temperature hourly until stable for 4 consecutive hours
- If the axilla temperature remains unstable for a consecutive period of 3 hours (3 x hourly checks) then return the infant to a pre-warmed incubator.

### 2.3.10 Nursing infant in cot

- Infants >1500g with no signs of respiratory distress may be nursed in a cot.
- Ensure infant's clothing and wraps are dry to minimise evaporative heat loss.
- Infant may require bonnet & booties and 1 or 2 wraps/blankets.
- If infant's temperature is not within the normal range within 3-4 hours, transfer to a CosyTherm™ warming mattress or an incubator.

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### 2.3.11 Management of hypothermia

#### Consequences of hypothermia:

- Increased oxygen consumption hypoxia and metabolic acidosis.
- Increased energy consumption hypoglycaemia, slow or delayed weight gain.
- Reduced oxygen delivery to vital organs, particularly the bowel and kidneys.
- Decreased surfactant production and decreased efficiency of surfactant.
- Increased risk of sepsis and haemorrhage.
- Vasoconstriction and reduced peripheral perfusion.
- Increased free fatty acid production – may displace bilirubin from albumin leading to increased jaundice.
- Severe cold stress resulting in tissue necrosis.
- Increased infant mortality.

#### Management

a) Observe for signs and symptoms of hypothermia (temperature  $<36.5^{\circ}\text{C}$ )

- Cold to touch
- Colour, cyanosis, pallor
- Lethargy
- Decreased or increased spontaneous activity
- Respiratory distress – grunting, tachypnoea. apnoea
- Bradycardia or tachycardia
- Not tolerating feeds

b) Identify possible cause of hypothermia:

- Sepsis
- Frequent handling
- Inappropriate temperature settings of incubator or radiant warmer
- Bathing
- Inappropriate positioning

c) For infant on radiant heater

- Check servo probe is securely attached.
- Warm infant slowly
- Nurse in flexed position and well nested
- Put bonnet and booties on, if not contraindicated
- Minimise draughts
- Check axilla temperature hourly until within normal range.

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- d) For infant in incubator on air control
  - Increase air temperature 0.2° – 0.5°C
  - Nurse in flexed position, well nested.
  - Check axilla temperature hourly until within normal range.
  
- e) For infant in incubator on servo control
  - Check appropriate probe placement
  - Check incubator temperature setting and mode setting
  - Reposition/replace probe if necessary
  - Consider servo mode under radiant warmer if skin integrity/gestation allows lid to be lifted for a short period – this is the most effective method of rewarming a cold infant.
  - Do not fully cloth or cover a cold baby in an incubator as clothing and linen inhibits the warmth penetrating to the baby's skin surface.
  
- f) For infant in a cot
  - Fresh warm linen
  - Put bonnet & booties on
  - Use extra wrap around baby; may use quilt
  - Check axilla temperature hourly until within normal range.
  - If infant's temperature does not rise 0.2° – 0.5°C within an hour, transfer into an incubator or a CosyTherm™ warming mattress.

### 2.3.12 Management of hyperthermia

#### Consequences of hyperthermia

- Recurrent apnoea
- Increased fluid loss hypernatraemia, increased jaundice
- Increased postnatal weight loss
- Increased neonatal mortality

#### Management

- a) Observe for signs and symptoms of hyperthermia (temperature >37.4°C)
  - Infant looks and feels hot
  - Irritability and restlessness
  - Tachycardia
  - Apnoea or tachycardia
  - Not tolerating feeds dehydration

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b) Identify possible cause of hyperthermia:

- Inappropriate incubator temperature or servo control setting
- Over-swaddling
- Phototherapy
- Baby lying on servo probe
- Incubator temp sensors covered
- Sepsis
- Cerebral damage
- Drug therapy
- Dehydration
- Adverse reaction to blood transfusion

c) Remedy situation if possible

Correct environmental factors which may have contributed to hyperthermia

- Reduce infant's temperature slowly by reducing incubator temperature 0.2° – 0.5°C per hour to prevent hypothermia.
- Reassess axilla temperature hourly prior to changes.
- If servo probe is being used, check probe position and attachment.
- May have to temporarily change incubator servo control to servo control under radiant warmer.
- May have to reduce humidity setting if infant is nursed in humidified incubator (refer to humidification guideline).

### 3 Evidence base

#### 3.1 References

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- GE healthcare. (2021) Giraffe OmniBed Carestation. Retrieved from: <https://www.gehealthcare.com/products/maternal-infant-care/giraffe-omnibed-carestation>

### 3.2 Associated Waikato DHB Documents

- Waikato DHB NICU nursing procedure: [Admission to Level III Intensive Care Nursery](#) (Ref. 4571)
- Waikato DHB NICU nursing procedure: [Admission to Level II Special Care Nursery](#) (Ref. 4946)
- Waikato DHB NICU nursing procedure: [Giraffe™ Omnibed Incubators and Cosytherm™ Use in NICU](#) (Ref. 1488)
- Waikato DHB NICU nursing procedure: [Criticool cooling device: Use of](#) (Ref. 1639)
- Waikato DHB NICU medical protocol: [Neonatal Encephalopathy Management](#) (Ref. 1588)
- Lippincott Procedures: [Thermoregulations during transition to an open crib, neonatal](#)

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