

THAMES VALLEY & WESSEX NEONATAL OPERATIONAL DELIVERY NETWORK

Nursing Guideline for Environmental Humidification on the Neonatal Unit.

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| Related documents | <p><u>References</u> Agren,J Sjors.G and Sedin G (2006) Ambient humidity influences the rate of skin barrier maturation in extremely preterm infants, <u>The Journal of Pediatrics</u>, Vol 148, no 5, pp613-7.</p> <p>ASPH (2017) Environmental Humidity. Neonatal Intensive Care Unit, Clinical Guideline, Ashford and St Peter’s Hospital NHS Trust. Found at www.asph.mobi/guidelines</p> <p>Boyd.H et al (2017) Care of 500-1500 gram premature infants in hybrid incubators. <u>Advances in Neonatal Care</u>, Vol 17, no 5. pp381-389.</p> <p>EoE (2020) Clinical guideline: Management of a baby requiring Humidity Version 2.0. Found at; https://www.eoneonatalpccsnetwork.nhs.uk/neonatal/downloads/humidity-guideline-benchmark/</p> <p>Fanaroff, A.A Fanaroff, J.M. (2013) <u>Klaus and Fanaroff’s Care of High-Risk Neonate</u>. (6th ed). Philadelphia: Elsevier Saunders.</p> <p>Gaylord.M and Lynam .L (2001) Improved fluid management utilising humidified microenvironments in the extremely low birth weight infants. <u>Journal of Perinatology</u> Vol 21, pp438-43.</p> <p>Glass, L. and Valdez, A (2021) Preterm Infant Incubator Humidity Levels: A systemic Review. <u>Advances in Neonatal Care</u>, 21(4), 297-307.</p> |

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| <p>Implications of race, equality & other diversity duties for this document</p> | <p>This guideline must be implemented fairly and without prejudice whether on the grounds of race, gender, sexual orientation or religion.</p> |

Guideline Framework for Environmental Humidification

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1.0 Aim of Guideline Framework

This guideline has been produced to direct staff in their care of neonates receiving environmental humidity. They are based on research findings and/or currently accepted best practice. For accessibility, the guidelines have been collated under distinct subheadings, in the order that information is likely to be needed in practice. However, the reader is advised to read the guidelines in full and to seek the advice and support of more senior or experienced colleagues, in the practice setting.

2.0 Scope of Guideline Framework

The guideline applies to all neonatal units and maternity units covered by Thames Valley & Wessex Neonatal ODN. This includes the following hospitals:

| Thames Valley | | |
|--|--|-------------|
| Trust | Hospital | Designation |
| Oxford University Hospitals NHS Foundation Trust | - John Radcliffe Hospital, Oxford | NICU |
| Buckinghamshire Healthcare NHS Trust | - Stoke Mandeville Hospital, Aylesbury | LNU |
| Frimley Health NHS Foundation Trust | - Wexham Park Hospital, Slough | LNU |
| Milton Keynes University Hospital NHS Foundation Trust | - Milton Keynes General Hospital | LNU |
| Royal Berkshire NHS Foundation Trust | - Reading | LNU |

| Wessex | | |
|--|---|--------------------------------|
| Trust | Hospital | Designation |
| University Hospital Southampton NHS Foundation Trust | - Princess Anne Hospital | NICU |
| Portsmouth Hospitals University NHS Trust | - Queen Alexandra Hospital | NICU |
| Dorset County Hospital NHS Foundation Trust | - Dorset County Hospital, Dorchester | SCU |
| Hampshire Hospitals NHS Foundation Trust | - Basingstoke and North Hampshire Hospital | SCU (Temporary designation) |
| Hampshire Hospitals NHS Foundation Trust | - Royal Hampshire County Hospital, Winchester | SCU (Temporary designation) |
| Isle of Wight NHS Trust | - St Mary's Hospital | SCU |
| University Hospitals Dorset NHS Foundation Trust | - Poole Hospital | LNU |
| Salisbury NHS Foundation Trust | - Salisbury District Hospital | LNU |
| University Hospitals Sussex NHS Foundation Trust | - St Richard's Hospital, Chichester | SCU |

3.0 Guideline Summary

- Fill the humidification chamber with sterile distilled water.
- Set incubator temperature to 35 °C on air temperature mode and 80 %humidity, and where possible allow approximately 30 minutes for incubator humidity to build up and temperature to stabilize.

- The baby should have their skin temperature monitored continuously using a skin temperature probe, which is placed onto a non-bony area of the abdomen, but never underneath the baby.
- To ensure effective humidity to all of the baby's skin the smallest appropriately sized nappy should be used, and no clothing put on the baby.
- Follow the Environmental Humidity protocol in section 4.2 (page 6), aiming to maintain the baby's temperature 36.6 C-37.2 C.
- Access the baby, where possible, only via the incubator portholes. Minimize the time the main doors of the incubator are open, and avoid raising the incubator canopy.
- Utilise incubator features such as 'air curtain mode' to minimise loss of incubator humidity. Such features should be used by staff and explained to parents as well.
- Every hour visually check that the temperature probe remains in place, and check and record the baby's skin temperature.
- Check and record the baby's axilla temperature at least every 4 hours.
- Refer to the trouble shooting guideline, if required in section 4.3.5 (page 10).
- The majority of babies requiring incubator humidity are able to safely come out of the incubator for skin to skin cuddles with their parents.
- Wean EH according to protocol, and cease when humidity reaches 40%.
- Take care to ensure that the water reservoir is emptied after ceasing environmental humidity, to avoid stagnant water becoming a source of infection.

4.0 Guideline Framework

4.1 Background Information

As the foetus is maturing in the womb their skin begins to keratinise from 18 weeks gestation onwards, until by 32 to 34 weeks gestation the stratum corneum (which controls evaporative heat loss and transepidermal water loss (TEWL)) has become well developed. For babies born before 30 weeks their skin immaturity puts them at increased risk of dehydration and hypothermia. For those babies born 26 weeks and below it is certain that they will lose large amounts of fluid from their skin by TEWL (approximately 150mls/kg/day) affecting urine output, causing electrolyte disturbances and requiring high fluid maintenance volumes. In addition the water lost by evaporation uses up precious calories and heat, often more heat that the baby is able to produce itself at rest. (Heuchan et al, 2006)

After birth the skin of preterm babies is exposed to a gaseous environment and has been seen to mature rapidly, both in its epidermal structure and its barrier function (Agren et al, 2006). So that by 2-3 weeks after birth (whatever their gestation) the neonate's skin functions like that of a term baby (Fanaroff et al, 2013)

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 (usually incubator) that the premature infant is nursed in. This environmental humidification (EH) is able to reduce TEWL and assist with temperature regulation. However, nursing babies in EH has also been shown to slow the natural process of epidermal barrier formation or 'skin adaptation' to the external environment.

Consequently, there is a challenge for health professionals to balance the infants' need for heat and humidity with the adaptive benefits of a drier environment for stimulating epidermal DNA synthesis. In addition babies of different gestations will have different EH requirements and all babies will require a gradual reduction in incubator humidity as TEWL levels reduce and a transition is made from the artificially humidified environment to 'normal' room humidity.

4.2 Protocols

Fig 1 Environmental Humidity Protocol

| |
|---|
| Babies born at 27 weeks and 6 days gestation or below |
| ▪ Commence 80% incubator humidity. |
| ▪ To stay at 80% humidity until the end of day 7. |
| ▪ On day 8 of life begin weaning humidity by 5 % each day. |
| ▪ Cease incubator humidity when 40% is achieved. |
| Babies born between 28 weeks and 29 weeks and 6 days gestation |
| ▪ Commence 80% incubator humidity. |
| ▪ To stay at 80% humidity until the end of day 1 |
| ▪ On day 2 of life begin weaning humidity by 5% each day. |
| ▪ Cease incubator humidity when 40% is achieved |

Fig 2. How environmental Humidity protocol alters over time in neonatal nursery setting.

| Day | Baby <28 weeks gestation | Baby 28 weeks to 29+6 weeks gestation |
|-----|--------------------------|---------------------------------------|
| 0 | 80% | 80% |
| 1 | 80% | 80% |
| 2 | 80% | 75% |
| 3 | 80% | 70% |
| 4 | 80% | 65% |
| 5 | 80% | 60% |
| 6 | 80% | 55% |
| 7 | 80% | 50% |
| 8 | 75% | 45% |
| 9 | 70% | 40% - OFF |
| 10 | 65% | |
| 11 | 60% | |
| 12 | 55% | |
| 13 | 50% | |
| 14 | 45% | |
| 15 | 40%- OFF | |

4.3 Practice Guidelines

4.3.1 Prior to Commencing EH

- Turn on incubator and set humidity to 80%- if possible allow 15-30 minutes (depending upon the particular incubator) for humidity to build up.
- Where the delivery of a premature baby is anticipated the incubator could be prepared in advance. However, there are some situations where the labour is prolonged over days, or the baby may not survive to be cared for on SCBU. So preparation must be balanced by these possibilities. If the humidity is commenced and then the incubator is not required, it will need to be emptied and cleaned fully as if it had been used.
- If a baby is already nursed in the incubator to be used for EH, it is safe for them to remain in the incubator whilst EH is commenced and builds up. Some changes are likely to be needed to their bedding, and temperature monitoring-see section 4.3.2 below.
- The temperature of the incubator should be set to 35 C as a standard starting temperature, and set to air mode, not baby controlled or servo controlled, until the baby's temperature has stabilised.
- It is recommended to fill the humidification chamber with sterile distilled water. The sterility helps to reduce the chance of any bacteria or viruses growing and using distilled water aims to prevent the build up of scale. Tap water must never be used.
- From now on access the baby where possible only via the portholes. Instead, where possible, minimize the time the main doors of the incubator are open, and avoid raising the incubator canopy/lid unless a medical necessity such as reintubation. All to help retain the humidity.
- It is recommended that soft toys are removed from incubators, but that cloths used for passing parental scent to the baby, can be left in the incubator. This is because of concern that germs on soft toys may proliferate in the extra warm and humid environment of the incubator during EH. There is no definitive evidence for this, but soft toys are not usually sterile or washable at 60 °C, whereas the items such as muslin squares typically used to expose a baby to parental scent are washed before use and are washed frequently- unlike soft toys which tend to remain with the baby for the duration of their stay.
- Some of the incubators designed for use with EH have special features designed to help retain the humidity. For example a button that can be pressed before opening the portholes or main door. This causes a 'curtain' of air to blow across the open door or porthole and helps to retain the humidity. Such features should be used by staff and pointed out to parents as well. Research has shown that these features do have a positive effect on incubator temperature stability. However it is important users know whether these features need to be turned off again or will cease automatically, as they may interrupt the incubators self regulation systems if left on unintentionally.

4.3.2 Temperature Management

- Check and record the baby's temperature at the point of commencing incubator humidity.
- Recheck and record the temperature within half an hour of commencing EH, as the biggest changes in baby's temperature are likely to occur when EH is commenced.
- The baby should have their skin temperature monitored continuously.

- The temperature probe should be placed on a non bony area of the abdomen, but should also **not** be positioned so that the baby is lying on it. This is for two reasons; Firstly, as heat can build up between the baby and the surface, causing the probe to over read and secondly, the baby's fragile skin is at high risk of pressure damage.
- The probe cover should be reflective in nature, and designed for use in humidified environments.
- All carers should be aware that the humidity is often absorbed by the adhesive backing of the temperature probe, causing it to swell and fall off after 6-12 hours. Great vigilance must be taken to ensure that the probe remains securely attached to the baby, especially if servo control mode is selected.
- The probe site must be changed at least 4 hourly. However if the baby is being disturbed before this time for another activity, it may be appropriate to consider moving the temperature probe at the same time. Clustering some activities in this way, can help the baby to be disturbed less overall.
- Aim to maintain the baby's temperature 36.6 C-37.2 C.
- Visually check that the temperature probe remains in place once an hour.
- Record the baby's temperature from the probe every hour.
- Check the baby's axilla temperature 2-4 hourly according to the condition of the baby.

4.3.3 Equipment

- EH should only be carried out in an incubator designed for the purpose. Using this appropriate equipment, the humidity can be accurately and safely administered and there will be clear written guidelines from the manufacturers about use, set up and appropriate cleaning of equipment.
- When the water reservoirs for humidity are filled, a new and unopened bottle of water should be used.
- When topping up the water in the humidification chamber, the individual manufacturers guidelines must be followed, as there is some variation in recommended practice between different incubator brands and models.
- For optimum function avoid overfilling the reservoir.
- Cleaning and/or disinfection of the water reservoir should be according to the manufacturer's guidelines and local infection control policy.
- Phototherapy can be used for babies receiving EH, however carers should be aware of the possibility of temperature fluctuations caused by the heat from the phototherapy.
- It is NOT appropriate to coat the interior of the incubator with any substances, in an attempt to reduce the condensation that may build up. The substance may evaporate and affect the baby's skin or airways or run down the inside surface of the incubator and come into contact with the baby.
- The incubators interior surface should be wiped at least once a day with a clean, lint free paper towel to remove any particles.

- If the incubator needs to be cleaned on the inside, it should ideally be changed. If this is not possible because of the condition of the baby, then plain water ONLY can be used to clean the internal surfaces of the incubator.
- Staff should document the asset number of the incubator a baby is nursed in whilst receiving EH. If there are any concerns in the future about transmission of infection and incubators, then this will aid in investigating this.

4.3.4 General Care

- Environmental humidification does not exclude a haemodynamically stable baby from participating in skin to skin care- as the potential increase in TEWL is small and it transpires to marginal clinical importance.
- The humid environment increases the risk of nosocomial skin infections- so baby's skin (especially skin folds) should be observed for signs of infection and concerns reported to the medical team.
- Hand hygiene prior to handling a baby in EH is especially important as infections will multiply very quickly in the humid environment.
- The humidity is absorbed by the adhesive backings of many monitoring leads that are attached to the baby, and can cause them to fall off or dislodge. Take extra care with adhesive items such as ECG leads, adhesive endo-tracheal fixation systems, cannula and central line fixations.
- Babies nursed in humidity are especially slippery, extra care is required when handling these babies.
- Care for every baby should be individualised- however if staff feel that a baby should not follow the humidification protocol outlined in this guideline this decision should always be made in discussion with the ward round.
- There is no clear evidence for increasing humidity above 80% (above the protocol recommendations), however many neonatal medical teams do request this if a baby's blood sodium level is high and/ or rising.
- To ensure effective humidity to all of the baby's skin the smallest appropriately sized nappy should be used and no clothing put on. Bedding can be used to nest and position the baby, but covers should not be placed over the baby and if using a positioning nest, the straps must not be tucked in over the baby.
- Urine output should be measured and recorded for all babies being nursed in EH. There is very minimal absorption of humidity into the nappy, so the values should be accurate.
- Measure and record urine specific gravity at least once a day, as a rise in specific gravity can be an indicator of dehydration. Report any increase to the medical team.
- Measure and record the total fluid balance status of the baby on a 24 hourly basis. Fluids to consider;
 - Maintenance fluids
 - Milk feeds
 - Blood products
 - Volume and consistency of stool passed
 - Volumes of iv medications
 - Saline flushes
 - Boluses of fluid

**Report variations
from balance
to medical team**

- Remind all colleagues about;
 - Hand washing
 - Methods to avoid heat loss
 - Monitoring urea and electrolytes.

4.3.5 Trouble Shooting

| | |
|---|---|
| <p>A- The baby is too cold</p> | <p>-Ensure the temperature probe is securely attached to the baby. -Check the baby’s axilla temperature to confirm the skin probe is correlating. -Is the incubator temperature display panel set to show the air temperature instead of the baby’s temperature? -Check that the bedding has not become excessively damp or wet from condensation. -Check that the plastic covering used to insulate the baby during procedures has not been left in place. -Increase the incubator temperature and recheck baby’s temperature in 30 minutes. -Consider infection and other causes for temperature instability. -Inform the medical team. -Turning up the incubator humidity setting should be the last choice, and should only be done after consultation with a senior member of medical or nursing staff.</p> |
| <p>B- The baby is too hot</p> | <p>-Ensure the temperature probe is securely attached to the baby. -Check the baby’s axilla temperature to confirm the skin probe is correlating. -Check if the baby is lying on the temperature probe. -Reduce the incubator temperature and recheck baby’s temperature in 30 minutes. -Consider infection and other causes for temperature instability. -Inform the medical team. -Turning down the incubator humidity setting should be the last choice, and should only be done after consultation with a senior member of medical or nursing staff.</p> |
| <p>C- There is excessive condensation</p> | <p>-In the short term, wipe the inside of the incubator with a clean and dry cloth, to ensure good visibility of the baby. -Utilise a thick cover to insulate the incubator and reduce condensation. -If possible, avoid positioning an incubator being used for EH in direct line of the air conditioning unit output, as this will cool the incubator excessively and encourage condensation formation. -If possible increase the air temperature of the room, especially if air conditioning may be excessively cooling the room.</p> |
| <p>D- There is a lack of humidity.</p> | <p>-Check if the water reservoir is low or empty. -Has the humidity setting accidentally been lowered or turned off? -Is there bedding or soft toys obstructing the air and humidity from circulating round the incubator? -Has the main incubator doors been open unnecessarily or for a prolonged period, allowing the humidity to ‘escape’? -Is there a porthole left accidentally open? -Do parents and staff know to use the special facilities to retain humidity such as, ‘hot air curtain’.</p> |

4.3.6 On Cessation of EH

- Wean EH according to protocol, when humidity reaches 40% this is equivalent to 'normal' room humidity and the humidity can be discontinued.
- There is a risk that the baby will lose more heat in a non humidified incubator and become cold. Check the baby's temperature within 1 hour of discontinuing EH and adjust incubator temperature accordingly.
- Consider dressing the baby or covering with blanket if the baby's condition allows.
- The water reservoir should be emptied and cleaned according to local protocol and the manufacturers guidelines (both to stop scale building up in an unused system and for hygiene reasons.)
- Staff should take care to ensure that the water reservoir is emptied after use, as there has been an increasing prevalence of water born infections on neonatal units (such as pseudomonas.) Stagnant water inside an incubator reservoir would be an ideal place for bacteria to replicate and become a source of infection for a baby.

4.3.7 Parents

- Explain to parents the purpose of EH, its limitations and their babies likely plan of care with regards to EH. Document when parents have been given this information.
- Offer parents written information relating to EH.
- Keep parents informed about their baby's progress whilst receiving EH.
- If a baby is stable EH should not stop a baby from receiving hands on care from their parents within the incubator.
- Encourage and support parents to interact with and care for their baby whilst requiring EH.
- A cuddle is still possible, but be guided by individual assessment of the baby's skin condition, temperature stability and restrict the length of a cuddle if clinically appropriate.
- Explain to parents why kangaroo care is likely to be inappropriate.
- Explain to parents why soft toys should be removed from a baby's incubator whilst EH is in use.
- Ensure parents are informed about the 'hot air curtain', or other features that an incubator may have to assist in the provision of EH.

4.3.8 Documentation

- Use local environmental humidity care plan if available.
- Every hour document;
 - The baby's temperature from the temperature probe (at least 4 hourly from axilla).
 - The humidity setting.
 - The humidity actually present in the incubator.
 - Any change made to the humidity setting.

- Document the condition of the baby’s skin each shift, to include;
 - Condition of the skin
 - Skin maturity
 - Skin integrity
 - Any areas of skin damage

5.0 Parents information leaflet

See appendix 1.

Version Control:

| Version | Date | Details | Author(s) | Comments |
|---------------------|-------------------|----------|-----------|--|
| 1 | June 2012 | New | KR/Team | Neonatal Network Board approved |
| 2 | December 2015 | Reviewed | KR/Team | TV&W Neonatal Governance Group approved |
| 3 | December 2019 | Updated | KR/Team | TV&W Neonatal Governance Group ratified 26.03.2020 |
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| Review Date: | March 2027 | | | |

Appendix 1 Information for parents

Environmental Humidity: Information for parents

What is Environmental humidity?

The skin of a premature infant is immature at birth and still needs to complete its development. Before the skin is fully mature fluid can escape from the baby's body, through the skin, by evaporation. This has a cooling effect and also means that the baby can lose vital fluid from its system and use up valuable calories which he could be using for growth.

A system of 'environmental humidification' in the incubator has been developed to reduce evaporation and heat loss from your baby. This consists of a sterile, warm water vapour which is created within in the incubator. This then reduces the heat loss and evaporation from your baby.

Which babies need EH?

All babies below 30 weeks gestation are nursed in incubators with EH. He will start off with 80%humidity.

How long will my baby need EH?

A premature baby's skin matures very quickly once he is born. By 2 weeks after birth (whatever their gestation) the skin will function like that of a term baby, and EH can be discontinued. The setting on the incubator at this time will be 40%.

Things for Mums and Dads to consider.

You can still care for your baby whilst he is receiving EH as long as his condition is stable.

Always wash your hands thoroughly and put on alcohol gel before touching your baby.

Your baby will be wearing a small nappy and no clothes or blankets. This will optimise the amount of EH he receives.

Soft toys should not be placed in baby's incubator whilst EH is in use, due to concerns that germs on them will multiply in the warm, moist environment. However, a cloth with parent's scent on may stay in the incubator with baby, as it will have been washed at 60°C before use, which would have destroyed any germs on it.

Ensure that access to your baby is through the portholes only. Try not to take the sides down. This ensures that the humidity loss is kept to a minimum and your baby is in a stable environment.

If your baby's incubator has a button to produce an air curtain press this before opening the portholes/doors.

Check with your baby's nurse as to when the doors were last open. It may be sensible to let the EH build up in the incubator if the portholes have been opened recently.

Please give any wet or dirty nappies to your baby's nurse for weighing. This will enable us to measure how much urine he has passed.

You may notice that electrodes do not stick very well to your baby's skin please let his nurse know if one falls off during cares.

When a baby is in environmental humidity it is very likely that you may be able to have him/ her out for a cuddle. Skin to skin care should be possible if your baby is stable in their temperature regulation and their fluids/ electrolytes. The nurse looking after them can let you know if this is possible each day.

Please always ask if you have any questions or concerns, we will be happy to explain anything.