Clinical Performance Guideline
Neonatal Resource Services
Thermoregulation

Purpose: To explain the importance of the principles of thermoregulation in the NICU.

Target Client Population: Any neonate in the NICU; however, these guidelines are applicable to those neonates who are at least 32 weeks gestational age and require assistance in maintaining their neutral thermal environment.

| Background | Control of thermoregulation is one of the critically important factors in physiological maintenance of the neonate in the NICU. The normal axillary temperature in an open crib with appropriate clothing is 36.5-37.4°C (97.7-99.3°F). (Engle, 2007; Riley, 2012) Heat loss in the neonate, especially the very small premature neonate, is due to the properties of the skin, low insulation (i.e., fat), high evaporation and limited ability to vasoconstrict. Importantly, the body surface area is high in relation to weight in the neonate; a factor that significantly facilitates heat loss in this group. Maintenance of thermoregulation in the neonate involves reducing one or more of the four mechanisms of heat loss; convection, conduction, evaporation and radiation. The use of an incubator/radiant warmer to facilitate maintenance of a thermoneutral environment is routine practice in the NICU until the neonate is able to maintain his/her own thermoregulatory control. An environmental temperature of 22-26°C (72-78°F) will assist this transition to an open crib. (Riley, 2012) Isolated weight loss is not an indication to place an infant back in an incubator. For infants placed back into the incubator, a repeat trial of weaning to an open crib should be considered within 24 hours if parameters for weaning continue to be met. An evaluation of the NICU environment (temperature and physical location near sources of heat loss) and/or medical reasons for crib failure should be considered. |
| Treatment Criteria | Clinical evidence supports the following in neonatal thermoregulation: -The neonate should be weaned from the incubator or radiant warmer when the following parameters have been met:  
  - When the incubator temperature is less or equal to 28 degrees C.  
  - When the neonate’s physiological status (ability to self-regulate temperature) is demonstrated and not based on the neonate’s actual weight, corrected gestational age or attainment of full oral feedings.  
  - When the neonate has a consistent weight gain of 10-15 g/kg/d in the incubator, if this is expected based on the infant’s gestation and corrected gestational age.  
  - When the neonate shows evidence of cardiovascular stability (i.e., stable vital signs).  
- Infants have the ability to begin successful incubator weaning as early as 1500 grams without adversely affecting or sacrificing weight gain. (Medoff-Cooper, 1994; |
Meier, 1994; West, 2005)
- Crib failure leading to placement back in an incubator should be based on axillary temperature measurements less than 36.5°C (97.7°F) while appropriately dressed and bundled. (Engle, 2007; Riley, 2012)
- Weaning from a thermoregulated environment should occur prior to achieving full enteral feeds. This proactive approach has been shown to reduce LOS.
- The use of servo temperature control™ during weaning would be considered the preferred method. Servo temperature control is an electronic feedback system which functions as a thermostat to maintain a constant temperature at the site of the probe, usually on the skin over the abdomen, to maintain a constant abdominal skin temperature at 36C - 36.5C, thereby reducing the risks of cold stress or overheating.

There is insufficient clinical evidence to support the theory that infants will not gain weight at the same trajectory when in a crib compared to an incubator. (Schneiderman, 2009)
There is insufficient clinical evidence to support weaning the infant from the incubator or radiant warmer for any other indication.

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<th>Clinical Evidence</th>
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<td>- A meta-analysis by the Cochrane Neonatal Collaborative Review Group (1998, 2002 and 2008), included data from two randomized/quasi randomized clinical trials in which servo-control of the abdominal skin temperature at 36C was measured against incubator air temperature at 31.1-32.2C. The findings showed that by keeping the baby’s temperature at 36C by servo-control reduced the newborn death rate in low birth weight babies rather than setting a constant incubator temperature of 31.8C.</td>
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<td>- A retrospective nonrandomized study by Schneiderman et al (2009), found that on average for every additional 100 g an infant weighed at an open crib was associated with an increase in time to achieve full PO feeding by 0.8 days, a decrease in weight gained per day by 1 g and an increased LOS by 0.9 days.</td>
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<td>- A prospective randomized clinical trial by Zecca et al (2010) studied infants who transferred from an incubator to an open crib at 1600 g versus 1800 g. The authors concluded that weaning moderately premature infants at a body weight of 1600 g versus 1800 g was safe and reduced the average length of stay (LOS) by 9.5 days. The trial noted that the time spent in the open crib was the same for both groups. The infants in the early transfer group did not require more time to achieve full feeding competency, and the breast feeding amount was similar to that in the standard transition group. The authors did note that future trials should replicated the findings with more preterm infants.</td>
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<td>- A multicenter randomized controlled trial reviewed by New et al (2012), reached a similar conclusion. The authors concluded that medically stable infants can be transferred to open cots at a birth weight of 1600 g without any significant adverse effects on temperature stability or weight gain. However, this study noted that an earlier transfer to an open cot did not necessarily result in a shortened LOS. A possible explanation as to why the LOS was not impacted was that achieving full oral feeds had more influence on the timing of discharge. It was noted that the feeding milestone is one of the last milestones to be achieved by preterm infants born less than 32 weeks.</td>
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• Another randomized clinical trial regarding weight at weaning preterm infants from the incubator conducted by Berger, et al (2013), came to the same conclusions that weaning very low birth weight infants from an incubator to a warming bassinet at a body weight of 1500 g is feasible with no significant deleterious effects on weight gain or resting energy expenditure.

• Meier (1994) provided an overview of the existing literature on thermoregulation in preterm infants as part of the research committee for the Association of Women’s Health, Obstetric, and Neonatal Nurses (AWHONN). Although the literature did not define a minimum weight for weaning eligibility, an approximate weight of 1,500 grams was determined to be appropriate based on institutional thermal challenge protocols.

• An observational trial by West et al (2005) attempted to determine whether premature infants could be safely weaned from an incubator to an open crib at a bodyweight of 1,500 grams. Sixty-one infants with a birthweight <1,500 grams were divided into four cohorts and the thermal weaning process was initiated when each cohort reached a targeted weight of 1,500 grams (n=15), 1,600 grams (n=16), 1,700 grams (n=16) and 1,800 grams (n=15) respectively. No differences in temperature control were noted between the cohorts and only three infants overall needed to be returned to the incubator (one in the 1,700 g cohort, two in the 1,500 g cohort). There were no hypoglycemic episodes or medical complications in the three infants that failed transfer. The rate of weight gain did not differ between the four cohorts and both gestation and weight were similar at discharge.

• An AAP clinical report by Engle et al (2007) provided guidelines for the evaluation and management of the late-preterm infant. The authors described a late-preterm infant as physiologically immature and more likely than a term infant to be diagnosed with temperature instability. Minimum discharge criteria should include an axillary temperature of 36.5-37.4°C (97.7-99.3°F) while in an open crib appropriately clothed.

• Schafer et al (2014) evaluated the accuracy of skin sensor placement in the assessment of neonatal body temperature. Skin sensors were placed on the right upper abdomen, left flank and right axilla of 36 hemodynamically stable neonates. Digital axillary temperatures from the left axilla were compared to the three skin sensor sites in the supine placed neonates. The authors found no statistically significant differences in temperature between the skin sensor locations. In addition, the differences between the skin sensor readings and the digital axillary temperature were also not found to be significant.

• A feasibility study by Barone et al (2014) evaluated early weaning from an incubator to an open crib at 1,600 grams. Eighty neonates successfully transitioned to an open crib when their weight registered between 1,600 and 1,699 grams without any adverse effects related to temperature stability or weight gain. Twenty-one neonates transferred from an incubator at a weight of ≥ 1,700 grams and the need for respiratory support was identified as the main reason for delayed weaning. A significantly reduced length of stay was associated with the early weaning.

• New et al (2011) analyzed the data on preterm infants’ body weight as they transitioned from incubators to open cribs. Four randomized/quasi-randomized studies met the authors’ inclusion criteria comparing infants transferred to
open cribs at higher versus lower body weights. After analysis of these trials, the authors concluded that medically stable preterm infants of 1,600 grams could be transferred to an unheated open crib without any detrimental effects on temperature stability or weight gain.

**Bibliography**


Riley LE & Stark AR, editors; AAP Committee on Fetus and Newborn and ACOG Committee on Obstetric Practice. Guidelines for Perinatal Care, 7th ed. 2012.


**Revision History**

The following are approved changes incorporated into the revision numbers indicated below.

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description of Change</th>
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<tr>
<td>1.0</td>
<td>05/16/2013</td>
<td>New guideline (MB)</td>
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<tr>
<td>2.0</td>
<td>05/01/2014</td>
<td>Job aid revised into medical necessity clinical guideline. (LK)</td>
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<tr>
<td>3.0</td>
<td>05/03/2015</td>
<td>Annual review with update by RS. (CE)</td>
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<tr>
<td>3.1</td>
<td>05/05/2016</td>
<td>Annual review with update by RS. No changes to criteria. (CE)</td>
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