

Evidence table : Environmental Humidification for Premature Neonates Reference	Evidence level (I-VII)	Key findings, outcomes or recommendations
<p>Agren, J., Sjors, G. & Sedin, G. (2006). Ambient humidity influences the rate of skin barrier maturation in extremely preterm infants. <i>The Journal of Pediatrics</i>. May, 613-617.</p>	<p>II</p>	<p>Demonstrates that the relative humidity of the environment significantly influences the rate at which the skin barrier forms after extremely premature birth. Transepidermal water flux is an important signal for establishment and recovery of skin barrier structure and function. A gradual reduction in incubator humidity from 85% to 50% after the first postnatal week would allow higher TEWL, therefore promoting skin barrier formation. This can be achieved without causing dehydration and hyernatraemia.</p>
<p>Allwood, M. (2011). Skin care guidelines for infants aged 23-30 weeks' gestation: a review of the literature. <i>Neonatal, Paediatric and Child Health Nursing</i>. 14(1), 20-27.</p>	<p>II</p>	<p>Underdeveloped stratum corneum in neonates 23-30 weeks. By 32 weeks epidermal development is mainly complete. In the first 2 weeks of life the stratum corneam matures at an accelerated rate for premature neonates; this development is less rapid for gestations below 27 weeks. Humidity decreases transepidermal water loss in premature neonates. Summary of small randomized controlled trial which showed that nursing neonates in humidity greater than 75% beyond 14</p>

		days of life may slow stratum corneum formation, and ideal humidity is 85% in first week followed by 50% humidity, adjusted over 12-24 hours, to allow stratum corneum formation.
Eastern Regional Neonatal Benchmarking Group. Humidity for infants < 30 weeks gestation. <i>Clinical Guideline</i> . February 2006	VII	Possible causes for hypo / hyperthermia when in humidity & management / investigations. Suggested humidity guide for different gestations
Fanaroff, A.A. Fanaroff, J.M. (2013). Klaus & Fanaroff's Care of the High-Risk Neonate. (6th ed). Philadelphia: Elsevier Saunders.	VII	Premature neonates have thin and fewer layers of stratum corneum than term neonates Due to this there is increased permeability and transepidermal water loss, leading to evaporative heat loss, increased fluid requirement, and risk of toxicity from tolically applied substances There is acceleration in the maturation of the stratum corneum during the first 10-14 days of life inprematue neonates, and

		<p>decreased barrier function may last up to 28 days</p> <p>Skin barrier function reaches mature levels more slowly in neonates born below 25 weeks gestation, and may take up to 8 weeks or to corrected gestation 32 weeks</p>
<p>Fidler, H. (2011). Incubator Humidity. <i>Advances In Neonatal Care</i>, 11(3), 197-199. doi: 10.1097/anc.0b013e31821d0074</p>	VII	<p>Discussion around technology and difficulties with providing humidity based on incubators available.</p>
<p>Flenady, V. & Woodgate, P.G. (2009). Radiant warmers versus incubators for regulating body temperature in newborn infants (Review). The Cochrane Collaboration. Wiley Publishers.</p>	I	<p>Review of 8 quasi-randomised or randomized trials in which radiant warmers were compared to incubators in neonates</p> <p>Radiant warmers increase water loss in low birthweight babies when compared with incubators</p>
<p>Gardner, Sandra Lee, et al. <i>Merenstein & Gardner's Handbook of Neonatal Intensive Care</i>, Elsevier, 2015. ProQuest Ebook Central, https://ebookcentral-proquest-com.ez.library.latrobe.edu.au/lib/latrobe/detail.action?docID=2074582.</p>	V	<p>Incubator humidity has been shown to decrease fluid requirements and decrease electrolyte imbalances in babies <1000g.</p> <p>Incubator humidity can also help maintain ambient temperature if the incubator temperature is at maximum level and the skin temperature of the neonate is still not within neutral thermal range.</p>

		<p>Where radiant warmers cannot be avoided such as for surgical procedure, the time should be minimised by keeping pre-prepared incubator available for immediate transfer into once procedure is completed.</p> <p>Reminder of the importance of parents within the NICU, and that kangaroo care should be offered when neonate is physiologically stable, that environmental humidity does not contraindicate neonates from receiving skin-to-skin care.</p>
<p>Glass, L. (2019). <i>Preterm Infant Incubator Humidity Levels: A Systematic Review</i> (Phd). Walden University.</p>	<p>V</p>	<p>Incubator humidity of 60-70% in the first week is effective at preventing TEWL in premature neonates \geq 26 weeks gestation.</p> <p>Humidity use in incubators is not without risk, so eliminating unnecessary use of incubator humidity is wise.</p>

<p>Gomella, T & Cunningham, M (2013), 'Management of the Extremely Low Birthweight Infant during the First Week of Life', (pp163-174), Neonatology: Management, Procedures, On-Call Problems, Diseases and Drugs, 7th edition, McGraw-Hill Education, USA.</p>	<p>VII</p>	<p>Neonates have a large body surface area and minimal reserves for maintaining normothermia. Radiant warmers not suitable for providing humidity due to evaporation.</p>
<p>Royal Women's Hospital Clinical Guideline (17th May, 2016), 'Ambient Humidity in NICU'.</p>		<p>Data comparison for consensus across clinical sites</p>
<p>Sinclair, L., Crisp, J. & Sinn, J. (2009). Variability in incubator humidity practices in the management of preterm infants. Journal of Paediatrics and Child Health. 45, 535-540.</p>	<p>VII</p>	<p>Review of NICUs within Australia and New Zealand on the practice and availability of specific guidelines related to environmental humidity for premature neonates There was wide variability in practice in regards to gestational age, level of humidity, length of time humidity was provided</p>

		<p>Potential risks of humidity – hyperthermia and sepsis</p> <p>Humidity reduces transepidermal water loss</p> <p>There is lack of evidence regarding optimal level of humidity over time and when complete maturation of extremely premature skin occurs</p> <p>Humidity above 70% after 14 days of age may increase transepidermal water loss</p>
<p>Sinclair, L. & Sinn, J.K.H. (2009) higher versus lower humidity for the prevention of morbidity and mortality in preterm infants in incubators. Intervention Protocol. Cochrane Neonatal Group.</p>	<p>V</p>	<p>Systematic review of evidence in relation to incubator humidity to determine optimal levels and duration, associated benefits and risks.</p> <p>There is no consensus on the levels of humidification that are optimal to maintain neutral thermal environment while minimising TEWL and reducing the metabolic rate and oxygen consumption.</p> <p>Suggestions that reaching >30 weeks post-conceptual age presents a signpost of developmental significance in relation to maturation of the neonatal skin.</p> <p>The opinion that stratum corneum is sufficiently mature by 14 days of age to support a reduction in TEWL, but not fully matured until 5-7 weeks of post-natal age.</p>

		This article also discusses the principle that the use of humidity could delay maturation of the stratum corneum.
Sherman, T., Greenspan, J., St. Clair, N., Touch, S. and Shaffer, T. (2006). Optimizing the Neonatal Thermal Environment. <i>Neonatal Network</i> , 25(4), pp.251-260.	V	Discusses principles of thermoregulation, and how technology has advanced over time to support our most vulnerable neonatal population.
Smith J. Small Baby Guideline. Management of infants < 27 weeks gestation. Royal Prince Alfred Hospital. Newborn Care Guideline. April 2010.	VII	Fluid & electrolyte imbalances in premature infants. General monitoring & Nursing care including skin care
Wada, M., Kusuda, S., Takahashi, N. and Nishida, H. (2008). Fluid and electrolyte balance in extremely preterm infants <24 weeks of gestation in the first week of life. <i>Pediatrics International</i> , 50(3), pp.331-336.		Investigation of fluid and electrolyte abnormalities during first post-natal week of life.