



GUIDELINE

Thermoregulation

Scope (Staff):	Nursing and Medical Staff
Scope (Area):	NICU KEMH, NICU PCH, NETS WA

Child Safe Organisation Statement of Commitment

CAHS commits to being a child safe organisation by applying the National Principles for Child Safe Organisations. This is a commitment to a strong culture supported by robust policies and procedures to reduce the likelihood of harm to children and young people.

This document should be read in conjunction with this [disclaimer](#)

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Aim

Outline the management of neonates in relation to thermoregulation.

Risk

When thermoregulation is mismanaged, an infant is at risk of being compromised by thermal stress. In extreme cases this can lead to further deterioration of morbidity and thus higher risks of mortality.

Key Principles

Neonatal Temperature Ranges

Normal Range is **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 available, then check axilla temperature 15 minutely.
- Attach manual infant skin temperature probe to a non- bony area on the infant's abdomen or back (this should correlate within in 0.5°C of the per axilla (PA) temperature).
- Ascertain the accuracy of temperature probe checking the axilla 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.

Preventing Heat Loss at Birth

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

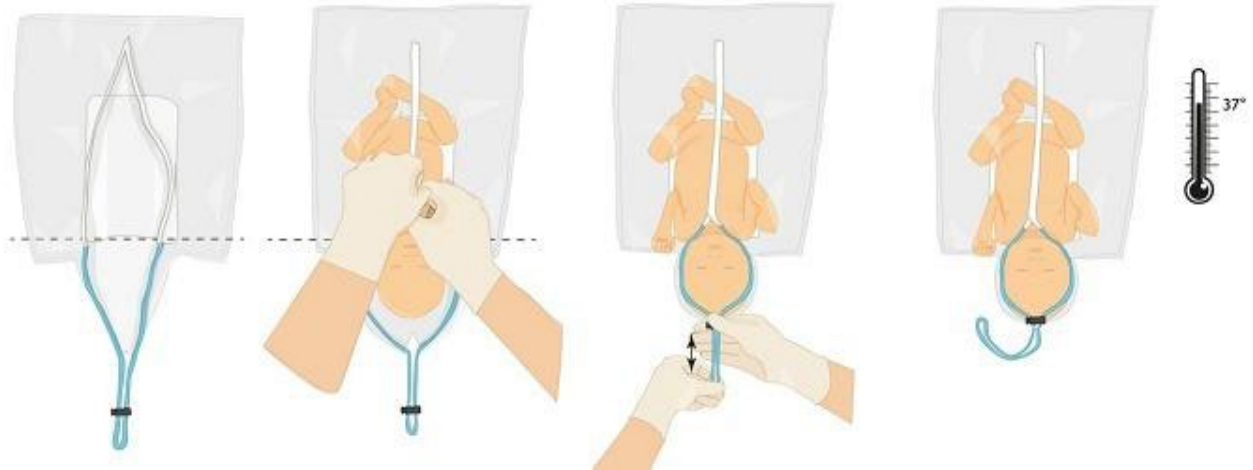
Infants >37 weeks gestation and not low birth weight

- Dry the infant and remove wet wraps.
- Wrap the infant in warm blankets.
- Place warmed hat on head.
- All infants of >37 weeks gestation if requiring resuscitation at birth are to have a Neowrap™ placed over the body (or wrapped in Neowrap™).
- Check axillary temperature for prolonged resuscitation/stabilisation prior to transfer to SCN (if low address this with adjunct i.e: Shuttle/Neowrap™/ new warm blankets).
- If infant is having delayed cord clamping after LUSCS in the sterile field, then a Neowrap™ can be used to cover the infant during this time (always use sterile towel to move infant to resuscitaire).

Infants <37 weeks gestation or low birth weight

- Allocate a staff member to thermoregulation control.
- Ensure temperature of theatre and in delivery room 1-7 set to 25 degrees.
- USE NEOHELP™ for all <37 or LBW
 - Sizes <1kg and 1-2.5kg available
- In theatre
 - Open Neohelp™, prepare a small hole for the right hand to apply oxygen saturation probe with sterile scissors and place the bag in the operative field to allow the infant to be placed in the bag to allow for delayed cord clamping (if baby breathing and vigorous)
 - Sizes <1kg and 1-2.5kg available.
- In delivery room
 - Open Neohelp™ and lay it down flat on the resuscitaire, prepare a small hole for the right hand to apply oxygen saturation probe then take the bag to the midwife/Obstetric delivery team so the infant can be placed in the bag during delayed cord clamping on mother's abdomen
- Draw the string around the infant's head and close the Velcro with the umbilical cord and clamp external to the bag.
- Bring the right hand OUTSIDE the Neohelp in the small hole that has been pre-made for placement of oxygen saturation probe.

- Always transfer infant in a Neohelp™ within a blanket to avoid slipping in transfer
- If Neohelp™ unavailable the NeoWrap™ can be used with a knitted hat.



- Prior to transfer measure the infant's temperature and if not in the normal range address this prior to transfer.
 - If hypothermic (<36.5) chemical blanket should be applied,(Ensure mattress is placed white side up and **with a blanket between** the mattress and baby if not available fresh warm blankets should be used.
- Shuttle is to be used for transfers to nursery. If shuttle not available utilise fresh warm blankets for transfer and on arrival to nursery plug the resuscitaire in so the heater can emit heat whilst preparing to transfer the baby to a neonatal bed.

Extra measures for <25 weeks if Code LUSCS or SVD (i.e if environment temp <25° C)

- Use a thermal transport mattress if no contraindication (i.e maternal fever).
- Ensure mattress is placed white side up and **with a blanket between** the mattress and baby (still use Neohelp™).
- Take thermometer to theatre in order to check infant's temperature if mattress is used for >15 minutes.

Admission to the Nursery

On admission transfer infant to a radiant warmer or Omnibed, depending on the infant's gestation and/or acuity. Refer to [Handover and Transition to the Neonatal Unit guideline](#).

Radiant Warmer

The use of radiant warmers is not without risk of overheating and/or cooling of infants. Radiant warmers should be placed in a draft free zone to prevent convection heat loss.

Admission of infants onto a radiant warmer <32 weeks gestation or <1500 grams birth weight	
Equipment	
• Radiant warmer with temp probe • Polyethylene wrap such as NeoWrap™ • Hat	• 1x External humidification unit and tubing (2 only in the case of extended procedures, occurrence of temperature instability or neonatologist request) • Hypotonic water for injection (1000 mL bag) – for external humidification unit
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 KEMH and PCH and Handover and Transition to the Neonatal Unit. 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 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 Neowrap™. Do not cover the head and face unless the infant is ventilated. 9. Position the humidifier tubing so that it directs humidified air over the mattress. 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. Observe the heater output reading to ascertain effectiveness of external humidity. Ideally heater output should be less than or equal to 50%. 11. Practice minimal handling principles. When access is needed to the infant remove as little of the plastic coverings as possible. 12. Per axilla (PA) temperature should be checked hourly until within normal limits and documentation should include the infants PA admission temperature along with the radiant heater set temperature and the temperature probe reading. 13. Transfer the infant to an incubator as soon as possible when the admission procedure is completed, and the infant is stable.	

**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 using radiant warmer weighing scales.
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 infant's axilla admission temperature along with the amount of heater output, radiant heater set temperature and the temperature probe reading.

Omnibed

The Omnibed is to be used for any:

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

The COMFORT ZONE

A guide to setting temperature within the Omnibed

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

- 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 the touch screen or Temperature Control Buttons, adjust the air temperature up or down to the desired temperature (in air mode).
- Exit “*Comfort Zone*”, if no touch screen - Depress control knob to return to accessory control panel screen.

Omnibed in an Admission

Baby control mode (servo) in the Omnibed

- After setting the COMFORT ZONE, as above, the BABY control MODE should be activated.
- Identify the position of where the temperature probe should be placed. Clean skin with sterile water and when skin area is dry place a piece of Sil-Flex fixation tape and set with gentle pressure until tape is adhered.
- A temperature probe is placed onto the Sil-Flex tape using a reflective covered temperature probe.
- Select Baby Control Mode via the touch screen or button.
- Using the touch screen or temperature control button 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

Transitioning from radiant warmer mode to incubator mode to implement humidity for infants 1250 grams and /or less than 30 weeks gestation.

- Initially, set humidity at 60-70% RH > 70% for ELBW.
- Use the COMFORT ZONE chart as a guide to set 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 can 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 requirements.
- Hyperthermia in humidity: decrease humidity setting by 5% increments to the minimum of 30%. Allow 30 mins between changes in 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 required, 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

If infants born <32 weeks gestation or <1500 grams, are not able to be initially admitted into an Omnibed, they are to be placed into a humidified incubator as soon as possible; aim for less than 4 hours from admission. It is recommended that ventilated infants are administered their second dose of surfactant in 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 drafts.

Birthweight and Incubator Temperature Range

Within each range, the younger the infant and/or the lower the infant's weight, the higher the temperature required (guide for when Omnibed is not available or indicated)

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	

Transferring Infant from Warmer to Incubator

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 infant's 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 in-situ
 - 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 fortnightly 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.

FiCare, Handling and Incubators

Even though an infant may be in an incubator or an Omnibed, skin to skin cuddles with parents are still encouraged. It is important to maintain a neutral temperature zone in the incubator while the infant is on their parent or being handled.

- If an infant is on ISC before removing infant from incubator, set the incubator to air control. The temperature should be set to the level of degrees Celsius that was needed to keep the infant normothermic before removal.
- When an infant requires handling or cares, ISC should be switched to air control mode. Set the temperature to the degrees Celsius required before the cares commence. On completion of cares or handling, ISC should be reinstated.

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 with no intravascular devices. See [Skin Care guideline](#) for further information about bathing and hygiene.

Transition from Incubator to Open Cot	
Equipment	
• Perspex cot • Thin mattress • Sheet	• 1-2 blankets • Clothing - hat and booties, vest, top and cardigan (pre-warmed).
Procedure	
1. 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). 2. 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. 3. 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. 4. 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 feed intolerance, 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, vest, 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 infant with cuddly and blanket (do not swaddle as this will inhibit the heat transfer to the baby).
4. Monitor temperature by using a skin temperature probe and physiological monitor (i.e. MP50) 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. Otherwise remove skin temp probe.
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.		

Clothing

Parents are to be included in the choice of clothes for the infant to wear from the clothing provided by the hospital.

Parents may bring clothes in for their infant to wear if their infant is clinically stable (including those on CPAP and HHF).

The clothing and infant needs to be approved by the CNC for the area and documented in patient notes. Parents must be informed that the clothes may become lost if the clothes are inadvertently put into the hospital laundry.

Suitable clothes must have:

- Fasteners on the front.
- Hands and feet of the baby uncovered by the clothes.

And the clothes cannot require excessive manipulation of the limbs or over the head application.

Related CAHS internal policies, procedures and guidelines

[Admission to NICU KEMH and PCH](#)
[Handover and Transition to the Neonatal Unit](#)
[Skin Care](#)
[Skin to Skin Holding](#)
[Ventilated Neonate: Care of](#)

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This document can be made available in alternative formats on request.

Document Owner:	Neonatology		
Reviewer / Team:	Neonatology Coordinating Group		
Date First Issued:	June 2006	Last Reviewed:	September 2023
Amendment Dates:	Amended Sept 23, details added for checking axilla temp in prolonged resus/stabilisation prior to transfer Amended Nov 2024, details added regarding bathing, and reference to skin care guidelines. Included infant clothing from Cares, Hygiene and Clothing guideline.	Next Review Date:	25 th October 2025
Approved by:	Neonatology Coordinating Group	Date:	19 th December 2024
Endorsed by:	Neonatology Coordinating Group		
Standards Applicable:	NSQHS Standards:  Child Safe Standards: 1,10		
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 Healthy kids, healthy communities CompassionExcellenceCollaborationAccountabilityEquityRespect Neonatology Community Health Mental Health Perth Children's Hospital			