

Clinical Guideline: Management of a baby < 30 weeks gestation requiring humidity

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For use in: EoE Neonatal Units
Guidance specific to the care of neonatal patients

Date of Ratification: September 2025

Review due: September 2028

Registration No: NEO-ODN-2025-15

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Scope

For use in neonatal units in the East of England

1. Aim

- To reduce high levels of transepidermal water loss (TEWL) and maintain/stabilise electrolyte/fluid status and body temperature in the optimal range (36.5-37.5°C) for infants <30 weeks gestation.

2. Background

In utero, a baby's skin begins to keratinise from 18 weeks gestation onwards, until becoming effective by around 34 weeks gestation (Modi, 2004). This, in addition to thinner epidermis layers, a reduction in the elastin fibres, and a lack of cohesion between the stratum corneum and dermis layers (which make up the epidermis) makes a baby's skin less able to protect against TEWL and less effective in thermal management (Kilby et al, 2020).

After birth the skin of preterm babies is exposed to a dry environment and has been seen to mature rapidly. So that by 2-3 weeks after birth (regardless of their gestation) the neonate's skin functions like that of a term baby.

During this period of 'adaptation' health professionals caring for premature babies have the challenge of trying to prevent heat loss and minimize TEWL. One method commonly used is to heat and humidify the environment in which the premature infant is nursed, known as environmental humidification (EH).

However, nursing babies in EH has been shown to slow the natural process of epidermal barrier formation, as well as a possible increase in incidence of infection (Karlsson et al, 2012, cited in Glass & Valdez, 2021).

Consequently, the challenge for health professionals is to balance these needs, and among babies of different gestations, who have different EH requirements.

Recent changes in NLS guidance (Fawke et al, 2021) have stated the need to use a plastic wrap at birth for all babies < 32 weeks gestation (previously < 30 weeks). However, the consensus among East of England ODN Neonatal experts was the not change the gestation of babies receiving EH from those < 30 weeks.

3. Reasons for Humidity

- Humidity reduces skin water loss, limiting TEWL - helping maintain serum sodium levels.
- Humidity improves temperature maintenance, as infants can become hypothermic even when nursed under radiant heat if the relative humidity is low (Jones, 2020)
- Humidity can reduce the energy used to maintain normothermia, as heat loss may otherwise occur through evaporation
- Prevent drying of the skin
- Reduce maximum overall weight loss (Sung et al, 2010)

4. Care of the baby

- Infants less than 32 weeks gestation who are delivered into a polyethylene wrap (as per NLS guidance) should remain in the wrap until central lines placed and set percentage of humidity is reached. This prevents heat loss and limits TEWL.
- Ensure that the room temperature around the incubator is warm and that draughts are limited

- The infant should be nursed in a double walled incubator, to help reduce heat loss by radiation and conduction - if an infant is admitted to an open warmer they should be transferred to a closed incubator as soon as possible
- Identify that the incubator allows humidity & ensure familiarity of user with manufacturer's instructions
- The temperature of the incubator/radiant warmer should be sufficient to create a neutral thermal environment (at least $>35^{\circ}\text{C}$)
- Obtain sterile water for humidity to prevent colonisation by bacteria. The chamber should be filled with this water. Tap water must **never** be used.
- Keep the incubator doors shut as much as possible and use portholes and the air boost function. Encourage parents to do the same if they are accessing their baby in the incubator.
- Assess the infant's need for humidity according to their gestation, postnatal age and maturity of the skin, current sodium levels and their ability to maintain their temperature at a normal range ($36.5\text{-}37.5^{\circ}\text{C}$) with minimal fluctuations
- The baby should be nursed in a nappy and no other clothing, blankets or developmental care aids which cover the baby, such as Zaccy hands. Bonding squares use should continue to be encouraged
- Ensure that the water chamber is kept full. The chamber should be emptied, washed, dried and refilled once in 24 hours (as per manufacturer's guideline)..
- Remember that the TEWL is going to be greatest in the first few days after birth and as the functioning stratum corneum develops this loss will decrease

Monitoring of the baby:

- Electrolyte, including sodium, levels should be checked 6-12 hourly for the first 72 hours, then 12-24 hourly thereafter. Gas sodium levels can be used to monitor trends, but must be validated with serum sodium
- Daily weight of baby checked
- Daily urine analysis should be checked
- If the serum sodium levels are high, it may be necessary to increase the humidity as an adjunct to medical decisions about fluid increase and sodium decrease
- Fluid intake and output should be recorded, and imbalances escalated and acted upon
- Nappies should be weighed to assess urine output. Humidity should not affect the wetness of the nappy.

- Skin temperature should be recorded continuously with a skin probe and axilla temperatures taken and recorded at least 4-6 hourly. If axilla temperature is unstable check every 2 hours. These measurements may need to be more frequent if clinically required.
- TEWL can increase during delivery of phototherapy (Jones, 2020). This will require closer monitoring of electrolyte levels and consideration for fluid replacement
- A skin integrity risk assessment tool should be carried out at the frequency required as per EoE ODN Skin Integrity or local guideline
- Monitor for, and consider swabbing any areas of skin showing signs of infection as environmental humidity increases the risk of infection

Ongoing care:

- Leads/probes, ET fixings and other monitoring may need replacing frequently, if the humidity levels cause loss of adhesion
- The incubator should be changed and cleaned according to the manufacturer's instructions and Infection control recommendations.
- Skin to skin with parents should not be avoided in favour of nursing the baby in a humidified environment (Karlsson et al, 2012, cited in Glass & Valdez, 2021)
- Once humidity has been discontinued the infant should continue to be nursed in the incubator until ready to move into an alternative hot cot/cot as per thermal management and developmentally supportive care requirements
- If there are problems maintaining the infant's temperature, consider:
 - Ensure the temperature probe is secured properly
 - Check baby's axilla temperature to confirm the skin probe is correlating
 - Ensure that the bedding has not become damp or wet from condensation
 - Increase or decrease incubator temperature accordingly and recheck axilla temperature in 30 minutes
 - Consider infection and other causes of temperature instability
 - Inform medical team
 - **Increasing (for low temperature) or decreasing (for high temperature) the humidity should be the last choice and only done after consultation with a senior member of the medical and nursing team**

5. Suggested protocols

Although high humidity will reduce the large evaporative water losses through the skin, it may also result in a slower rate of skin barrier formation as compared with lower humidity. Consequently, very high ambient humidity should only be used during the initial period with extremely high TEWL, that is, as long as it is needed to maintain an adequate fluid balance.

A gradual reduction of incubator humidity **after** the first postnatal week for babies less than 28 weeks, will allow for a higher TEWL, while promoting skin barrier formation. Maturation of the skin can be linked to gestational age with significant structural changes around 28-30 weeks gestation, potentially improving barrier function (Reed et al, 2021). For babies above 28 weeks gestation it is acceptable to commence weaning humidity after 48 hours. It has been suggested that a Relative Humidity (RH) of 50% was of greater advantage than a RH of 75% from the second postnatal week (Argen et al, 2006). Because experimental studies have shown that an abrupt and large decrease in ambient humidity might lead to abnormal skin barrier function, it is strongly recommended that changes in environmental care conditions for preterm infants should always be gradual and carefully monitored and that extremely low humidity should be avoided.

There is a paucity of strong evidence recommending humidity levels in the more extreme preterm population due to the small numbers being born. Looking at Insensible water loss (IWL) by gestational age suggests babies born <24 weeks have the highest IWL. Those above 24 weeks were comparable to babies born at 26 weeks (Sung et al, 2013). A study by Kurimoto et al, (2022) looked at incubator humidity in babies born at 22-23 weeks, supports the need to give higher incubator humidity to this group of babies.

Babies < 23+6 weeks gestation	Babies 24 - 27+6 weeks gestation	Babies 28 - 29+6 weeks gestation
1) Commence humidity at 90% 2) Reduce to 85% after 24 hours then to 80% on day 4 if temperature remains stable 3) If temperature and fluid balance stable on day 6, begin to wean by 5% each day 4) Discontinue incubator humidity when 40% is achieved or at 21 days (whichever is reached first).	1) Commence humidification at 80% 2) Maintain humidification at 80% for first 7 days 3) If temperature and fluid balance stable on day 6, begin to wean by 5% each day. 4) Discontinue incubator humidity when 40% is achieved or at 21 days (whichever is reached first).	1) Commence humidification at 80% 2) If temperature and fluid balance stable after 48 hours, begin weaning by 5% each day 3) Discontinue incubator humidity when 40% is achieved

The table below suggests a protocol for starting and weaning humidity in an incubator. It is based on recent evidence on

Age (days)	Humidity (%)		
	Babies < 23+6 weeks gestation	Babies 24- 27+6 weeks gestation	Babies 28 - 29+6 weeks gestation
0	90	80	80
1	85	80	80
2	85	80	75
3	85	80	70
4	80	80	65
5	80	80	60
6	80	80	55
7	75	75	50
8	70	70	45
9	65	65	40
10	60	60	Discontinued
11	55	55	-
12	50	50	-
13	45	45	-
14	40	40	-
15	Discontinued	Discontinued	-

6. Audit

Audit will be through annual benchmarking activity and consequent action planning using infant's charts and care plans to assess quality outcomes and guideline adherence. Poor scores may necessitate more frequent audits to ensure progress is being made.

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Appendix A: Parent Information

Incubator Humidity – Information for parents

When a baby is born prematurely, their skin needs to continue to develop, which takes about two weeks for most babies, regardless of how prematurely they have been born.

Babies born below 30 weeks gestation are particularly vulnerable to losing heat and fluid through their skin, by evaporation, within this first two weeks.

Incubator Humidity or Environmental Humidity (EH) consists of sterile, warm water vapour within the incubator which helps to reduce this evaporation. It is added to the incubator via a chamber at the top end of the incubator, using bottles of sterile water.

The amount of EH your baby receives is set as a percentage on the incubator settings and is weaned down during the two weeks. Your baby will have some blood samples taken to check their salts (electrolytes) levels, which can be affected by fluid loss. You will be supported to provide comfort for your baby during these, and we will do this if you are not able to be with your baby when the blood samples are taken. Your baby's nappies will be weighed when they are changed so we can monitor how much urine they are passing – please check with the Neonatal nurse if you need to keep the nappy for them if you are changing your baby's nappies.

You can still care for your baby whilst they are receiving EH, and it is still extremely beneficial to have skin-to-skin with your baby during this time. Speak to the Neonatal nurses looking after your baby about this.

EH escapes from the incubator when the sides are taken down. To reduce this, try to use the port holes with the “air curtain” when you reach into the incubator to touch your baby.

Your baby will be nursed in a nappy only in their incubator, with no clothes. They will have monitoring electrodes/probes on their skin, but the EH can reduce the stickiness of these. Ask the Neonatal team caring for your baby about these if you would like more information.

EH can increase the risk of infection, as it keeps the environment warm and moist. To reduce this risk, always wash your hands before placing them in the incubator. You will also be asked not to have soft toys etc in the incubator with your baby. Ask your Neonatal nurse about comfort squares to use in the incubator for you and your baby to swap scents – this can help comfort them, and you, and can help with milk production if you are expressing milk for your baby.

Please ask if you have any questions or worries about your baby receiving humidity.

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