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EFCNI european foundation for
the care of newborn infants



Thermal management in newborn babies



Conflict of interest

The content of this presentation has been independently developed by EFCNI.

We thank



for their support on this topic from June 2020 until present.



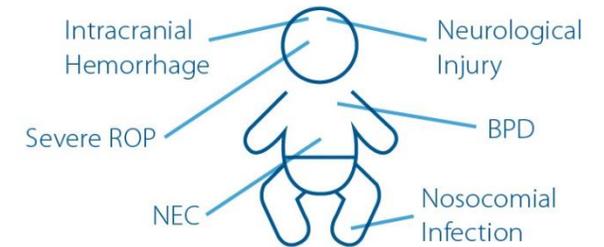
Contents

1. Why focus on thermal management?
2. How can newborn babies lose heat/gain heat?
3. What can we do to improve temperature stability?

Consequences of hypothermia

- Increased risk of mortality
- Negative effect on surfactant function
- Impaired growth
- Increased risk of sepsis and apnea of prematurity

Cold, stressed or hypothermic babies potential complications:



On admission to the NICU every 1°C decrease under 36°C in neonatal temp results in:



Thermoregulation: key facts

- Central aspect of neonatal care: ability to balance between heat production and heat loss to maintain a body temperature within the normal range
- WHO classification of levels of hypothermia
- Open debate over “moderate” classification, i.e. that it is too wide a range
- Large global variation: 26% – 74% of babies arriving cold to NICU (1,2)



Mild: 36 – 36.4°C



Moderate: 32 – 35.9°C



Severe: <32°C



4 out of 10

babies still arrive cold into the NICU ⁽³⁾



Source:

(1) McCall et al. Interventions to prevent hypothermia at birth in preterm and/or low birth weight infants. Cochrane Database of Systematic Reviews. 2018; Issue 2; Art. No.: CD004210

(2) Lee et al. Clinical impact of admission hypothermia in very low birth weight infants: results from Korean Neonatal Network. Korean J Pediatr. 2019; 62 (10): 386-394

(3) Vermont Oxford Network. NICU By The Numbers. Accessed March 1, 2019 <https://public.vtoxford.org/nicu-by-the-numbers/despite-decreases-nearly-4-in-10-infants-are-cold-when-admitted-to-the-nicu/>



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Mechanisms of heat production

Mechanism	Source
Increased metabolic activity	<ul style="list-style-type: none">• The brain, heart and liver produce the most metabolic energy by oxidative metabolism of glucose, fat and protein.• The hypothermic infant is at risk for respiratory distress, hypoxia and hypoglycaemia – respiration and blood glucose should be monitored closely.
Peripheral vasoconstriction	<ul style="list-style-type: none">• In response to cooling, peripheral vasoconstriction reduces blood flow to the skin and decreases loss of heat from the skin surface. Superficial vasoconstriction causes the mottled appearance of the skin.• Preterm infants have poor vasomotor control, limiting their ability to control vasoconstriction.



Mechanisms of heat production

Mechanism	Source
Shivering and non-shivering thermogenesis	<ul style="list-style-type: none">• Due to immature neonatal muscles, preterm infants do not shiver in response to the cold. Term babies will shiver at a temperature of 32-34°C and lower.• Non-shivering thermogenesis is the production of heat by metabolism of brown adipose tissue and is the primary source of heat production in neonates. Brown adipose tissue is evident after 26 weeks of gestation and is predominant around the kidneys, scapular region, adrenals and neck.



Mechanisms of heat loss

Evaporation

Evaporation is one of the main ways in which babies lose heat when born. Water loss occurs through the skin or respiratory tract. Preterm babies are especially at risk of this type of heat loss as their immature skin loses water more easily and their high respiratory rates cause more water loss on their breath



Radiation

All body surfaces emit heat energy in the form of electromagnetic waves. Energy transferred through radiation will cause the body temperature to change, depending on the rate of heat loss and the proportional temperature difference between the skin and radiating surface, e.g. a cold wall or window



Mechanisms of heat loss

Conduction

This type of heat loss occurs when heat is lost from the baby coming into contact with a cold surface or object, e.g. a cold blanket, a hand or stethoscope



Convection

Moving air or fluid across the baby's body that is colder than the baby's skin temperature can cause convective heat loss, e.g. when the baby is delivered into a cold room and then carried from the mother to a nearby warming table

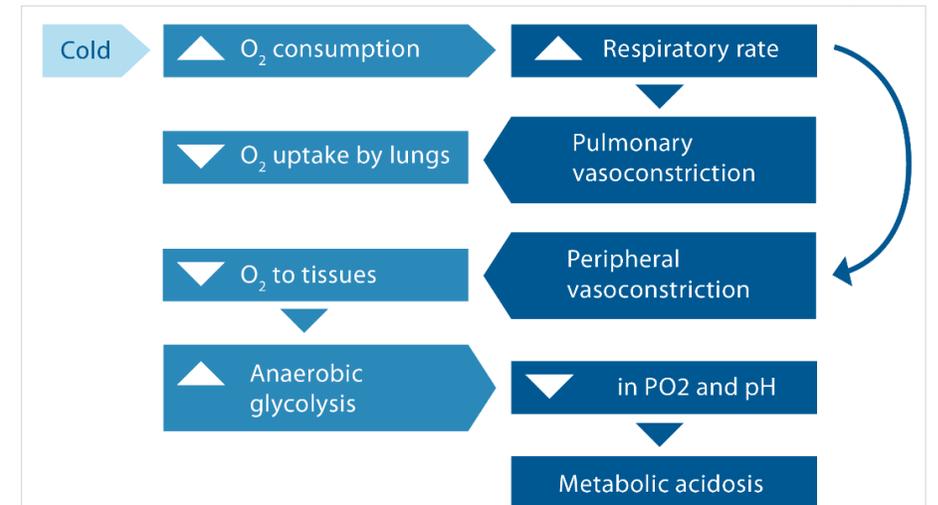


Signs and symptoms of hypothermia

- Respiratory distress, e.g. increased respiration, increased breathing
- Lethargy (decreased activity)
- Cold, pale, mottled skin = vasoconstriction
- Increased oxygen requirement
- Apnoea/bradycardia demonstrated through desaturation
- Hypotonia
- Hypoglycaemia
- Feed intolerance/vomiting



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Hyperthermia is also a risk

External or environmental factors can also cause overheating, which has damaging consequences.

Signs and symptoms:

- Lethargy
- Poor feeding/feed intolerance/vomiting
- Vasodilation, e.g. flushing of skin, warm extremities
- Hypotension
- Tachycardia
- Tachypnoea/apnoea
- Irritability
- Seizures



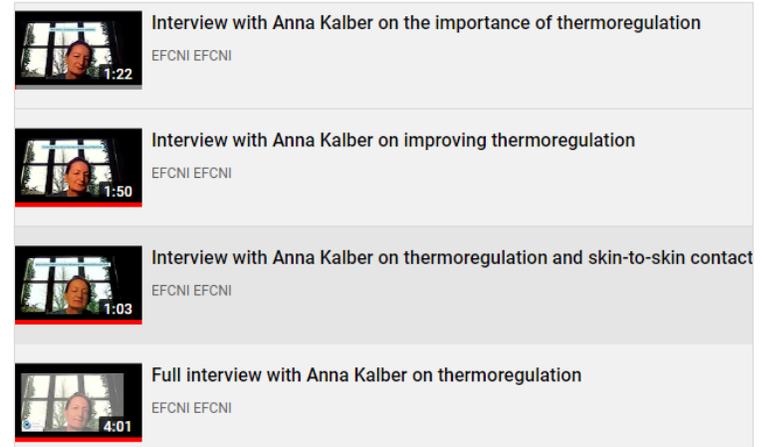
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Source: Sydney Children's Hospitals Network (SCHN). Thermoregulation in neonatal care - CHW Practice Guideline, 2021.
https://www.schn.health.nsw.gov.au/_policies/pdf/2007-0006.pdf

Informative videos

- Dr. Mark Johnson, Princess Anne Hospital, Southampton (UK):
https://www.youtube.com/watch?time_continue=5&v=hgbg2cdyJ7I&feature=emb_title
- Anna Kalbér, neonatal nurse and trainer, Berlin (Germany):
<https://www.youtube.com/playlist?list=PLXFEAU1xkn18DfrhHBzdX9-u2N6F6pFqn>





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ERC Guidelines

- European Resuscitation Council Guidelines for Newborns, 2021 update:

<https://www.cprguidelines.eu/assets/guidelines/European-Resuscitation-Council-Guidelines-2021-Ne.pdf>

- Mention of thermoregulation in top 5 messages

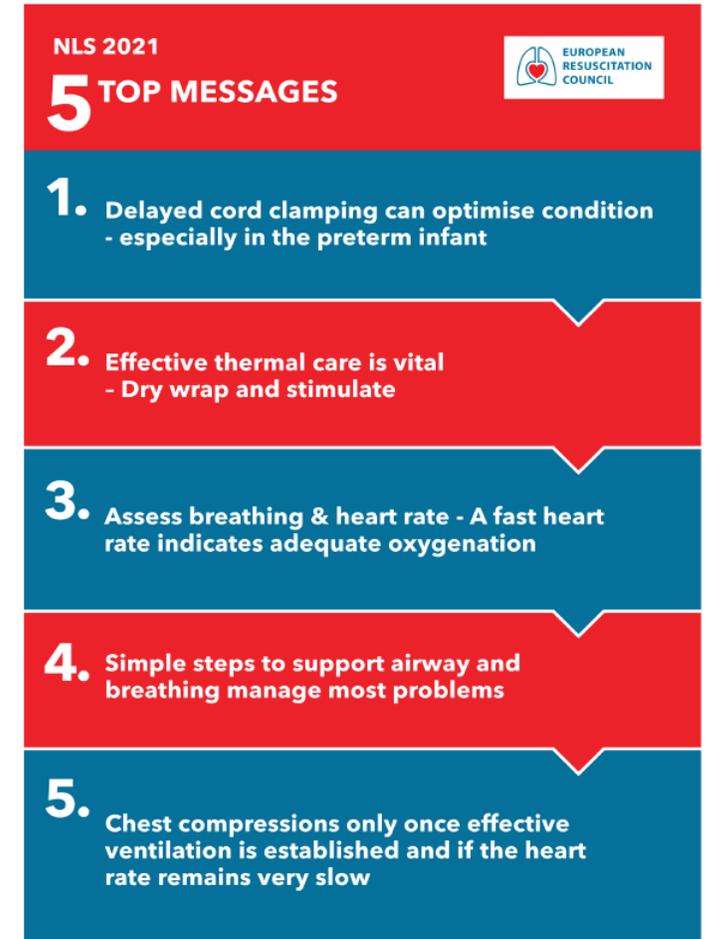


Fig. 2 - NLS infographic.



Labour and delivery

- Increase room temperature: according to WHO, this should be 26°C for babies <28 weeks, 25°C for babies >28 weeks (1)
- Drying: babies born >32 weeks should be dried immediately after birth, wrapped in a warm, dry towel not covering the face with a hat. Alternatively, the baby can be placed on the mother and both covered with a warm, dry towel (1)
- Plastic covering: babies born <32 weeks should have their head and body (excluding face) covered with a polyethylene (plastic) wrapping without drying beforehand (2) – place immediately in plastic bag
- Skin to skin: should be initiated as first action during delayed cord clamping
- Radiant heater: placing the baby under a radiant heater prevents heat loss when further assessment of resuscitation is necessary (2)



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Source:

- (1) Madar et al. European Resuscitation Council Guidelines 2021: Newborn resuscitation and support of transition of infants at birth, Resuscitation (2021). doi:10.1016/j.resuscitation.2021.02.014
- (2) Sharma. Maternal Health, Neonatology, and Perinatology (2017) 3:16. doi:10.1186/s40748-017-0057-x



Labour and delivery

- Air draughts: the baby should be protected from all draughts, e.g. from windows, doors, heat and air conditioning vents etc.
- Objects in direct contact with the baby: these need to be pre-warmed before use e.g. warmers, mattress, bedding, scale, walls etc.
- Objects not in direct contact with the baby: the baby should not be placed directly beside a cold wall or window



Stabilisation and transfer

- Humidified respiratory gases: particularly babies <32 weeks may need heated and humidified gases to maintain a stable temperature (1) when in an incubator
- One baby, one bed: bed transfers should be minimised due to the risk of heat loss. Shuttle incubators or other technologies could be used when necessary – ensure battery options are available to transport incubators or warmers
- Incubator opening: the incubator should be opened as little as possible



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Source:

(1) Madar et al. European Resuscitation Council Guidelines 2021: Newborn resuscitation and support of transition of infants at birth, Resuscitation (2021).
doi:10.1016/j.resuscitation.2021.02.014

In the NICU

- Incubator use: studies show that double walled incubators are superior for decreasing heat loss (1)
- Control incubator mode: use the mode best suited to the baby based on, e.g. clinical condition, gestational age etc.
- Interventions: any interventions, when possible, should be carried out through the portholes of the incubator
- Humidity: there are varying practices concerning humidification depending on gestational age and birth weight (2)



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Source:

(1) Laroia, Phelps, Roy. Double wall versus single wall incubator for reducing heat loss in very low birth weight infants in incubators. Cochrane Database of Systematic Reviews, 2007(2).

(2) Rizk, D'Angio, Kent. Humidification Practices of Extremely Preterm Neonates: A Clinical Survey. Healthcare (Basel), 2022. 10(8):1437. doi: 10.3390/healthcare10081437. PMID: 36011094; PMCID: PMC9408417

In the NICU

At what gestational age do you begin humidification?		
Answers	Outside Institutions (NKC = 15 / NANN = 27) N = 42	Home Institution (GCH / URMC) N = 89
</= 28 Weeks	20 (48%)	52 (58%)
</= 27 Weeks	2 (5%)	10 (11%)
</= 26 Weeks	1 (2%)	5 (6%)
</= 25 Weeks	1 (2%)	5 (6%)
Other	18 (43%)	16 (18%)
No Response	0 (0%)	1 (1%)

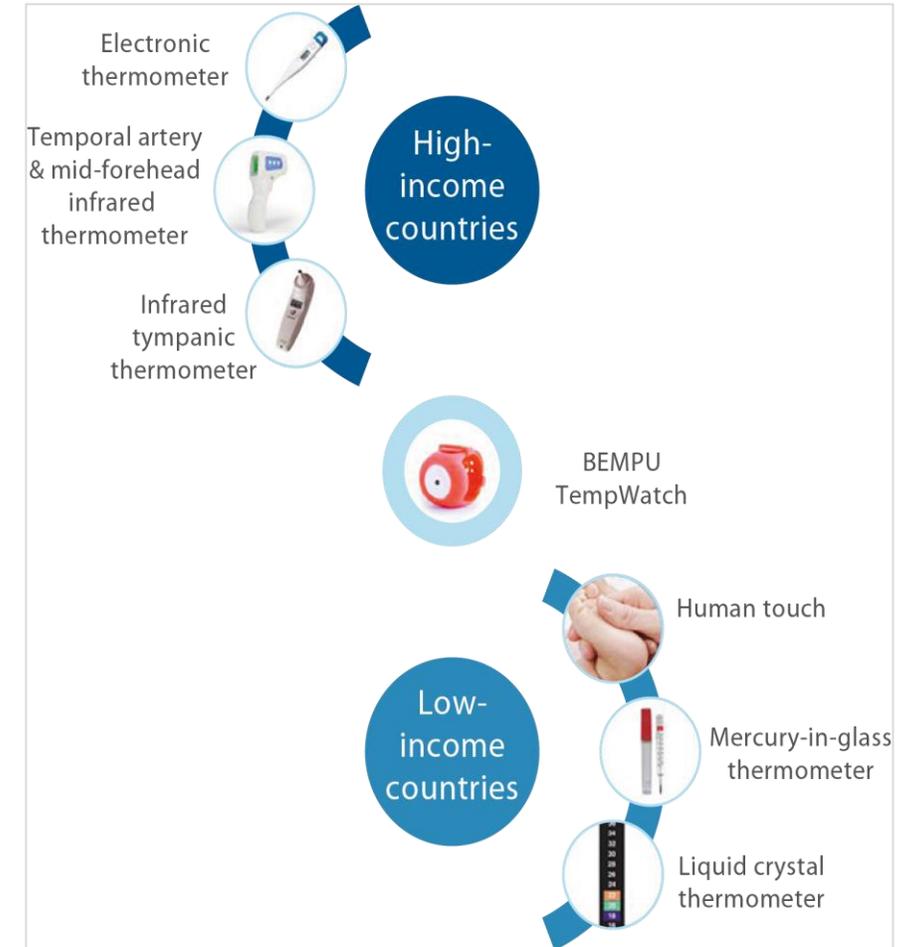
At what percentage do you begin humidification?		
Answers	Outside Institutions (NKC = 15 / NANN = 27) N = 42	Home Institution (GCH / URMC) N = 89
90% or Higher	2 (5%)	39 (44%)
80% to 89%	19 (45%)	30 (34%)
70% to 79%	13 (31%)	4 (4%)
60% to 69%	2 (5%)	1 (1%)
50% to 59%	0 (0%)	2 (2%)
40% to 49%	0 (0%)	0 (0%)
Other	6 (14%)	13 (15%)
No Response	0 (0%)	0 (0%)



Source: Rizk, D'Angio, Kent. Humidification Practices of Extremely Preterm Neonates: A Clinical Survey. Healthcare (Basel), 2022. 10(8):1437. doi:10.3390/healthcare10081437. PMID: 36011094; PMCID: PMC9408417

In the NICU

- Axillary and abdominal skin temperatures are preferred sites for measuring skin temperature
- Continuous skin temperature monitoring required for neonates in an open warmer or incubator to avoid cold stress
- Skin temperature should be monitored during skin-to-skin care
- The skin probe is insulated with a reflective probe cover to ensure the infant's body temperature and not an external heat source is measured
- The skin probe should be placed on an area that is not between the infant and mattress. The probe should not be placed over a brown fat area, e.g. nape of neck, where a falsely high temperature may be recorded



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Treatment of hyperthermia

- Remove layer of clothing or blankets if the baby is overdressed/overwrapped
- Consider checking for sepsis if body temperature is $>38^{\circ}\text{C}$ and environmental temperature is appropriate
- Monitor axillary temperature hourly until back in normal range for 2 consecutive measurements



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Temperature monitoring

- Implementation of quality improvement measures, e.g. monitoring the number of babies arriving cold to NICU
- Continued education and awareness, e.g. staff training
- Assignment of roles within care team, e.g. one person dedicated to temperature management
- Learn from Dr. Alok Sharma's experience here:
<https://www.efcni.org/news/thermoregulation-alok-sharma-story/>



<https://www.mproveacademy.com/quality-improvement/toolkits>



Find out more

- Consult the factsheet on thermoregulation in preterm babies (available in EN, DE, ES, FR, HU, IT & RU):

<https://www.efcni.org/thermoregulation-in-preterm-born-babies/>

- Further information/interviews on thermoregulation:

<https://www.efcni.org/thermoregulation-in-preterm-born-babies/>





Thank you very much for your attention!

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