the children's hospital at Westmead

SMALL BABY PROTOCOL - GCNC - CHW

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

Improvements in perinatal care mean that an increasing number of premature and extremely premature infants are being admitted to GCNC for surgical management, the population of these infants include those <28weeks gestation or <1000g. These fragile infants have unique demands. This practice guideline was developed to assist in clinical care with the following aims:

- Minimise trans-epidermal water loss (TEWL) and energy loss
- Maintain and preserve skin integrity.
- Reduce infection rates.
- Effectively manage pain.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
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CHANGE SUMMARY

New sections added to the document following revision include:

- A guide to weaning from an incubator
- Change to incubator weaning gestational age and weight
- Addition of a thermal management flowsheet
- Addition of positioning and sleep recommendations
- Addition of recommendations on incubator covers and lighting exposure.
- **9/07/21**: Minor review. Updated flowchart Management of normothermia, hyperthermia or hypothermia in an incubator .

READ ACKNOWLEDGEMENT

All clinical staff working in Grace Centre for Newborn Care to read and acknowledge changes to the revised document.

- Read Acknowledge: all clinical staff to read and acknowledge the document.
- Updated copy to be included to unit based orientation packages
- Bedside clinical education to update staff regarding changes in thermoregulation management

TABLE OF CONTENTS

Defining statement

The extremely low birth-weight infant, has a limited ability to control body temperature. Many factors contribute to this, including; a single cell layer, functionally immature skin, large surface area/body mass ratio, negligible subcutaneous fat stores, and high body water content predisposing infants to increased trans-epidermal water loss (TEWL) and associated evaporative heat loss[1,2]. Evaporative losses play a major role in fluid balance and thermoregulation[3,4] and constitute a large part of insensible water loss[1,2,3,4]. This is most apparent and problematic in infants less than 28 weeks gestation[5]. This policy focuses on the care of the small baby <28 weeks gestation and/or <1000g.

Thermal Management

Expected outcomes	• Reduce evaporative heat loss and maintain body temperature within normal range • Minimise energy expenditure for heat production • Decrease insensible water loss thus maintaining stable fluid and electrolyte balance • Growth of skin layers to maturity with intact skin integrity • No increase in incidence of culture positive sepsis

Thermal management

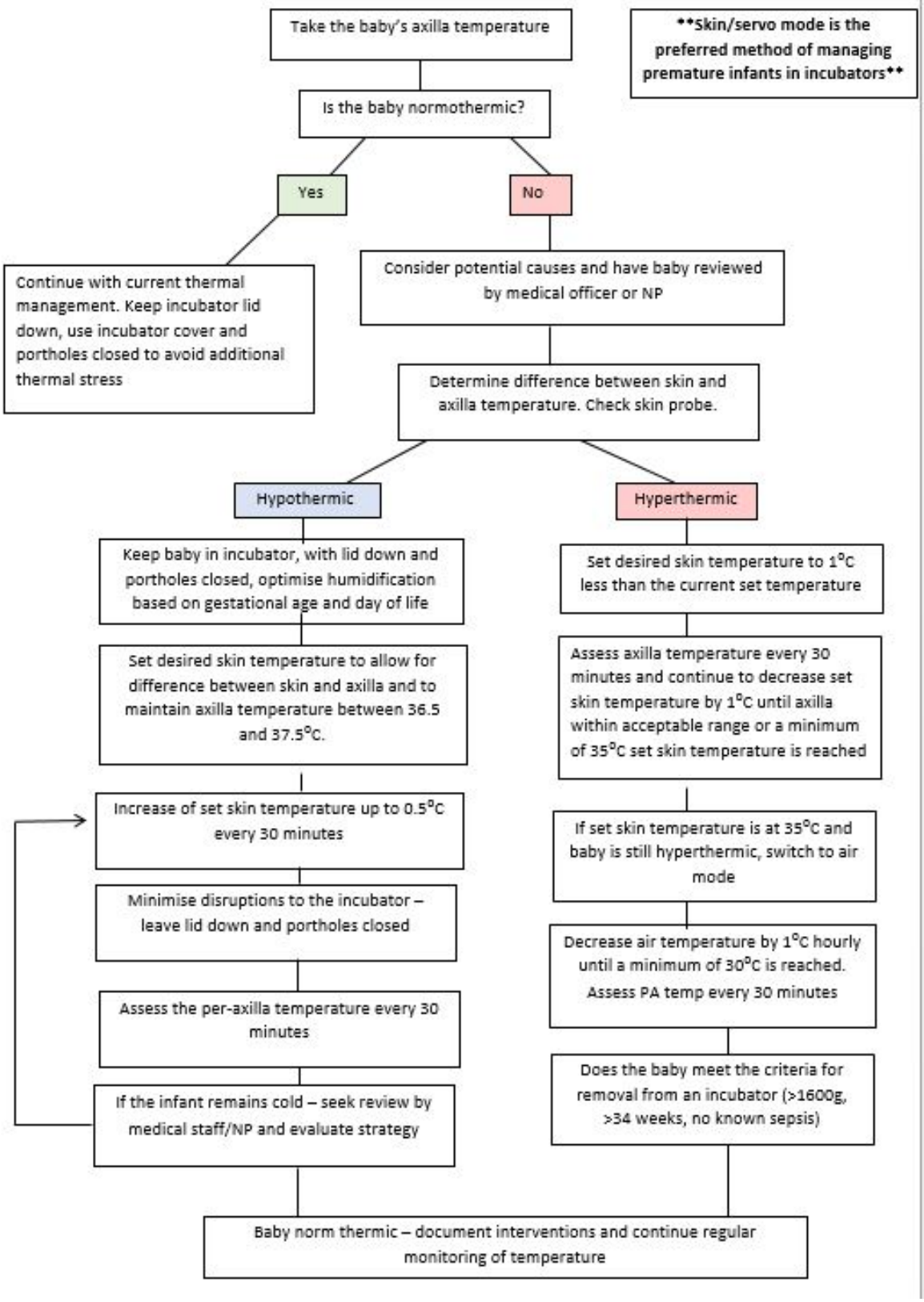
- Target axillary temperature range is 36.5-37.5ºC
- A double walled incubator is used on skin (servo) mode. Target skin temperature between 36-36.7ºC and monitor continuously.
- When nursing an infant on skin/servo mode it is important to take note of the correlation between axilla temperature and skin temperature and adjust target skin temperature as indicated by axilla temperature.
- If an infant becomes overheated in an incubator, follow the **flowsheet on page 6**.
- Air mode is generally only used to preheat the incubator prior to the baby being placed into the incubator. Appropriate air temperature can be selected by looking at the infant's Neutral Thermal Zone (NTZ) or selecting the 'Comfort zone' button on the Giraffe Omnibed®. NTZ should be documented in the infant's clinical observation chart.
- Air mode may also be used during a procedure where the skin probe needs to be removed or if the baby is having skin to skin to minimise temperature fluctuations in the incubator.
- Apply infant temperature probe and reflective probe cover for continuous monitoring of skin temperature. Choice of temperature probe site is ideally on the upper abdomen.

- The sensor should not be placed over areas of bony prominences or between skin folds. Lying on the probe will give a false high skin temperature by increasing skin insulation[6]
- Probe site and/or cover should be changed if lifting or if removed during procedures. At a minimum probe site and reflective cover should be changed 8 hourly to prevent false high readings. Minimise the time portholes are open during procedures and cares to minimise heat loss via convection. The air curtain button should be used when accessing the infant through the portholes. The air curtain increases the speed at which the fan moves air around the incubator, thus reducing heat loss through the portholes.
- Procedures need to be undertaken with consideration of the infant's temperature, allowing time for the infant to be re-warmed and preventing episodes of cold stress.

Weaning from an Incubator

- When the baby is **1600** grams or **34 weeks**, the baby can commence being weaned from the incubator[7,8].
- When the incubator air temperature has been at 32 degrees Celsius or less for at least 24 hours, begin decreasing the air temperature by 0.5 degrees every 4 hours if tolerated[7,8].
- If at any time the baby experiences temperature instability, maintain or increase the air temperature as needed.
- Once a temperature of 30 degrees Celsius is reached, the baby should be dressed in the incubator and weaning continued by 0.5 degrees every 4 hours until an air temperature of 26 degrees Celsius is reached[7,8].
- The baby can then be placed in a cribette, dressed and wrapped. Temperature should continue to be monitored continuously for 48 hours.

Management of normothermia, hypothermia or hyperthermia in an incubator



Incubator Humidity

In most preterm infants (23-25 weeks gestation) water loss is highest immediately after birth and decreases with both postnatal age and gestation[2,4]. Trans-epidermal water loss can be up to 15 times greater than the infant at term[5]. Fluid loss results in hypothermia, dehydration, and electrolyte imbalance as well as heat imbalance and poses a significant problem for the very preterm infant. It is therefore necessary to create a neutral-thermal environment that minimises water loss and promotes thermal stability. Incubators are heated convectively with warm air and can create such a microenvironment. However as the air temperature in this enclosed environment is increased the relative humidity decreases. This phenomenon occurs because warmer air has an increased capacity for water vapour. Raising the ambient temperature without increasing water vapour further increases the potential for TEWL and evaporative heat loss[9].

The skin of the extremely preterm infant is immature and is an inefficient barrier in the first days of life, resulting in high trans-epidermal water losses. The epidermis matures very rapidly after the first 7 - 14 days of life by which time it is similar to a term baby in structure and function and becomes a much more effective barrier to trans-epidermal water loss[1,3,5.] The aim of providing environmental humidification is to reduce trans-epidermal water loss, improve skin integrity and avoid temperature instability, dehydration and electrolyte imbalance[3,9.] A humidified microenvironment should be provided for all preterm infants <28 weeks gestation in the first three weeks after birth.

Sterile distilled water must be used to fill the humidifier reservoir.

- Infants who require surgery should still be nursed in an incubator and the shuttle utilised to allow them to be transferred between departments.
- Humidity is set at a high level (80%) after birth but can be increased if the infant is hypothermic or difficult to warm.
- There is a concern that an enclosed environment with high relative humidity may pose a risk for nosocomial infection in this vulnerable population. Modern incubators have however been designed with such concerns in mind and have changed the way in which humidity is provided. Sterile humidity is created and administered in a gaseous vapour state leaving no airborne water droplets.
- Humidification filters are changed every 3 months by biomedical engineering. The water chamber needs to be left in place even when not in use to reduce exposure of the filter to air.

Weaning Humidity

- Humidity can be weaned by 5% every 24 hours whilst monitoring the infant's temperature closely.
- Weaning should commence on day 4 of life with humidification target range at end of the first week of life 65% – 70%.
- Continue with weaning criteria and wean to 55%-65% by three weeks of age. After this time humidification can cease once thermal stability and a satisfactory fluid and electrolyte balance have been achieved.
- As humidity is decreased the infant will require more heat to maintain normothermia. If the infant is nursed on servo mode as recommended, the bed will make these adjustments automatically.
- If the infant is on air mode for any reason, the incubator temperature should be increased slowly in 0.5 degree increments as required to maintain body temperature within normal range. The air temperature, rather than humidification should be titrated to the infant's needs.
- Direct contact with the infant (by staff) should be kept to a minimum. If access is needed, humidity levels within the incubator remain most stable when the access is through portholes. However if a door access is required – ie for re intubation/resuscitation, the turbo boost air curtain function available on the *Omnibed* should be used to minimise loss of humidity and air temperature.
- Cardiorespiratory monitoring leads may have to be renewed frequently due to loss of adherence in this highly humidified environment.
- If significant condensation (rainout) occurs along any surface of the incubator to the point where the observation of the infant is obscured, wipe down the sides and if necessary decrease humidity by 5% increments until good visibility has been achieved. Placement of cover over the incubator can reduce rainout but should not obscure direct vision of the infant.

A Guide to Weaning Humidification

Day of Life	Day 1-4	Day 5	Day 6	Day 7-12	Day 13-18	Day 19-21	Day 22
Humidity %	80%	75%	70%	65%	60%	55%	Off

Caveat to Guideline:

- If an issue arises with humidification eg. Infant's gestational age is borderline - Individually assess infant and infant's condition with medical and nursing team to determine a management plan.
- If there is a mechanical problem arising from the incubator/humidification system, alert the nurse in-charge and contact biomedical services.

Maintenance of skin integrity

Due to a lack of subcutaneous fat and very thin skin, the premature infant is at an increased risk of trauma or disruption to normal barrier function. The prevention and maintenance of skin integrity in this population is paramount.

- Hydrocolloid products such as *comfeel*, should be used under all adhesives e.g. to secure endotracheal tubes, umbilical lines, intra-gastric tubes, indwelling catheters and long line hubs.
- Use *hydrogel* products for all electrodes and to secure skin temperature probe.
- Avoid using peripheral cannula in the ELBW in the first week of life if possible. If required for urgent transfusion, secure with *steristrips* and transparent occlusive dressing.
- Transcutaneous electrodes should not be used within the first 14 days of life as they can strip the immature epidermis, cause burns and increase sepsis risk[10].
- Urine bags should never be used – cotton balls placed in the nappy can be used for urinalysis[11] and sterile cultures should be collected via in/out catheter.
- Use only aqueous chlorhexedine 0.1% as an antiseptic solution. 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[12].
- Document and monitor the general condition of the skin – observe and clean areas such as the neck, behind the ears, axillae and groin. Attend eye and mouth care as required. Observe the back during cares and document skin integrity.
- Use of a soft mattress is recommended to alleviate pressure and promote comfort.
- Taping of lines should not circumnavigate the limbs. They should be secure enough to hold the devise in place but not too tight to cause circulatory or lympahatic compromise.
- If skin integrity does breakdown, inform the in charge of shift/CNC +/- medical staff. Record the incident into IIMS.

Emollient use

- Topical emollient is often used during the first week of life to reduce TEWL and reduce heat loss. After this time, it can be used in more mature infants with dry, fragile or superficial damage to the skin.
- Some evidence states that prophylactic emollient use in preterm infants weighing 750 grams or less is associated with increased risk of infection. Emollient use in this population should be weighed against the risk of infection and be in consultation with the neonatologist[13]. To reduce the risk of infection do not apply emollient to the limb where there is a long line inserted.

- Emollient product examples: QV Cream™, Cetaphil Cream™, CeraVe cream™ Kenkay Extra Relief Cream™, Mustela Stelatopia Moisturising Cream™, La Roache Posay Lipikar Baume AP™, Bioderma Atoderm Crème™, Dermeze Treatment Cream™, Hamilton Skin Therapy Cream™, Avene Xeracalm™

Analgesia and sedation

Premature infants exhibit physiologic, hormonal, metabolic and behavioural responses to invasive procedures. Exposure to repeated painful stimuli early in life is known to have short- and long-term adverse sequelae. These sequelae include physiologic instability, altered brain development, and abnormal neurodevelopment, somatosensory, and stress response systems, which can persist into childhood[14].Pain relief decreases physiologic instability, hormonal and metabolic stress and the behavioural reactions that accompany painful procedures[15].

- There is insufficient evidence to advocate the routine use of opioids for mechanically ventilated newborns (premature or term). Opioids should be used selectively, when indicated by clinical judgment and evaluation of pain scores[16].
- If sedation is required, morphine is haemodynamically safer than midazolam as Midazolam can lead to brain cell apoptosis[17].

For further information on Pain Management in Newborn Infants please refer to the Pain Policy.

Developmental Care

Procedures in the NICU for preterm infants can result in exhaustion that can turn into physiological (tachycardia, bradycardia, apnoea and desaturation) or behavioural (loss of tone, fatigue and difficulty sleeping) instability and signs of pain and distress[18.] The following are recommended to help minimise stress and distress:

Caregiving	• Prepare all of your equipment prior to commencing cares • Care giving should be based on the infant's behavioural cues • Cares are completed by 2 people, one person to provide support and the other to undertake the caregiving.
Nesting	• Nurse in a supportive nest and kept in flexed positions during care giving and where possible during procedures.
Nappy change	• Change nappies in a side lying position, there is less handling associated with this method and less chance of lifting the lower body above the head. • Slide the nappy under the baby to avoid raising legs as

	increase to intracranial pressure occurs when infant's legs are lifted, especially if above the head[19].
Parental participation	• Encourage the parents to participate in care giving and support of their infant where possible. • Kangaroo Care should be discussed daily on the ward rounds and offered where possible as it enhances physiological stability[20].
Sound	• Sound should be minimised particularly when the doors or portholes of the incubator are opened. • Attend to alarms promptly and carefully observe the sound ears in the nursery to determine if sound levels are too high. • Premature infants should be nursed in quiet bed spaces where human traffic is minimal.
Light	• Light should be introduced based on the baby's gestational age and responses, and the infant's eyes shielded when bright lights are in use. • When using an incubator cover the baby should be able to be visualised by staff at all times to ensure responsiveness to the their behavioural responses • The use of a partial incubator cover is recommended up to 34 weeks gestation. • When introducing light the following is recommended: - From 32 weeks exposure to moderate light for at least 2 hours per day (baby facing away from light source) - Closer to term exposure should be closer to 8 hours - At night – near darkness

Sleep protection

Sleep plays a fundamental and important role in a neonate's growth and development. It is specifically of great importance for the development of the central nervous system, cerebral structures and sensory and behavioural systems[21].

The following evidence based interventions are encouraged to protect and promote sleep in the NICU[21]

Interventions to protect sleep	Interventions to promote sleep
Reduction of noise Reduction of light Provide care-giving based on the infants sleep wake cycle	Cycled lighting Nesting Swaddling Non-nutritive sucking Use of maternal scent Skin to skin

It can be difficult to determine sleep wake states in preterm infants additional information on state determination can be found at this link.

Positioning

Positioning of the preterm infant can influence stress responses in fragile infants[22]. Developmentally safe positioning focuses on encouraging flexion, allowing movement and the promotion of joint alignment and symmetrical posture. The following strategies are recommended[22].

Prone positioning	• May be useful to conserve energy, promote self-regulation behaviours and improve respiration by increasing oxygenation. • Prone positioning should be undertaken with caution with consideration of the infants clinical condition including IV access.
Supine positioning	• Facilitates easy access to the neonate for procedures and interventions and is where they display the most stress behaviours compared to other positions.
Side-lying positioning	• Is a position where infants display less stress behaviours (when nested), improved physiological stability and increased self-regulation behaviours.
Changing position	• Positions should be altered based on the infants preferences and with consideration of minimising pressure area.
Midline positioning	• Where possible preterm infants should be nursed with their head and spine in alignment i.e. not on their back with their head turned to the left or the right. If the head is facing to one side the body should be facing the same way. • This is based on an evolving area of evidence exploring cerebral perfusion pressure alterations when the head is turned with a potential reduction in cerebral blood flow.

Additional information on infant positioning can be found at the following link.

Please refer to 'Developmentally Supportive Care for Newborn Infants' practice guideline for appropriate developmental care principals.

Medications and Intravenous Fluids

Medications

Oral antifungal	• Prophylactic oral antifungal therapy is given orally sixth hourly (0.5ml Nystatin) until all central lines are removed [23,24].
Vitamins	• Penta-vite contains Vitamins A, B group, C and D and is indicated for infants <35 weeks on breast milk and continued for up to 3 months. • A dosage of 0.45mls is administered daily orally or intra-gastrically once the infant is established on feeds. • Vitamins are added to formula milk already and so are not required in formula fed infants.
Caffeine Citrate	• Is used in infants <35 weeks with apnoea of prematurity. • A loading dose of 20mg/kg followed by a maintenance daily dose of 10 mg/kg is given either orally or intravenously. • Infants <46 post conceptual age who are undergoing operative surgery e.g. hernia repair or if they have a previous history of apnoea of prematurity are administered caffeine.
Probiotic	• Bifidobacteria and lactobacilli probiotic is used in preterm neonates <32 weeks to inhibit intestinal colonisation by pathogenic organism. • The on-call Neonatologist will assess if the preterm neonate is eligible for probiotic supplementation. Parental consent and SAS form completion is required. • The dosage is half to one capsule per day as a single dose dissolved in 2mls of breast milk or formula. See the drug manual for detailed information.

Intravenous Fluids

- The urine output in a preterm baby should be at least 0.5-1ml/kg/hour.
- IV fluid therapy in preterm babies should be administered with great attention to detail, aiming to provide hydration and adequate nutrition.

- Adequate humidification provides attenuation to the TEWL and the fluid requirement should be monitored with regards to urine specific gravity, insensible water loss and weight loss (extracellular fluid loss).[25]

Daily fluid requirements during first week of life (ml/kg/day)

Birth weight	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
<1000 grams	60	90	90	120	120	120	150
1000-1500 grams	60	90	90	120	120	120	150
>1500 grams	60	90	90	120	120	120	150

Intravenous fluids may be <u>increased</u> in the presence of[25]	**Intravenous fluids may be <u>restricted</u> in the presence of**[25]
o Increased weight loss (>3%/day or a cumulative loss >20%), o Increased serum sodium (Na>145 mEq/L) o Increased urine specific gravity>1.020 o Decreased urine output (<1 ml/kg/hr)	o Decreased weight loss (<1%/day or a cumulative loss <5%) o Decreased serum sodium in the presence of weight gain (Na<130) o Decreased urine specific gravity o Increased urine output (>3 ml/kg/hr) o In the presence of a PDA after 7 days or BPD

- TPN is usually commenced when central lines are placed. The TPN can be tailored when necessary to maintain fluid and electrolyte balance whilst maintaining crucial nutritional support in this group.
- Preterm TPN when compared to standard Term TPN contains greater amounts of amino acids, sodium, potassium, acetate and zinc and lesser amounts of glucose and chloride to meet the unique nutritional requirements of premature infants.
- Sodium and potassium should be monitored and added to TPN as indicated. Withdrawing nutritional support should only be done after discussion with the neonatologist.

Management of Intravenous Access Devices

- Blood tests should be kept to a minimum and amount of blood taken should be documented in the infant's output chart if the infant weighs less than 1000 grams. Beware of rapid blood extraction as this can lead to cerebral blood fluctuations which increase the risk of intraventricular haemorrhage in the ELBW baby.

- Umbilical arterial and venous access may be placed for mean arterial pressure, BSL and ABG monitoring.
- Exclusive use of umbilical arterial and venous catheters during the first week of life avoids multiple peripheral cannulation and use of adhesives. Insertion of umbilical lines has several advantages – nil discomfort, access is generally without issue and they can safely left in place for 7-10 days[26]
- Percutaneous central venous lines (PICC) are sited for ongoing parenteral nutrition allowing removal of the central umbilical catheters and should be inserted as early as possible.
- When securing IV lines, all adhesives should have *Comfeel* placed underneath to prevent dermal stripping.

Screening Investigations

Eye review	• All infants born before 30 weeks gestation should have ophthalmoscopy performed under local anaesthesia. • The first examination occurs at 32 post conceptual weeks or at 4 weeks of age for babies born at 29 or 30 weeks of gestation. • Further retinal examinations are at the recommendation of the ophthalmologist. • Sucrose should be used during examination as well as comfort measures. A nurse needs to be present during the examination to provide support for the infant.
Head USS	• All infants <30 weeks gestation should have 2 examinations • An initial screen at birth is recommended and then a formal screening ultrasound should be performed between days 5 and 7 of life. • If clinically stable a second screening cranial ultrasound is routinely performed at day 28 of life.
Hip USS	A hip ultrasound examination should be performed under the following circumstances: o Breech presentation o Family history of developmental hip dysplasia o Foot deformity or torticollis o Unstable hip(s) on clinical examination o GCNC length of stay longer than one month

Ventilation

- Use of etCO2 monitoring is preferred in premature infants as the tcCO2 electrode can cause dermal stripping as well as burns to their fragile skin. TcCO2 monitoring is strictly not to be used in the first 14 days of life.
- Suctioning should be avoided in the first 48hours following surfactant administration unless clinically indicated.
- Endotracheal suction is a 2 person technique, one person suctioning and the other person provides support for the infant. Providing support during procedures has been demonstrated to decrease crying, arousal, pain, stress and promote sleep. Minimise the number of passes to what the patient requires, rather than routine suction.
- Pulse oximeters are secured with non-adhesive Coban® and probes should be re-sited and skin inspected for excessive pressure every 4-6 hours. Saturations are targeted at 90-95%[26] unless otherwise indicated by a neonatologist or cardiologist. Alarm limits are set at 90-95% when the infant is receiving oxygen and 90-100% when the infant is in air.
- The use of excessive oxygen is associated with increased rates of ROP and blindness in preterm infants[28].
- Slight drops in oxygen saturations are common and as long as they spontaneously resolve intervention is often not required. Frequent 'chasing' of oxygen saturations is not recommended in premature infants.
- Babies ventilated using volume targeted modes of ventilation were more likely to survive free of lung damage. They needed ventilator assistance for a shorter duration and were less likely to develop pneumothorax. They had more stable carbon dioxide levels in the blood, and had fewer brain ultrasound abnormalities[29].

Initial Ventilator settings

- The initial set VT for infants should be 4.0ml/kg, but may need adjustments to maintain acceptable $PaCO_2$ values.
- Setting the PIP limit well above the working pressure is important to enable the ventilator alter the PIP to deliver the set VT, and to avoid frequent low tidal volume alarms.
- Combine VG with triggered modes that support all inflations (AC or PSV modes).
- A ventilator back up rate <40 per min permits the infant to trigger most breaths.
- VG automatically weans the PIP as the baby's lung compliance and respiratory effort improves.
- By controlling the expired VT, this mode is less influenced by endotracheal tube leak and can be used with ETT leaks up to 30%.

Continuous Positive Airway Pressure (CPAP)

Many premature infants will require CPAP once extubated to provide respiratory support, to decrease the work of breathing, assist in alveolar recruitment, prevent alveolar collapse and reduce apnoea's. CPAP has been shown to reduce the likelihood of respiratory failure and the need for re-intubation, particularly in preterm infants[30]. Preterm infants can be directly extubated without a trial of ETT CPAP[31]. Extremely preterm neonates commonly show signs of clinical instability during a trial of ET-CPAP and it may provide little added value in the assessment of extubation readiness[32]. However, they may be trialled on a few minutes of ETT CPAP at the discretion of the neonatologist on call[33]

- Commence on CPAP immediately after extubation to minimise de-recruitment. The pressure settings (5-8 cm H_2O) will be determined by the mean airway pressure required prior to extubation and work of breathing.
- The pressure should be titrated based on clinical examination, blood gas, and FiO_2 required to maintain target saturations. X-ray may be used to estimate the lung expansion and pressure setting.
- Use of CPAP pressure more than 8 cm should only be done in consultation with the neonatologist
- Wean CPAP gradually as clinically indicated to a predefined level of 5 cm H_2O and then stop[34]

Humidified High Flow Nasal Cannula (HHFNC)

High Flow Nasal Cannula has similar rates of efficacy to other forms of non-invasive respiratory support in preterm infants for preventing treatment failure, death and CLD[35]. Further evidence is required for evaluating the safety and efficacy of HFNC in extremely preterm and mildly preterm subgroups. There is currently no evidence available to suggest the best strategy for weaning and withdrawing HHFNC as a respiratory support in preterm infants[36].

- Decision to use high flow nasal cannula should be made by the on call neonatologist.
- Flow rates should be altered at the physician's discretion in a stepwise fashion, with mandated limits between 2 litres per minute to a maximum recommended of 6 litres per minute (Manley High Flow CPAP RCT 2013).
- Once flow rates of 2 litres per minute are reached, a trial without any flow or low flow oxygen should be considered.

See the Respiratory Support in Neonates Practice Guideline for further information on ventilation.

Transferring Premature Infants to other departments

- During transfer of the preterm infant where possible always transfer in the most appropriate environment i.e. incubator using shuttle and minimise multiple surface transfers due to risk of temperature fluctuations.
- Consider how you will protect the infant from light, noise and activity during the transfer and upon arrival at the other department.
- Ensure you frequently monitor the infant's temperature and utilise temperature maintenance strategies if they require removal from the incubator.

For additional information please refer to the Policy 'Transfer of a Neonate to the Operating Theatre and Other Hospital Investigative Departments' for information on using the shuttle and preparation for transfer.

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