

RPA Newborn Care Guidelines

Royal Prince Alfred Hospital

SMALL BABY PROTOCOL

To optimise management of the extremely preterm infant less than 27 weeks the first small baby protocol was introduced in 1997. This was in response to concerns that skin care protocols were not adequate to meet the unique demands of these fragile infants. Changes in care were both, pragmatic and based on research. Over time, internal reviews and new research has modified our care practices surrounding the management of these infants.

Incidence:

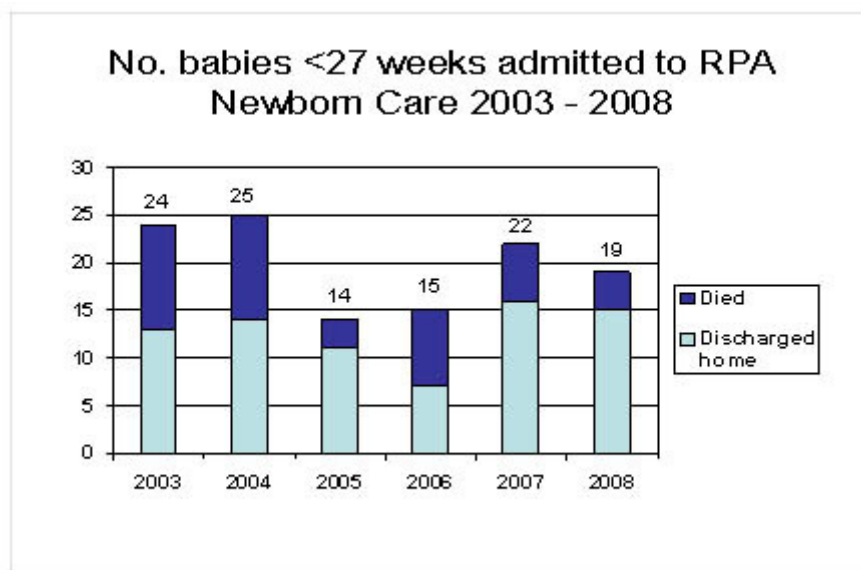


Figure one. Number of babies admitted and discharged home RPA Newborn Care (RPA NICU).

While the number of infants less than 27 weeks gestation admitted to Newborn Care has not increased in recent years, survival rates to discharge continue to improve with a 73-80% survival during 2007-2008. The nursery management and long term developmental surveillance of these infants remains a resource intensive and challenging aspect of neonatal care.

There are several important elements to the early and effective management of these extremely preterm infants. The aims of the following guideline are to:

1. prevent heat loss at resuscitation and during transport to the neonatal intensive care unit (NICU)
2. effectively manage the thermal environment in the NICU & minimise trans epidermal water loss

3. maintain skin integrity
4. adequately manage fluids and electrolytes

1. Prevention of heat loss at resuscitation.

Delivery suites and operating theatres are generally cold environments and cause thermal stress for the newborn which is associated with increased mortality and morbidity^{1,2}. The four mechanisms of heat loss - evaporation, convection, radiation and conduction³ can also be used to minimise heat loss during resuscitation and stabilisation. Application of radiant heat, warm wraps, use of plastic wraps to prevent losses through evaporation, convection and conduction^{4,5} and warmed and humidified gases to prevent evaporative losses from the respiratory tract are strategies used during resuscitation and transport to the NICU.

A systematic review⁴ reported use of a plastic barrier within the first 10 minutes of life for an extremely preterm/low birth weight infant was beneficial, reducing the incidence of hypothermia whilst allowing accessibility during resuscitation. Some babies managed in this way can become hyperthermic^{4,5}.

1.1 Clinical management – from birth & transfer to the NICU

Refer RPA Newborn Care Clinical Practice Guidelines⁶

- *Thermal management at resuscitation*
- *Resuscitation*
- *Surfactant preterm*

In addition to the routine equipment / procedures for the management of the high risk newborn, resuscitation and stabilisation of the infant less than 27 weeks includes:

- *Equipment*
 - Miller size 00 / 0 laryngoscope blade
 - 200mg/kg of surfactant (Curosurf®) & intragastric tube 5Fg (Indoplas)
 - Dräger 8000 ventilator with humidifier (Fisher & Paykel 850) set at FiO₂ 0.5; SIPPV 20/5; IT 0.3; backup rate 60/min; add sterile water, airway temperature 40°C³
- *After delivery*
 - The infant is transferred to the Resuscitaire® (Dräger Air Shields), placed under radiant heat and positioned on an occlusive polyethylene wrap.
 - Only the head and face are dried while the rest of the body is covered with the polyethylene wrap – when time permits apply webril® hat to head for transfer
 - The umbilical cord is left exposed (clamp in situ) and a pulse oximeter probe is applied to monitor heart rate and oxygen saturation (Masimo Radical™)
 - Before transfer to NICU cut umbilical cord at 6cms
 - Continue active resuscitation
- *When the infant is stabilised and ready for transfer to NICU*
 - Notify the NICU – 58459 / 55421
 - Ensure the endotracheal tube is secure, leave the infant in the plastic wrap and nest in warm towels

- Cover the Resuscitaire® with additional polyethylene wrap to reduce convective heat loss during the transfer
- Reduce the radiant heat to 50% to prolong UPS power for transfer
- Before disconnection of the medical gas from the wall, turn on the Resuscitaire® air and oxygen cylinders, ensure there is adequate pressure for ongoing ventilation during transfer
- Switch resuscitaire to UPS – check heating, ventilator & humidification systems before transfer
- *NICU*
 - Prior to transfer from Resuscitaire®, perform axilla temperature using a digital thermometer
 - Remove infant from the polyethylene plastic wrap and weigh on pre-warmed disposable sheet blue disposable (from Isolette®) OR using Isolette® C8000 scales
 - Webril® may be left on, but remember to make adjustment to birth weight (oximeter probe 23gms and endotracheal tube 4gms)
 - Thermal environment now managed in a pre-warmed 36°C / 80% humidified double walled Isolette® (Drager 8000, AirShields 2000 or Isolette® C8000) on air (manual) mode.

2. Management of thermal environment in the NICU

The skin of the extremely preterm infant is immature and the stratum corneum, the outer layer of the epidermis is functionally undeveloped and inefficient as a physical barrier in the first days after birth ^{7,8,9} - *Figure two*. As a result, high transepidermal water losses (TEWL) have been well described in this population especially over the abdomen where the skin looks thinner and more transparent ⁸ and nursery practices have been varied in an attempt to reduce these potentially significant losses ⁹⁻¹³.

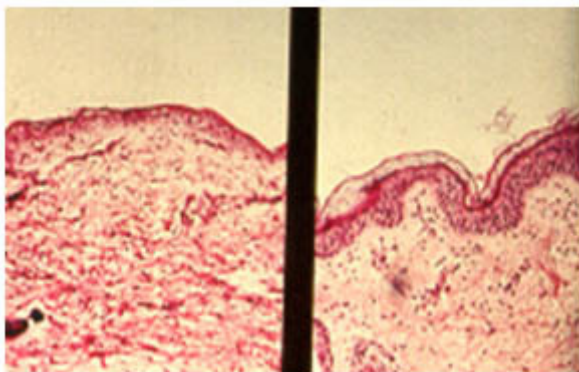


Figure two: Stratum corneum at 26 weeks gestation compared with an infant born at term. TEWL decreases with increasing post natal age and while acceleration in the maturation of the stratum corneum occurs after birth, TEWL for infants less than 27 weeks still remains more than twice as high as their term counterparts at four weeks postnatal age ¹¹

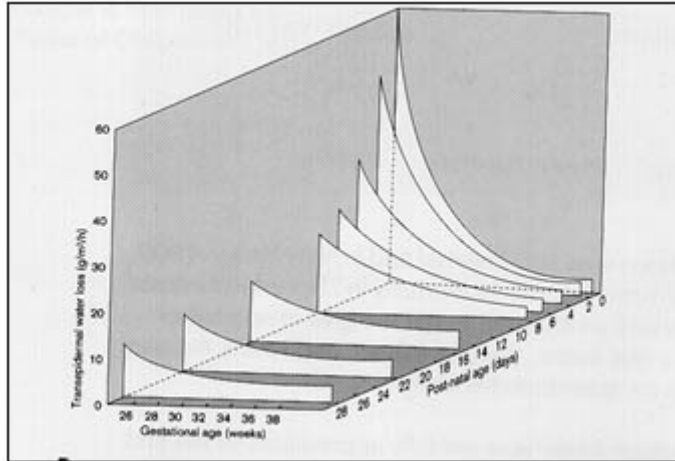


Figure three: The relationship of TEWL to gestational & post natal age (11)

Early researchers demonstrated significant reduction in TEWL can be achieved by increasing the relative humidity of the infant's environment ^{9,12}. Although open care systems with overhead radiant warmers allow free procedural access, these systems markedly increase evaporative water losses, increasing the risk of dehydration, electrolyte imbalance and injury to the infant's skin ¹⁵. The results of a systematic review comparing open care with closed care systems ¹⁴ do not provide sufficient evidence to guide clinical practice, however due to the increase in evaporative water losses associated with use of radiant heat and its associated risks for extremely preterm babies we nurse these infants in closed care systems.

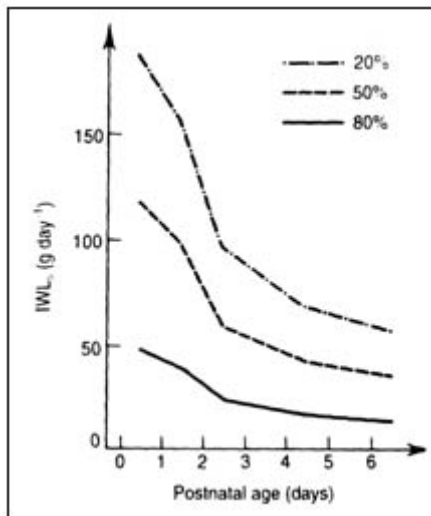


Figure four: Relationship between TEWL and postnatal age in different levels of ambient humidity ⁹

2.1 Clinical management of the environment

Refer RPA Newborn Care Clinical Practice Guidelines

- *Thermoregulation high risk newborn*
- *Skin Care*
- *Nursing management of ventilated infant*
- *Nursing management nCPAP*
- *Individualised care protocols*

Using the available evidence the infant less than 27 weeks gestation is nursed as follows:

A double walled Isolette® (Drager 8000, AirShields 2000 or Isolette® C8000) is used on air (manual) mode.

1. *Ambient temperature*

Set initial ambient temperature between 35.5 - 36.5 °C on air mode

Place skin temperature probe between mattress and trunk of infant to provide continuous yet non-invasive core temperature readings

Record axilla temperature using digital thermometer every 4-6 hours

Minimise the time doors on opposite sides of the incubator are open during procedures and routine care – this practice will increase heat loss via convection.

2. *Ambient humidity*

Ambient humidity is initially set at 80% or higher if the infant is difficult to warm or hypothermia is a problem. Avoid excessive rainout as visibility is reduced and bedding will be moist. New generation incubators have water reservoirs separate to the infant's immediate environment. Water is boiled before vapour is dispersed into the incubator, so reducing risk of environmental contamination from *Pseudomonas aeruginosa* or other water borne organisms ¹⁶.

Water reservoirs are changed daily and refilled with sterile water for irrigation (Baxter)

During the first seven days of life reduce or increase crib temperature whilst maintaining adequate humidity – if infant is higher than 37.0 °C make gradual adjustments in humidity.

Target range at end first week should be 65 – 70% ⁹ – *Figure 4*

Target range at three weeks 55 -65%. Infant will now remain within this range of humidity until 1500grams with gradual reductions in ambient temperature as required.

3. *Topical emollient*

The additional use of a topical emollient has also been demonstrated to reduce TEWL in preterm infants ^{17,18,20}. Topical emollient is used for all infants less than 27 weeks gestation – see below '*Maintenance of skin integrity*'. A single application of Eucerin™ (Beiersdorf Australia) will reduce TEWL and conserve calories by reducing heat loss.

3. Maintenance of skin integrity:

The stratum corneum is poorly developed and functionally incompetent⁸ predisposing the immature and fragile skin to mechanical injury as a result of accidental or iatrogenic damage.

Historical data has demonstrated systemic absorption of toxic agents such as aniline dyes, topical steroids, hexachlorophene and iodine¹⁹. Chemical burns have also been reported with the application of alcohol based solutions previously used for topical antisepsis. Epidermal stripping can occur with use of transcutaneous oxygen monitoring and application of adhesives.

Preservation of skin integrity is therefore essential for the optimal management of the extremely preterm infant. Breakdown of the epidermis will increase the risk of nosocomial infection, compromise temperature regulation, increase TEWL and cause pain and discomfort for the infant. Damage to the skin will also increase anxiety for parents and may cause long term scarring or disfigurement for the infant.

In addition to reducing TEWL and heat loss, a secondary benefit of topical emollient is markedly improved skin condition^{17,18,20}. This has been observed in our practice along with a noticeable reduction in the use of adhesives applied to the skin.

However in a systematic review by Conner et al²¹ more sepsis from coagulase negative staphylococcal was reported in infants receiving topical emollient compared with those infants who did not. When infections from coagulase negative staphylococcal were excluded from the analysis no differences was seen in rates of sepsis from other causative organisms²¹.

3.1 Clinical management – Maintenance of skin integrity

Refer RPA Newborn Care Clinical Practice Guidelines

- *Skin Care*
- *Nursing management nCPAP*
- *Candida infection*

On review of the data and the demonstrated benefits to skin integrity^{17,18,20,22} we have made a pragmatic decision to continue use of Eucerin™ (Beiersdorf Australia) with the following precautions.

Eucerin™ (Beiersdorf Australia) is the emollient of choice as it is a preservative free wool alcohol with a high molecular weight (minimal absorption). Use a new tube for each infant and discard after use.

Use is limited to one week and is applied after stabilisation and insertion of umbilical lines, usually within 2 hours of birth

Ensure the endo tracheal tube and umbilical lines are secure before each application

Eucerin™ is ordered on a medication chart and applied BD using a single coat and signed by two RNs.

Eucerin™ is not applied to the head, face, or abdominal area immediately surrounding the umbilical tapes or the anterior aspect of the thighs that may come in contact with umbilical line tapes.

Umbilical cord should be observed - if soiled clean with water. Ensure the area is dry and clean – report any inflammation or migration of lines. Remove linen tape around stump at 12 hours of age when there is no evidence of ooze.

Eucerin™ should not be used on a limb where a PIC line is inserted – the PIC dressing should be kept clean and intact. Medipore (3M) a special adhesive white tape should be used to secure the edges of the Tegaderm® (3M). Do not encircle the limb with tape.

Eucerin™ may be used under phototherapy – ensure infant does not over heat. Avoid use of the MicroLite® (Hill-Rom) if possible as the tungsten halogen bulbs can cause hyperthermia for infants nursed in incubators.

Application of Eucerin™ does not mean routine removal of cardiac leads – for some infants loss of contact and frequent alarms can be problematic. There are situations however where a continuous rhythm is necessary and chest leads should be left on or reapplied eg. hyperkalaemia.

Possible complications associated with use of Eucerin™ include dislodgement of endotracheal tube, lines, lifting of PIC line dressings, hyperthermia and difficulty in handling infant when first applied.

4. Additional Considerations

- *Infant identification*
 - Remove identification (ID) bands on admission to NICU due to the fragility of skin – ensure 2 bands are available within the incubator to correctly identify the infant prior to each procedure. Ensure ID bands are placed on infant as skin matures – approximately 2 weeks of age.
- *Skin management*
 - Document and monitor the general condition of the skin – be proactive, observe and clean areas such as the neck, behind ears, axillae and groin with sterile normal saline. Clean the mouth and eyes as required.
 - Ensure the infant does not lie on any foreign body that may cause pressure ulcers
 - Use of a soft mattress is recommended to alleviate pressure and promote comfort
 - Exclusive use of hydrogel products for all electrodes [23,24](#)
 - Use of a hydrocolloid product such as Comfeel Plus™ (Coloplast) under all adhesives - used to secure endotracheal tubes, umbilical lines, intragastric tubes, indwelling catheters and long line hubs.
 - Consider use of DuoDerm Extra Thin (ConvaTec) on areas of friction and erythema such as nasal septum when on nCPAP.
 - Insertion of a peripheral cannula is generally avoided and generally only used for administration blood products. Coban™ (3M) should be used to secure arm boards or stabilise a PIC line
 - If skin integrity is lost refer to neonatologist on service and CNC (81083) and / or CNEs (80922 / 81176). Referral to the plastic CNC / team may be required for advice on further management.

- *Use of topical antisepsis*
 - Aqueous chlorhexidine 0.015% (Baxter) is used for all topical antisepsis and this is currently under review.
 - Although a very dilute solution several precautions are needed – do not use friction when applying solution, apply to the smallest area possible to achieve an adequate sterile field, leave on the skin for at least three minutes for maximum effect and do not allow solution to pool under the infant. Any chemical has the potential to damage skin.
 - Chlorhexidine 0.5% and alcohol 70% (Baxter) is used to clean central line connections during change of lines and / or infusions and medications. Allow connections to dry for one minute.
- *Candida Prophylaxis*
 - Prophylactic oral antifungal therapy is prescribed (0.5 ml nystatin suspension three times daily from day 1) till all central lines are removed ^{30,31}.
- *Monitoring*
 - Pulse oximeters are used to monitor oxygen trends ³² and are secured with non adhesive Coban (3M). These probes should be resited and skin inspected for excessive pressure every 4-6 hours.
 - Alarm limits are set at 85 - 95% when in oxygen and 85 - 100% when in air. For those babies in the BOOST 2 trial receiving oxygen the target range is 88-92%.
 - Consider use of TCM after 2-3 weeks when hypercarbia is an ongoing concern.
 - Reset alarm limits to 83 – 97% during the chronic phase, that is approximately 30 weeks corrected age
- *Access*
 - Exclusive use of umbilical arterial and venous catheters during first 10 days of life avoids multiple peripheral cannulation and use of adhesives. Insertion of umbilical lines has several advantages – does not cause discomfort, access is generally without issue and they can be safely left in place for 7-10 days ²⁵.
 - Percutaneous central venous lines (PIC) are sited between 7 – 10 days for ongoing parenteral nutrition and the umbilical venous catheter is then removed ^{26,27,28,29}

5. Management of fluid and electrolytes

Infants less than 27 weeks gestation have increased TEWL due to immature epidermis and greater surface area to body mass which significantly increases the difficulties associated with fluid and sodium management ³³.

Considerations for infants less than 27 weeks gestation

- The fetus has a limited ability to compensate for changes to water balance and electrolyte levels by adjusting the concentration of the urine.
- After the first few days of life there is ongoing loss of sodium due to poor reabsorption of sodium in almost 100% of infants less than 30 weeks gestation ³³.
- All newborns are less able to excrete a potassium load. This is due to a low GFR and poor reabsorption of sodium in the distal tubule resulting in transient hyperkalaemia ³³.
- Higher glucose excretion and lower reabsorption of glucose frequently results in glycosuria. Since renal handling of glucose is inter-related to water balance, sodium and potassium, hyperglycaemia may lead to dehydration and hyponatraemia ³³.

- Serum bicarbonate levels and plasma pH are also low due to the low renal threshold for and inability to reabsorb bicarbonate³³.

A systematic review on restricted versus liberal water intake in preterm infants recommends careful water restriction³⁴. If dehydration is prevented this restriction of fluids could reduce the risk of patent ductus arteriosus and necrotising enterocolitis and perhaps overall risk of death. Because of the complex nature of fluid and electrolyte management in these infants fluid balance is individualised. RNs are not to grade up total fluid requirements and must discuss all fluid and electrolyte management issues with registrar.

5.1 Clinical Management – fluids and electrolytes

Refer RPA Newborn Care Clinical Practice Guidelines

- *Central lines*
- *Hyperkalaemia*
- *Total Parenteral nutrition*
- *Medication protocols*
- *Minimal enteric feeding*
- *Enteral feeding protocols*
- *Use of expressed breast milk*
- *Donor Milk Programme*
- *Early discharge - gavage feeding at home*

To optimise fluid balance aim for

- Urine SG 1005 – 1015;
- Urine output 2-5mls/kg/hour;
- Serum sodium 135mmol/L – 145mmol/L
- Serum glucose 2.5 – 5.5mmol/L but less than 10mmol/L

Initial fluid requirements when < 27 weeks and / or 750 grammes

- 60 – 80mls/kg/day 10% dextrose with no added electrolytes sodium or potassium in first 24 hours
- Consider use of double strength dilution in 10% dextrose for medications such as dobutamine and morphine. Multiple infusions then may be titrated to meet clinical needs whilst maintaining constant glucose infusion
- Secondary lumen in umbilical venous catheters is to be kept patent using 10% dextrose infusion if not needed for intropes or other medications. Insulin is to be infused in the same lumen as the maintenance solution (TPN or dextrose)
- Intra arterial lines are infused with 0.225% saline with one unit heparin / ml

Ongoing fluid balance and nutrition

- At 24hrs maintenance fluids are changed to either 0.225% sodium and 10% dextrose or preterm total parenteral nutrition (TPN) – lipids are generally commenced at 12mn.
- Expressed breast milk (EBM) introduced according to clinical condition. Commence with minimal enteric feed (MEF) 1ml every four hours. Grade as tolerated to 1ml every 2 hours then every hour. Grading up is usually every 24 hours.
- The infant should have a steady weight gain and may or may not still require HMF® (Nutricia) or other calorie additive after discharge home.

- Consideration should be given to the use of a post discharge formula in those infants born before 30 weeks gestation who are feeding on a low birth weight formula close to discharge. Transition to this formula should be implemented 2-3 days prior to discharge

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Key points

| Key Points | Level of evidence |
|--|-------------------|
| humidity reduces TEWL in the extremely preterm infant | ★★★ |
| TEWL is significantly increased under radiant warmers | ★★★★★ |
| application of a preservative free topical emollient inhibits TEWL, preserves skin integrity | ★★★★ |
| routine use of TCMs does not prevent ROP | ★★★ |
| Candida sepsis can be minimised with use of prophylactic anti fungal agents | ★★★★ |
| use of umbilical catheters for up to 10 days of life does not increase the risk of NEC or nosocomial infection | ★★★ |

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