



CLINICAL PRACTICE GUIDELINE

Guideline coverage includes NICU KEMH, NICU PCH and NETS WA

Thermoregulation

This document should be read in conjunction with the [Disclaimer](#)

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Preventing Heat Loss at Birth (All Gestations)

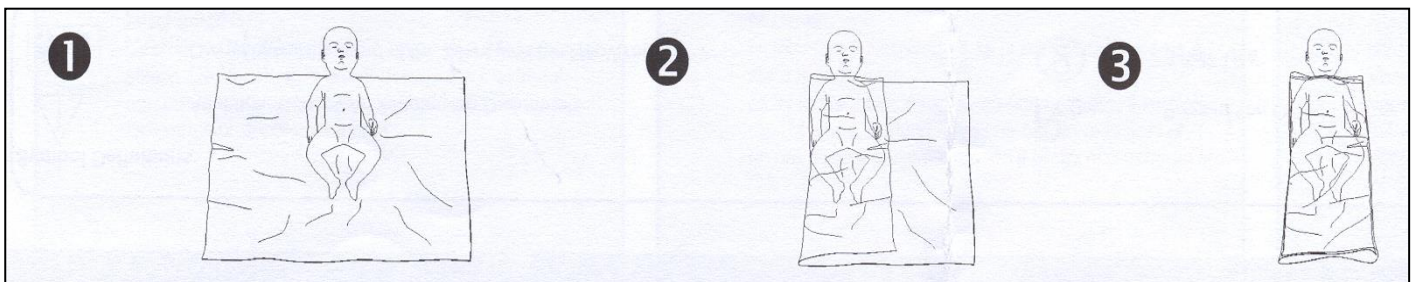
Ensure heater on resuscitaire is turned onto maximum output prior to delivery. If birthing in theatre turn up the air-conditioning to aim for at least 24 degrees.

Infants >32 weeks gestation and/or >1500 grams

- Dry the infant and remove wet clothes from the baby.
- Wrap the infant in warm blankets.
- Hat.

Infants <32 weeks gestation or expected to be <1500 grams

- Open the Neowrap™ and lay it down flat on the resuscitaire.
- Lay the wet infant on the Neowrap™.
- Immediately wrap the wet infant from the shoulders down in the Neowrap™ under the radiant warmer. A suggested method of wrapping is shown below.
- Dry the exposed head.
- Place rewarmed hat on head.
- Leave the plastic wrap on and additionally wrap the baby in warm blankets prior to transfer to the nursery.



Neonatal Temperature Ranges

Normal Range

36.5°C - 37.4°C for all infants measured per axilla.

The neonatal temperature is monitored per axilla using digital thermometers. Flank temperatures may be monitored using skin temperature probes.

An infant's core body temperature will generally be higher than the recorded skin temperature, with a difference of ~ 0.5°C in term infants; the difference may be narrower in very preterm or ill infants. If the temperature measured is out of the parameters of the target range, review the infant to establish if the cause is endogenous or environmental.

- **NOTE:** Skin temperature probes may be inaccurate if there is significant peripheral shutdown.

Effects of Rapid Heating/Cooling

Infants are to be warmed or cooled slowly to prevent rapid metabolic changes, vasodilation/constriction and shock.

- Aim to raise or lower the infant's temperature by 0.5°C per hour.
- During cooling or warming the temperature should be monitored continuously with a peripheral temperature probe, if available. If not then check axilla temperature 15 minutely.

- Attach manual infant skin temperature probe to a non- bony area on the infants abdomen or back (this should correlate within in 0.5°C of the per axilla temperature).
- Ascertain the accuracy of temperature probe checking the PA temperature when the probe has reached a stable temperature reading.
- Continuous monitoring can be achieved with a temperature probe. However, frequent evaluation is required with axillary temperature checks every 30-60 minutes to determine temperature is within normal limits.

Admission to Radiant Warmer

The use of radiant warmers is not without risk of overheating and cooling of infants, practices are required to prevent this from occurring. Radiant warmers should be placed in a draft free zone to prevent convective heat loss.

Admission of infants onto a radiant warmer <32 weeks gestation or <1500 grams birth weight

Equipment

- Radiant warmer
- Polyethylene wrap such as NeoWrap™
- Temperature probe
- Hat
- Thermal tunnel
- Plastic sheeting with sticky tape (only for intubated infants)
- Plastic cling wrap
- External humidification unit and tubing (2-3 may be required)
- Hypotonic water for injection (1000 mL bag)

Procedure

1. On admission, weigh the infant using radiant warmer scales. Polyethylene wrap should be left around the infant to reduce heat loss. Refer to [Admission to NICU: Level of Care](#) guideline.
 - **Note:** if no radiant warmer scales present weigh infant in blankets then subtract blanket weight from overall to give infant birth weight.
2. Place the infant on a pre-warmed radiant warmer, with a set of 36.6°C, on infant servo control (ISC).
3. Place a pre-warmed hat on the infant if not already present.
4. Attach the skin temperature probe (ISC) to a non- bony area on the infant abdomen or back or under the axilla.
5. Check the infant's axilla temperature. Ascertain correlation with the skin temperature probe.
6. Humidification is to be provided as quickly as possible when admitted onto a radiant warmer, if the infant is <32 weeks gestation and/or <1500 grams.
7. Set up 2-3 external humidifier units with the base temperatures set at 37°C, each attached to airflow of 10 L/min of air (prior to admission and warmed).
8. Cover the infant with a pre-warmed plastic wrap. Do not cover the head and face unless the infant is ventilated. If necessary a perspex thermal tunnel may be used in addition to the plastic wrap. The wrap may be laid over the tunnel to prevent cooler air circulating around the infant.

- **Note:** plastic thermal tunnels can limit the radiant heat transfer to the infant and therefore require more heat generation from the radiant warmer. Thermal tunnels are only to be used on radiant warmers in conjunction with humidifiers.
9. Position the humidifier tubing so that it directs humidified air inside the tunnel or under the plastic wrap. Never have the humidified air directed straight at the infant as burns may occur, always position it on the opposite side to the face.
 10. Cling wrap can be used to cover the entire warmer if the infant is required to stay on the warmer for any extended length of time. Stretch the plastic cling wrap from one wall of the radiant warmer to the opposite wall. Continue this procedure along the length of the radiant warmer bed until it is completely covered, again only if the infant is ventilated.
 11. Observe the heater output reading to ascertain effectiveness of external humidity. Ideally heater output should be less than or equal to 50%.
 12. Practice minimal handling principles. When access is needed to the infant remove as little of the plastic coverings as possible.
 13. Transfer the infant to an incubator as soon as possible when the admission procedure is completed and the infant is stable.
 14. PA temperature should be checked hourly until within normal limits and documentation should include the infants PA admission temperature along with the heater output, radiant heater set temperature and the temperature probe reading.

Admission of infants onto a radiant warmer >32 weeks gestation or >1500 grams birth weight

Equipment

- Radiant warmer
- Temperature probe
- Hat

Procedure

1. On admission, weigh the infant. Ideally using radiant warmer weighing scales.
 - **Note:** if no radiant warmer scales present weigh infant in blankets then subtract blanket weight from overall to give infant birth weight.
2. Place the infant on a pre-warmed radiant warmer, with a set of 36.6°C, on infant servo control (ISC). Remove the blankets from the infant.
3. Place a pre-warmed hat on the infant.
4. Attach the skin temperature probe (ISC) to a non- bony area on the infant's abdomen or back or under the axilla.
5. Check the infant's axilla temperature. Ascertain correlation with the skin temperature probe.
6. Transfer the infant to an incubator or an open cot as soon as they are stable and their temperature is within the target range. Documentation should include the infants PA admission temperature along with the amount of heater output, radiant heater set temperature and the temperature probe reading.

Omnibed

Omnibed to be used in if available for

1. Critically ill infant
2. Very low birth weight infant
3. Infants requiring easy access

COMFORT ZONE is a guide to setting temperature within the Omnibed

The Comfort zone settings are accessed using the control knob to right of Accessory Control Panel screen.

- Rotate control knob in clockwise direction until “*Comfort Zone*” icon is highlighted.
- Based upon expected birthweight, estimated gestational age, and postnatal age (natal day = day 1), you will see a recommended “*Comfort Zone*” air temperature setting that should be used to pre-warm the closed bed.
- NOTE: Simply enter estimated weight based upon your clinical experience.

Birth weight and gestation	Comfort zone range
<29 weeks or less than 1200g	Upper range increase from 33 to 37.1° C
>1200g	Lower to Middle range of increase from 33 to 34° C

- Using Temperature Control Buttons, adjust the air temperature up or down to the desired temperature (in air mode)
- Exit “*Comfort Zone*” chart by rotating control knob to “*Done/Exit*”.

Depress control knob to return to accessory control panel screen.

Omnibed in admission procedure mode

Baby control mode in the omnibed

- After setting the COMFORT ZONE as above the BABY control MODE should be activated.
- A temperature Probe should be attached to the axilla using a reflective covered temperature probe.
- Press Baby control Mode button the light will illuminate.
- Using the Temperature Control buttons adjust the skin temperature set point up or down to control the set skin temperature at 36.8 per unit policy.

HUMIDITY IN THE OMNIBED from radiant warmer to incubator mode

Key Points: 1250 grams and /or less than 30 weeks gestation.

IMPLEMENTING humidity in the OMNIBED

- Initial set humidity set at 60-70% RH > 70% for ELBW.
- COMFORT ZONE chart as a guide to setting initial temperature prior to baby mode being switched on or use in radiant warmer mode.
- Place a skin temperature probe over a soft non-bony area of the skin. Reflective cover should be placed over the temp probe Correlate with axilla temperature.
- If adjusting the humidity levels in patient control mode consider making these adjustments slowly so that the control algorithm is able to compensate for the changing heat requirements.
- If changing form radiant warmer mode to incubator mode and humidity is in use allow the baby temperature to be stable for an hour prior to hood closure.

- If using air temperature control the COMFORT ZONE should be used. Provide the infants BW GA and Actual age to determine the temperature range in which to nurse the infant.
- A skin temperature probe should be used in air mode to monitor the variations in the infant's temperature. This should correlate with the PA temperature.
- Titrate the humidity according to the infant's needs.
- Hyperthermia in humidity: decrease humidity setting by 5% increments to the minimum of 30%. Allow 30 mins between settings.
- Weaning humidity, reduce the humidity every 12 hrs by 5-10% for 3 days prior to ceasing humidity (2 weeks of age or less depending on skin condition and corrected age).
- Humidity levels within the incubator are the most stable when entry is gained through the port holes. If door access is needed the boost air curtain should be used to minimise loss of humidity and air temperature
- Humidity is provided by sterile distilled water placed in the reservoir approximately every 12-24 hrs.

Incubators

Infants born <32 weeks gestation or <1500 grams are to be placed into a humidified incubator as soon as possible following their admission (aim for less than 4 hours from admission). For ventilated infants it is recommended that these infants are administered their second dose of surfactant inside the incubator.

A skin temperature probe is to be attached to the infant nursed on 'air' mode to reduce the need for handling the infant frequently when temperature control is unstable. The skin probe may be viewed as a guide and enables the nurse caring for the infant to notice any fluctuations in temperature and be proactive in management to preventing cooling or overheating.

All infants nursed in incubators **must wear a hat** as the head is the greatest area of heat loss. Do not remove the hat if the temperature is out of the upper target range. Reduce the incubator temperature by 0.5°C and recheck the PA temperature.

Infants should be observed through the portholes with the incubator sides kept closed to reduce fluctuations in air temperature and creating drafts.

Birthweight and Incubator Temperature Range

Table 1: Neutral Thermal Environment For Infants Day 1 – 5 of Life				
Age	1000 - 1200g +/- 0.5°C	1201 - 1500g +/- 0.5°C	1501 - 2500g +/- 1.0°C	>2500g and >36wk
0 - 12 Hours	35.0	34.0	33.3	32.8
12 - 24 Hours	34.5	33.8	32.8	32.4
24 - 96 Hours	34.5	33.5	32.3	32.0

Table 2: Neutral Thermal Environment For Infants > 5 Days Of Age			
Age	<1500g	1501 - 2500g	>2500g and >36wk
5 - 14 Days	33.5	32.1	32.0
2 - 3 Weeks	33.1	31.7	30.0
3 - 4 Weeks	32.6	31.4	
4 - 5 Weeks	32.0	30.9	
5 - 6 Weeks	31.4	30.4	

Note: Within each range, the younger the infant and/or the lower the infant's weight, the higher the temperature required.

Procedure

1. The humidity and temperature settings should be individually assessed for each infant according to weight, gestation and the temperature recordings during the admission process.
2. Pre warm an incubator to 2 degrees above that required by the infant (remember to adjust after the baby has been placed in incubator).
3. Measure and document infant's PA temperature immediately prior to transferring to an incubator and recheck 30 min after transfer. Set the incubator to the required air temperature in air control mode.
4. If the infant is less than 32 weeks gestation and requiring humidity a temperature probe must be used to provide a guide to infant's temperature. Apply the temperature probe to a non- bony area on the infants abdomen or back or under the axilla and compare PA temp with temperature probe. Once accuracy of skin probe is confirmed, monitor continuously and record hourly. Differences of 0.5°C are acceptable.
5. If the infant's axilla temperature rises above 37.2°C, reduce the air temperature 0.5°C every hour until the infant's temperature falls within the target range.
6. If the infant's temperature falls below 36.5°C, increase the incubator temperature by increments of 0.5°C every hour until the temperature is within the target range. Adjust humidity accordingly. Recheck within an hour of making any adjustments. The temperature probe will provide continuous monitoring during this time.
7. All infants in incubators should be dressed (including a hat), except:
 - Umbilical lines insitu
 - Extreme levels of humidity
 - Poor skin condition
 - Phototherapy
8. Document PA temperature 4 hourly and incubator and temperature probe readings hourly.
9. Incubators must be cleaned daily and changed monthly or sooner if soiled.

Incubator Humidity

- It is recommended that infants' < 27 weeks gestation be commenced in an incubator humidity of 80%. However this should be assessed according to skin integrity, gestational age, CGA and the set temperature requirement of the incubator.
- Weaning of humidity should be alternated with weaning of the incubator temperature until a level is reached that maintains a PA temperature within the target range.

Suggested Values For Balance Of Humidity And Incubator Temperature	
Incubator Temperature	Humidity %
38	80
37	70
36	60
35	50
34	40

- Weaning of humidity should be commenced during the first week of life when the infant is able to maintain a per axilla temperature within the target range. Weaning should commence at 5% intervals over the period of a week to around 50% at the end of the first week of life.
- During the second week of life the humidity can be reduced to 40% and thereafter ceased if the incubator is at or less than 32 degrees. Some infants may require humidity until 2- 3 weeks of age however this should be discussed with a senior nurse.
- Incubator humidity is provided by acetic acid or sterile water; this will depend on the incubator used.

Acetic Acid	Sterile Water
Mainly used in the ATOM incubators. Empty and replace with new acetic acid every 7 days.	Used in Omnibed. Empty water and replace with new sterile water every 24 hours.

Incubator 'Rain Out'

Rain out should not occur. It usually means there is a mismatch between the humidity set and the incubator temperature. See above [Table](#) of suggested settings to avoid rainout. A bubble plastic sheet over the top of the incubator will stop environmental issues that affect the top and walls of the incubator.

Incubator Usage for Phototherapy or Isolation

Phototherapy

- Reduce the incubator temperature by 0.5°C when phototherapy commences.
- Increase the incubator temperature by 0.5°C immediately on completion of phototherapy until the infant can be dressed /graded out of the incubator.
- If the infant's temperature > 37.2°C reduce the incubator temperature by 0.5°C. Infant may need to be transferred into an open cot.
- Do not leave portholes open.
- Do not turn off incubator power.

Isolation

- Depending on the weight and age of the infant the incubator should be set at the appropriate temperature to maintain the PA temperature within the target range.
- Peripheral temperature probes may be used to reduce handling of the infant.
- If overheating occurs with infants in an incubator due to isolation/observation, remove any clothes, turn setting down to minimum.

Grading Out of Incubator

Thermal challenging should take place on a daily basis once the infants PA temperature has remained stable in the target range. Transition from a thermally regulated environment to an open cot can occur if the following criteria are met:

- Birth weight regained and weight gain following a normal curve on the growth chart (average 15-30 grams per day for a healthy preterm infant).
- Weight greater than 1200 grams.
- Parenteral fluids < 50% of total daily fluid allowance.
- Tolerating enteral feeds (intermittent or continuous).
- No apnoea and bradycardias requiring stimulation.
- Incubator air temperature has been consistently 32.0°C or less over a minimum of 24 hour period prior to weaning temperature by reducing 0.5°C each 4-8 hours until the incubator temperature is 29.0°C.

Key Points

- The infant's temperature will increase once he/she has been dressed because of the insulation effect of clothing. It is important that the infant remains dressed and a **hat** left on.
- Energy demands for thermal control take precedence over demands for growth, potentially leading to poor weight gain.
- During the thermal challenge the incubator should **NOT** be turned off and the portholes should **NOT** be left open. It is not possible to control the decrease in incubator temperature in these circumstances causing undue thermal stress for the infant, and having the port holes open is a safety issue.
- Infants nursed in incubators for reasons other than thermal management (such as phototherapy, observation or isolation) can be lifted out of the incubator into an open cot without following these guidelines.

Note: BATHING should not occur until core temperature has been maintained after transition into an open cot for at least 48 hours and the weight is > 1500 grams.

Equipment

- Perspex cot
- Thin mattress
- Sheet
- 1-2 blankets
- Clothing - hat and booties, singlet, top and cardigan (pre-warmed).

Procedure

1. A portable skin probe **may** be attached under the axilla to allow continuous monitoring of skin temperature. If temperature probe is not correlating 0.5°C with axilla temperature - resite the probe.

2. The incubator temperature should be reduced by 0.5°C at intervals of 4-8 hours until reaching a setting of 29.0°C (whilst maintaining axilla temperature in the target range).
3. Once the incubator temperature is 29.0°C the infant should then be dressed and wrapped in cuddly and blankets then placed in a perspex cot away from drafts.
4. Adding or removing of blankets or clothing may be required once transition has taken place in order to maintain temperature in the target range. Skin temperature monitoring may continue for the next 8 hours then cease.
5. Monitor PA temperature with cares 3-4th hourly.

Failing Transition

- If the infant's axilla temperature fails to be maintained in the target range during any of the above steps the procedure should be discontinued and the infant returned to an incubator or overhead radiant warmer in order to regain normothermia. In this case undress infant and remove blankets.
- Other signs of unsuccessful transition include vomiting, apnoea and bradycardia and weight loss after transition.
- The incubator temperature should be set at the last setting tolerated before transition commenced.

Heated Mattress / Cosy Therm[©]

The heated mattress is an external conductive heating device used for maintaining warmth for infants requiring thermoregulatory support. It can aid transition from an incubator to open cot for those infants who are more at risk of developing hypothermia.

- **Note:** It is **not** to be used as a re-warming device for infants who are hypothermic. These infants should be returned to an incubator or placed under an overhead warmer until they have rewarmed.

Temperature selection of the heated mattress is manual and is adjusted to deliver the required set temperature to maintain normothermia. It has an inbuilt pressure relief to reduce the risk of pressure injury to the infant.

Inclusion Criteria

- Birth weight regained and weight gain is following a normal curve on the growth chart (average 15-30 grams per day for a healthy preterm infant).
- Weight greater than 1200 grams.
- Parenteral fluids less than or equal to 50% of total daily fluid allowance.
- Tolerating full enteral feeds (intermittent or continuous).
- No apnoea and bradycardias requiring stimulation
- Incubator air temperature has been consistently 30.0°C or less over a minimum of 24 hour period prior to weaning temperature by reducing 0.5°C each 4-8 hours until the temperature is 30.0°C.
- Infants dressed (hat, singlet, top and nappy) in an incubator and maintaining axilla temperature with the incubator temperature set at 30.0°C.

Nursing Care of Infants on a Heated Mattress

1. Set heated mattress at 37.0°C and place a thin cotton sheet over mattress. Ensure the perspex cot is in a draft free area of the nursery.

2. Infant should be fully dressed (vest, top, cardigan, bonnet and booties). Jump suits may be used if the infant is likely to cool during cares and feeds.
3. Nurse the infant on the mattress then cover the infant with cuddly and blanket (do not swaddle as this will inhibit the heat transfer to the baby).
4. A skin temperature probe is recommended to observe sudden changes in the infant's temperature. This should be sited and correlated with PA temperature prior to transferring to the heated mattress.
5. Post-transfer, take PA temperature at 30 minutes. The mattress temperature should be adjusted every 30 minutes +/- 0.5°C in response to the infant's temperature readings.
6. Continue to record axilla temperature every 30 minutes for 2 hours.
7. If normothermia is maintained for 2 hours then temperature is monitored as standard with routine cares/feeds.

Failure to Maintain Normothermia

The mattress temperature may be increased 0.5°C every 30 minutes until reaching 38.5°C, if the PA temperature remains < 36.5°C but > 36.0°C for four consecutive readings then the infant should be placed back in an incubator for at least 24 hours.

Infants must be returned to the incubator at any time the PA temperature is < 36.0°C or if their clinical condition deteriorates.

Weaning from the Heated Mattress

- Reducing the mattress temperature setting should commence when infant's PA temperature is stable and has remained within normal limits for 3-4 hours.
- Reduce the mattress temperature by 0.5°C 3-4 hourly with feeds/cares as tolerated until the mattress setting is 35.0°C.
- Once the infant is maintaining PA temperature at > 37.0°C for 3-4 hours the heated mattress can be removed from the cot and replaced with standard thin mattress.

Open Cot

Infants nursed in open cots are to be dressed according to individual needs.

Fully dressed includes	Vest Top +/- Grow suit Cardigan Bonnet Booties	Wrapped in cuddly Blanket over the top
Order to reduce clothing as thermoregulation improves	1. Cardigan	*Leave top on
	2. Grow suit if used	
	3. Vest*	
	4. Booties	
	5. Bonnet	
Minimally dressed includes	Top and nappy	Wrapped in cuddly/ or cuddly over the top.

Note: Infants in the neonatal unit **do not** require to be attached to a monitor (if clinically not warranted) if wearing a bonnet.

By discharge home infants should be maintaining their temperature without a bonnet complying with SIDS guidelines.

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Related WNHS policies, procedures and guidelines

Neonatal Clinical Guideline – [Admission to NICU: Level of Care](#)

Document owner:	Neonatal Directorate Management Committee		
Author / Reviewer:	Neonatal Directorate Management Committee		
Date first issued:	June 2006		
Last reviewed:	13 th February 2018	Next review date:	13 th February 2021
Endorsed by:	Neonatal Directorate Management Committee	Date endorsed:	27 th February 2018
Standards Applicable:	NSQHS Standards: 1  Governance		

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