



# Neonatal Nurses College of Aotearoa New Zealand Nurses Association (NNCA NZNO)

## Recommendations for Care of the Periviable Infant (under 25 weeks gestation)

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A national collaborative project facilitated by the Neonatal Nurses College of Aotearoa, New Zealand Nurses Organisation

# **Recommendations for Care of the Periviable Infant**

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## Foreword

The Neonatal Nurses College of Aotearoa (NNCA) is a college of the New Zealand Nurses Organisation (NZNO). It has a committee of eight neonatal nurses and a membership of over 650 neonatal nurses. The NNCA objectives include formalising standards and recommendations for neonatal nursing practice.

In 2015, I was part of a group that completed an audit on the outcomes of 23 and 24 week gestation infants in Wellington Neonatal Intensive Care Unit (NICU). Initially as a staff nurse and later as a Nurse Practitioner, I was one of many nurses that stood at the side of an incubator, looking at an extreme preterm infant ventilated, with poor skin, and anxious exhausted parents sitting at the bedside wondering if we were doing the right thing for this infant and their family. The outcomes of the audit were more reassuring than anticipated and discussions were held regarding care of these infants nationally. The National Newborn Clinical Network set up working parties looking into antenatal, perinatal and neonatal care of the mother and infant, their families/whanau. The working parties were tasked with the development of national guidelines for all levels neonatal care, and the whole interdisciplinary team. As the Network NNCA representative, I was on the neonatal sub-committee.

As neonatal nurses we are tasked with providing expert care for our infants and their families. I presented at an NNCA conference some of the challenges in skin care and temperature control of the 23 week infant, and the mental and physical demands these infants and their families/whanau place on the neonatal nurse. The presentation sparked some interesting discussion and highlighted the diversity of care provision, the differing approaches and products used, and the range of support available. With such a small population in New Zealand and low number of these infants, there is a need to pool resources and knowledge in order to provide equity of care. Outcomes for these infants can be directly related to the care they receive in the first weeks of life especially temperature regulation and handling, most of which is directly provided by the neonatal nurse.

When feeding back to the NNCA committee on the work being undertaken by the Clinical Network group, it became apparent the focus was predominantly from the medical perspective and there was a place for nursing guidelines. I was pleased to facilitate these and recruited expert nursing staff from the tertiary centres currently managing 23 and 24 week gestation infants. Tracey, Sandy, Jane, Michelle and Juliet all have expertise in managing these infants and their families/whanau, and together we have pleasure in presenting these guidelines on behalf of NNCA.

The guidelines are designed to be a starting point for care, a quick reference in an emergency or a baseline checklist. They can be incorporated into local existing models of care and it is hoped they will evolve as technology and practice develops and improves.

Finally, these infants are among the most complex and demanding we have to look after as neonatal nurses, we need to support each other and debrief regularly.

Paula Dellabarca

Facilitator on behalf of NNCA

## Te Tiriti ō Waitangi

Whakahaere o Aotearoa me Te Rūnanga o Aotearoa hoki, i tēnei tuhinga motuhake, a, ka whakanui ka whakapiki hoki tātou kia rite te tunga ō te tangata whenua me ngā Neehi Whakahaere ō Aotearoa.

Neonatal Nurses College of Aotearoa (NNCA), as a college within New Zealand Nurses Organisation (NZNO), is committed to Te Tiriti ō Waitangi as the founding document of Aotearoa/New Zealand, and is determined by the partnership relationship with Te Rūnanga ō Aotearoa, NZNO (Te Rūnanga).

Te Tiriti ō Waitangi acknowledges the rights of all peoples to their place in this land – Māori as Tangata Whenua and others as Iwi kainga (those that have come to make a home for themselves here).

The NNCA would like to acknowledge the place of Te Tiriti o Waitangi in its nursing practice, and incorporates its commitment to Te Tiriti o Waitangi in this document.

“Parents hold their children’s hands for just a little while... their hearts forever.”

(Author unknown)

“Ahakoa, ka haere tinana te tamariki ka noho tonu te wairua, me nga whakaaro kia rātou”

## Use of the Document

- This document is designed to enable nurses to support parents in decision-making.
- It is designed to enhance practice and to assist the parents in their journey caring for an infant at the extremes of viability. This includes expectations, and interactions with the extended neonatal clinical team.
- Care is targeted for the first 2 weeks of life but many principles will extend beyond this timeframe
- The table of contents refers to sections and appendices, which can be used independently as a quick reference to care.
- Templates provided may be adapted to meet individual DHB needs.
- The content is designed to be used as an educational tool and may be used to develop individual approaches in consideration to the resources available within each DHB.
- It is designed to be used in conjunction with the NNCA Palliative care document when appropriate and the Newborn Clinical Network periviable bundle.

## **Executive Summary**

The vision for these practice recommendations was to collate expertise from all tertiary centres within New Zealand that provide care for infants from 23 to 25 weeks gestation and formulate a plan of care that fits within the New Zealand context. It is designed to ensure equity of care delivered for all infants and their families/whanau, to be sensitive to the exceptional needs of this population, and to meet their physical, psychological, social and spiritual needs. It is also designed to support those who care for these infants and their families/whānau, to provide navigation and care direction for this vulnerable and challenging group.

The purpose of these guidelines is to provide a brief synopsis of the main areas of care required for this group and identify their unique needs. It is acknowledged that 23 week gestation infants are an infrequent occurrence, and can often present when resources and expertise are scarce, therefore the guidelines include a set of appendices that form a quick reference for care.

NNCA have primarily aimed this document for tertiary neonatal nurses. However, it will also prove useful to the wider clinical team, including providing information for those transferring mothers for tertiary care, and those stabilising infants for emergency transfer. It has been specifically developed for practice in New Zealand however the underpinning principles are relevant globally.

## Background

Pregnancy ends prematurely (< 37 weeks gestation) in 7.4 % of births in New Zealand, with 0.5% ending before the 28th week. The viable gestational age has progressively fallen as a result of advancing neonatal intensive care, ventilation improvements, antenatal steroids and surfactant replacement. However, survival is associated with an increased risk of co-morbidities. The developmental consequences of extreme prematurity can be reduced by nursing vigilance and expert care, reducing parental anxiety and improving quality of life.

Provision of care for both mother and infant at extremely preterm gestations takes place at one of six tertiary centres in NZ. As a result more than a third of care is given at a distance from the family/whānau's local DHB. While some variation in care is inevitable given our country's geography, striving for equity of care and equity of outcomes is important.

In order to provide consistent care, clinical care guidelines have been shown to be helpful for parents and health care professionals. Representatives and clinicians from all specialities involved in neonatal care agree that it is important to have a national guideline that describes best practice for New Zealand. NNCA recognise the need to include nursing guidelines as a part this.

## Principles of Neonatal Care

Every infant born in New Zealand regardless of race, religion or culture has the right to benefit from:

- The same respect and dignity as adults
- Decisions affecting their care being made in their best interest
- The same level of specialist care as children and adults
- The same access to specialist care comparable with other similar countries and circumstances
- The information and support required to assist their parents achieve the best quality of life possible
- Their parents/caregivers to be acknowledged as the primary carers and involved as partners in all care and decisions
- Consultations with a paediatric/neonatal specialist who have particular knowledge of their condition
- Timely access to support including:
  - Communication
    - interpreters where required
    - communication to be honest, consistent and sensitive to the family's needs
    - recognition that multiple stressors make it challenging for parents to comprehend complex and distressing information
  - Psychological support
    - Families should be offered the opportunity to meet with a hospital social worker, counselling service, Kaitiaki, Maori liaison or other DHB support services
    - Complex care may be supported by specialist care teams in some hospitals

- Local charitable support groups
- Use of primary nursing care models or family liaison nurse
- Spiritual support
  - Understanding spirituality is not just a person's religious affiliation, it may include rituals and traditions that are particular to their beliefs
  - Support is a personal preference and may include a member of their church, hospital chaplain, Maori chaplain or significant other
- Cultural support
  - Care should reflect the personal cultural wishes and beliefs of each family
  - The principles of Treaty of Waitangi - partnership, participation and protection should be recognised, including models of Maori health such as Te Whare Tapa Whā (Durie, 1982)
- Social support
  - Information specific to each DHB should be made available by the social worker for parents informing them of benefit and support entitlements



## **Preparation for Periviable Delivery and Resuscitation**

As previously mentioned, advances in neonatal care have improved survival rates in periviable infants. However concerns exist regarding the long-term neurodevelopmental outcome. Neonatal resuscitation is complex and requires the coordinated expertise and action of multiple team members. Therefore whenever possible, periviable infants should be delivered at a tertiary centre with an adequately experienced team.

Family members and the medical team will experience immense anxiety when delivery is imminent. Even when adequate preparation time has been possible, parents face complex decisions regarding their baby's care. Collaboration with, and support from, the obstetric and neonatal teams will be required by the family.

Delivery room care of the extremely preterm infant significantly impacts short-term and long-term outcomes. Through use of evidence-based guidelines and attention to detail, significant improvement in quality of care in the delivery room can be achieved. Emphasis is placed on thermoregulation, respiratory management, oxygen delivery and delayed cord clamping.

Communication and collaboration (inter- and intra-team), along with standardisation of care management and documentation of teamwork-related processes (evidence-based protocols) can increase consistency and decrease potential for complications to occur. Therefore teamwork and communication are vital with pre-allocation of individual roles and responsibilities, and the proposed plan of care.

Transition from foetal to extra-uterine life is characterised by a series of unique physiological events with the lungs changing from liquid-filled to air-filled, a significant increase in pulmonary blood flow and the cessation of intra-cardiac and extra-cardiac shunts. In the preterm infant lung, compliance is reduced as a result of surfactant deficiency, along with immature airways and respiratory muscles. Hypoxia at birth results in an immediate increase in ventilation followed by a later decrease. However high oxygen levels reduce ventilation which is then followed by hyperventilation

The need for intubation will be determined by the degree of respiratory depression, work of breathing and response to facemask ventilation. Whilst evidence suggests reduction of the combined outcome of death and bronchopulmonary dysplasia (BPD) by use of initial CPAP, it is unlikely infants at 23 weeks gestation will cope without ventilation and surfactant delivery. Provision of warmed humidified resuscitation gases not only reduces injury to the lungs, it protects available surfactant and assists with thermoregulation.

Minimising heat losses, by ensuring tight thermal control during postnatal transition reduces the incidence of hypothermia. Hypothermia may impede effective resuscitation, increase oxygen consumption and increase risk of intraventricular haemorrhage. Subsequent stabilisation and assessment should be done through the plastic wrap, under a radiant warmer.

Delayed cord clamping is associated with increased placental transfusion, increased cardiac output, and higher and more stable neonatal blood pressure. Aim for delayed cord clamping for up to one minute if appropriate. Notable benefits included reduction in blood transfusions and IVH. Cord gases are also of value, providing an objective means of assessing the baby's condition just prior to birth.

## Admission to NICU

The admission of the periviable infant always requires some preparation. Outcomes are improved if they are born in a tertiary neonatal unit which provides appropriate equipment and more experience in planning and accommodating the requirements of the periviable infant and their family.

Allocation of roles and Golden Hour protocols are two ways to improve coordination of care and streamline admissions. Good communication and standardisation of care management increases consistency and reduces potential complications. An example of a Golden Hour strategy is in [Appendix ONE](#)

Admitting staff are usually focused on the immediate needs of the infant. This is a time of immense anxiety for the accompanying partner or support person. A designated person, such as the Associate Charge Nurse Manager (ACNM) or equivalent, should be allocated to caring for family present.

## Skin

One of the greatest challenges in the first two weeks for the extreme preterm infant is skin care. It has an essential role in barrier function, thermoregulation and is a receptor for sensory information including pain and touch. Immature skin requires optimal management to reduce neonatal mortality and morbidity.

Skin structure of the dermis, epidermis and hypodermis is formed throughout foetal development, the neonatal period and into early childhood. The structure of skin is dependent upon gestational age, increasing thickness from 0.9mm at less than 37 weeks to 1.2mm at term. Vernix caseosa, present in the final trimester, acts as a protective barrier against amniotic fluid and is thought to play a role in the formation of the stratum corneum. The stratum corneum contains 10-20 layers in full term newborns and adults. Under 30 weeks gestation there may be as few as 2 or 3 layers, and less in the extremely premature infant. Thickening of the stratum corneum accelerates when the infant is born prematurely, however the bonds between layers or tissues can remain immature, leaving the skin vulnerable to injury from adhesives and friction.

The skin forms a chemical, biological and physical barrier. As a chemical barrier the acid mantle is responsible for the inhibition of bacterial growth. The biological barrier is responsible for activating the immune response in the skin to initiate cellular responses against foreign antigens. The neonatal microbiome is a relatively new area of research investigating the development of the newborn immune system and gut as a result of early exposure to microbial flora during birth and through feeding.

Immature skin lacks the ability to block chemical substances including bacteria and allows the diffusion of water through trans-epidermal water loss (TEWL). The extreme preterm infant can lose up to 100 ml/kg/day via TEWL if not nursed with adequate ambient humidity. This impacts on both fluid and heat loss. Incubator technology has advanced to a point where >90% humidity is achievable, and this is required for the extreme preterm infant to reduce the rate of TEWL. Close monitoring of serum sodium and weight is required when calculating fluid requirements. The preterm is at risk of percutaneous absorption from agents applied to the skin that may cause toxicity including neurotoxicity, nephrotoxicity,

ototoxicity and skin necrosis. Complete barrier maturation in preterm infants is usually achieved by 2-4 weeks. However, this is delayed in those born at 23-25 weeks gestation.

Use of a skin assessment tool that identifies risk based on gestation, number and types of interventions, and potential for injury has been shown to highlight those infants vulnerable and reduce incidence of harm. An example of a skin care tool designed for neonatal skin care is in **Appendix TWO**

## **Thermoregulation**

The skin also assists in maintaining thermal homeostasis, however immaturity and paucity of cell layers leave the neonate vulnerable to heat loss. The 23- and 25-week gestation infant is vulnerable to hypothermia which leads to increased morbidity and mortality.

Heat transfer occurs through four primary mechanisms: conduction, convection, evaporation and radiation. The risk of hypothermia is greatest at the time of birth. The newborn is wet with a large body surface to mass area, and exposed to the ambient room temperature away from the warm stable uterine environment.

Hypothermia causes several physiological changes within the body. Metabolism is increased leading to increased oxygen and glucose requirements. The extreme preterm infant is compromised by respiratory distress and poor glycogen stores. Hypothermia, can further exacerbate symptoms leading to worsening respiratory distress, with increased oxygen requirements, depletion of glycogen stores, and subsequent anaerobic metabolism to generate heat. This results in metabolic acidosis, pulmonary vasoconstriction, decreased surfactant production and hypoxia. Hypothermia is also associated with increased risk of intraventricular haemorrhage and mortality.

Hyperthermia can have iatrogenic causes e.g. the infant probe becoming detached, phototherapy, or the incubator positioned in sunlight.

Sweating does not occur in infants of less 34/40. Hyperthermia may present as tachypnoea, tachycardia, restlessness, or apnoea. Hyperthermia is associated with the risk of increased TEWL, dehydration, hypernatraemia, increased serum bilirubin, increased postnatal weight loss, seizures, and long-term morbidity.

## **Respiratory Support and Oxygenation**

Due to their extreme prematurity the periviable infant will require respiratory support. While there is variation across units in ventilation management, the monitoring and outcome expectations are the same for all infants in this group be the same i.e. minimal lung damage and maximum lung function for future development.

Ventilation strategies that best support this outcome includes the use of volume guarantee (targeted tidal volume) and pressure support ventilation. Some units may use high frequency oscillation (HFOV) strategies to manage pressure requirements and aid CO<sub>2</sub> removal.

Taping of the endotracheal tube (ETT) and tube positioning varies from unit to unit, but the aims are the same i.e. ETT security to reduce unplanned extubation, and the prevention of pressure injury. Unplanned extubation compromises the infant's stability and should be managed and reported as a critical event.

Surfactant administration may need to be repeated with a second and sometimes third dose. Suction should be performed only as necessary, and an in-line closed system is preferable. Lavage with normal saline is not recommended.

Current literature supports early extubation to continuous positive airway pressure (CPAP) to reduce barotrauma and volutrauma. However, many of the infants in this group have poor respiratory drive and weak respiratory musculature, and therefore remain intubated longer than their more mature counterparts. They often require one or more attempts at transition to non-invasive ventilation until they are successfully extubated. This may involve steroids or respiratory stimulants until they can maintain spontaneous breathing on CPAP support.

CPAP care is crucial in the periviable infant with extremely delicate skin and a moist warm environment making them vulnerable to pressure injuries due to the device. Rotation between correctly fitting mask and prongs is recommended to reduce the risk of nares, septal and nasal bridge injury.

There is evidence that shows improved oxygenation when infants are positioned prone, however this is not possible until umbilical lines have been removed. Infant change of position has the advantage of reducing pressure injuries and varying the areas of perfusion in the lungs, promoting alveolar recruitment. Preventing positional areas of collapse and subsequent re-inflation reduces long-term alveolar inflammation.

## **Nutrition**

The periviable infant is at risk of hypoglycaemia due to lack of energy stores and lack of ability to produce and store glycogen. The premature brain is susceptible to hypoglycaemia, and early glucose administration is essential. In the periviable infant umbilical lines are the preferable means of administering fluids and nutrition. Peripheral access is difficult due to fragile skin structure. Early protein administration is recommended with parental nutrition to prevent catabolism and stimulate insulin secretion.

Over the first few days trans-epidermal fluid loss makes fluid balance complex. Additional fluid may be required to prevent hyponatremia. However fluid choice is important to avoid hyperglycaemia which may cause further dehydration through large urine output.

Early breast milk is essential in promoting gut flora. Breast milk administration varies

protocols vary across units and include strategies such as EBM mouth cares, should begin as soon as breast milk is available and titrated as per local guidelines. Probiotics are also recommended for necrotising enterocolitis prophylaxis.

## **Neurodevelopmental Support**

Strategies to support infant development include staff education in relation to neurodevelopmental and neuroprotective care such as infant-responsive cares, recognition of infant physiological and behavioural responses, and recognition and response to pain. Evidence-based unit guidelines for staff should be available to guide practice.

Aims for periviable infants are to:

- Provide neuroprotective developmentally supportive positioning and therapeutic handling
- Promote normal motor development
- Minimise chances of developing abnormal movement patterns
- Minimise energy expenditure

### **Positioning and handling**

In utero, the infant is contained in 360° of well contained boundaries. These boundaries support the rapid development that takes place in the third trimester of neuronal migration and organisation. Interruption of this environment due to preterm birth causes disruption of the development of synaptic connections.

The unsupported resting posture of a preterm infant is flat, extended and asymmetrical with external rotation and abduction of limbs. Over time, and without appropriate support, ongoing neural pathway development may tend to normalise this flattened posture, leading to significant postural and developmental variance.

Therapeutic positioning to support postural control can influence neuromotor and neuromuscular development as well as physiological function and stability, including growth. Positioning can also influence skin integrity, thermal regulation, sleep, brain development and bone density.

### **Environmental Control**

The in-utero environment is warm and fluid filled, and sounds are muted with constant maternal sounds (heartbeat, gut sounds). It is dark and red-toned, and has amniotic fluid which carries diluted tastes and smells. It also has boundaries and curves and provides support against gravity.

In comparison the NICU environment has bright lights that are yellow/white/blue toned. It is noisy with constant background noise interspersed with intermittent loud sounds. There is no consistency and no predictability. The air is cold and dry relative to in-utero, the surfaces are flat and dry, and the infant is touched and handled, both by people and equipment.

## **Sleep and Rest**

During pregnancy the placenta provides the hormones important for the brain growth and development that occurs during sleep. Usual development is for infants born at term to develop day/night sleep patterns weeks or sometimes months after term.

Sleep patterns are disrupted following preterm birth by many factors including the cessation of placental hormones, infection and inflammation, and growth restriction. The environment can also affect sleep development through factors such as positioning of the infant being affected by restrictive equipment. The extreme preterm infant may have incurred brain injury which can disrupt sleep.

The NICU environment creates chronic sleep deprivation which causes a delay in the maturation of sleep states and disruption of neural network connectivity. This is seen when sleep quality and quantity is reduced, which delays the development of sleep regulation. It may delay the onset of sleep i.e. takes longer for the infant to go to sleep. These effects can persist into infancy with increased incidence of night waking and long-term effect on growth and development such as memory, learning, behaviour and emotions.

Infants born pre-term at less than 28 weeks have not developed clear sleep states. They may only sleep for a few minutes at a time, and it is difficult to ascertain which sleep state the infant is in. Once they reach a corrected gestational age of around 34 weeks, infants can start to develop a pattern of waking and sleeping which is mostly driven by feeding. Increased night sleep is helped by the change in environment as the infant progresses away from high acuity areas. Here there tends to be less noise, a day/night light cycle, and staff/parent awareness of need for sleep. Sleep is also affected by the infant's own hormone regulation which begins to develop towards term, and also by hormones in breast milk which alter during evening/night feeds.

## **Sleep States**

Preterm infants spend short periods of time in deep sleep and move out of sleep states quickly

### **Deep Sleep**

- Steady, slow, regular breathing
- Still face and body
- Important state for growth and recovery

### **Light Sleep (REM)**

- Facial movement, eye movement, can seem to be "dreaming"
- Some body movement
- Important time for brain growth and neural connections

### **Drowsy (transitional)**

- In between asleep and awake
- Unclear if infant is waking or going back to sleep
- Important to allow infant to transition (don't interrupt)

## **Sensory Development**

### **Auditory**

Hearing is functional from about 25 weeks and continues to develop until about 6 months of age. Reassuring sounds are ones that are gentle, rhythmical and familiar such as parent voices. Continuous loud noise or sudden noises cause disruption to the infant's stability; excessive noise may damage delicate hearing (auditory) structures and can cause harmful (adverse) responses in heart rate, breathing etc. and activity (physiological and behavioural).

### **Vision**

Preterm infants can distinguish shapes and contrast between light and dark; low levels of lighting support rest and stability. Growth occurs during deep sleep cycle which is present from 28 weeks, and this can be supported by day/night lighting.

### **Smell**

Amniotic fluid carries smells and the foetus is exposed to maternal smells in utero such as perfume but these are much diluted. Preterm infants are sensitive to smell; reassuring smells include parental skin during skin-to-skin care and breast milk. Strong smells such as perfume and exposure to second-hand smoke from carers' clothing should be avoided – ideally change clothes before coming into unit.

### **Taste**

Most closely associated with smell. Positive taste experiences include EBM in the mouth which can be achieved for extreme preterm infant through EBM mouth cares.

### **Touch**

Physical contact builds positive brain connections. Reassuring touch includes gentle, smooth movements and continuous contact such as parent sitting with hands over the baby, gentle stroking while awake, and skin-to-skin. Touch such as patting, stroking or interruptions during sleep cause disruption to stability.

## **Stress and Pain**

Minimising handling, using effective nesting and a low stimulus environment reduces stress for the periviable infant. Boundaries and gentle holding or containment during procedures is recommended to reduce the infant becoming disorganised and stressed. Once a procedure is completed, the infant should be nested and settled immediately after. Other non-pharmacological interventions include supported midline position with flexion of limbs, hands-to-mouth for self-soothing, non-nutritive sucking. Reducing external stimuli (light, noise), and minimizing painful stimuli.

Pain scores should be used. In the first instance, apply non-pharmacological interventions as described above. If an infant appears to be in pain (as assessed by pain scale) after all practical non-pharmacological comfort measures have been attempted, assess infant to exclude factors that may contribute to pain or stress response i.e. IV infiltration, skin breakdown, tissue damage, birth trauma, side-effects of other medication, low blood glucose level.

Decisions to initiate pharmacological pain relief vary across units. Each unit should have appropriate guidelines available for staff. Use of sedation varies across units. If an infant is persistently irritable or appears to be in pain, strategies should be implemented as appropriate. Analgesics should be administered as per local guidelines, with pain scores continuously reviewed to ensure adequacy of pain relief.



## **Perivable Infant Assessment Guide**

Adaptation to extrauterine life is the most dynamic, sophisticated and critical path the newborn must navigate. While this is often a relatively smooth transition for most full-term infants, the same cannot be said for the premature infant, and especially those born on the margin of viability where circulatory and pulmonary transitional changes may still be evolving for up to six weeks.

The experienced bedside nurse must have excellent knowledge and clinical assessment skills, with a clear understanding of both normal physiology and pathophysiology associated with the perivable infant. The ability to perform a systematic, accurate and detailed infant assessment forms an integral and critical component of the neonatal nurse's skill mix. The responsibility of delivering round the clock care places the bedside nurse in a unique position, enabling early recognition of abnormalities and detecting the subtle changes in trends, vital signs and infant behaviours. The importance of this cannot be overemphasised and these subtle and sometimes non-specific markers may well be early signs of neonatal sepsis. These subtle changes may go undetected by persons not continually monitoring the infant, with potentially catastrophic results.

The bedside nurse should:

- Be aware of the obstetric and perinatal history,
- Be aware of the current neonatal course,
- Be skilful in involving the family in care,
- Be able to articulate and communicate clearly,
- Participate in team decision-making,
- Be aware of the baseline and acceptable norm with a low tolerance for any deviation,
- Be aware of trends and changes over time,
- Anticipate and be alert to changes or clinical deterioration.

Careful assessment and evaluation of the major systems such as pulmonary, cardiovascular, gastrointestinal and neurological allows for timely referral and prompt intervention in order to minimise risk or harm to the infant.

Although major advances in neonatal care have resulted in increased survival and improved outcomes, these often carry a cost. Given the increased survival of younger and smaller infants, the focus must change from reducing mortality to reducing morbidity. The role of the bedside nurse is critical within the team to achieve this. Prompts for consideration when performing an infant assessment are outlined in the guide in Appendix Three. Each unit should have an infant assessment guideline available for staff.

## Checklists for Care of the Periviable Infant

The following checklists have been designed for easy and quick reference to care planning. These are designed for care within the first 2 weeks of life.

Preparation for Periviable Delivery and Resuscitation	
<b>Preparation</b>	<p>Refer to NZRC NLS Guidelines</p> <p>Staff – Neonatal Consultant, Nurse Practitioner/CNS(ANP)/Registrar, ACNM/Senior Registered Nurse</p> <p>Allocation of individual roles, including documentation role. Discuss planned procedure including possibility of delayed cord clamping.</p> <p>Set resuscitation room temperature at 26-27° (minimum 26)</p> <p>Preheat resuscitaire on maximum temperature, manual mode</p> <p>Ensure handover from LMC/Midwife/Obstetrician</p> <p>Caesarean delivery - Provide sterile plastic cord clamp and plastic wrap / bag to theatre staff</p> <p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>- Resuscitaire with overhead heat source</li> <li>- Warm towels, plastic wrap or bag, hat under radiant heat</li> <li>- Latex free gloves where available</li> <li>- Stethoscope</li> <li>- Neopuff, appropriate small mask, pressure 20-25/5</li> <li>- Oxygen saturation monitor</li> <li>- Functioning Laryngoscope with size 0 and 00 blades</li> <li>- Size 2.0, 2.5 ETT</li> <li>- Stylet introducer</li> <li>- Exhaled CO2 monitor where available</li> <li>- Tape or ETT holder</li> <li>- Suction equipment pressure set at 100mmHg and 8FR catheter</li> <li>- Humidified air/oxygen blender (sterile water added)</li> <li>- Transport incubator; pre-warmed to 35°</li> <li>- Surfactant and administration equipment</li> <li>- Vitamin K</li> <li>- Emergency Trolley easily accessible</li> </ul>

<b>Resuscitation</b>	<p><b>Temperature</b> Place in warmed plastic bag/wrap without drying the infant, secure the bag/wrap around the infant</p> <p><b>Delayed cord clamping</b> for up to 1 minute if appropriate</p> <p>Transfer to radiant warmer Cover or dry head as per local guidelines</p> <p>Use non-invasive respiratory support as the first line therapy for all infants</p> <p>Begin <b>resuscitation</b> (according to NZRC guidelines) with 30% oxygen and titrate every minute by 10% to achieve target saturations</p> <p>Attach oxygen saturation monitor to right hand</p> <ul style="list-style-type: none"> <li>- Turn on oximeter</li> <li>- Connect sensor to cable</li> <li>- Apply wrap</li> </ul> <p>Consider monitoring temperature – at 10min intervals / Servo</p> <p>Vitamin K 0.05mg to be given with consent</p> <p>Blood Sampling – cord arterial and venous pH and lactate</p> <p>Placenta – sent for histology, maternal and foetal surface swabs (ensure a record is kept of the location of placenta for later return to family/whanau)</p>
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Transfer to NICU	
<b>Transportation</b>	<p>Appropriate identification of infant prior to departure</p> <p>Ensure ventilator settings have been set appropriately</p> <p>Maintain humidified gases to baby when placing baby onto CPAP/ventilator</p> <p>Check temperature of transport incubator</p> <p>Change over to incubator monitoring</p> <p>Place baby in pre-warmed incubator</p> <p>Maintain temperature and ventilation</p> <p>Enable Mother to see the baby if possible and reassure that baby is stable prior to transfer (as appropriate)</p> <p>Father or support person to accompany if wishes</p>

<b>Admission to NICU</b>	<p>Discussion and delegation of roles</p> <ul style="list-style-type: none"> <li>• Admitting nurse: positioning of infant, weight, temperature and monitoring</li> <li>• Support nurse: assist with positioning / weight, documents, initial recordings, assist with fluids and checks medications</li> <li>• Admitting registrar/ NNP/ CNS/ Consultant: insertion of lines, charting of fluids and drugs, evaluation of ventilation/ gas</li> <li>• Support person for partner/family member e.g. ACNM</li> </ul> <p>Preparation of bed-space including location within NICU</p> <ul style="list-style-type: none"> <li>• pre-warming and humidification of incubator</li> <li>• pre-warming of linens</li> <li>• in bed scales</li> <li>• servo-control temperature</li> </ul> <p>Pre-humidified ventilator/ CPAP, CO<sub>2</sub>, saturation and invasive BP monitoring</p> <p>Preparation of umbilical line trays and intra-venous fluids</p> <p>Pre-warming of skin preparation fluid and drapes</p> <p>Documentation and parent information i.e. visiting</p>
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### Strategies to support skin integrity

Minimal, gentle handling and teaching parents how to achieve this

Humidified incubator to avoid skin from drying out and breaking down

Hydrogel electrodes

Careful positioning of probes and nappies as the skin tears easily

Use of clean, soft linen (may need to be changed twice daily as becomes damp)

Consider applying paraffin impregnated gauze to areas showing signs of breakdown (avoid umbilical stump area and tapes as it may impact line security)

Consider topical antifungal prophylaxis (if not using oral), local guidelines apply

Minimal use of adhesive tape to the skin to avoid epidermal stripping

Vigilance regarding movement of lines and tubes and securing immediately (Loss of the endotracheal tube and resulting replacement destabilises the infant increasing the risk of intracranial haemorrhage)

Umbilical lines to provide monitoring, sampling and administration of fluids and medications with minimal skin involvement

Avoidance of iatrogenic injuries including: extravasation, pressure and chemical injuries

Skin cleansers – sterile water; saline; tap water (nappy area only)

Skin prep – 0.1% chlorhexidine (alcohol free), no pooling of solution, consider gently washing off after procedure completed

Use of skin assessment tool

Skin injury documented in local incident reporting system and if appropriate ACC form , chemical injury

### **Strategies to support thermoregulation**

Temperature monitoring; use of servo-control. Observe and manage temperature trend

Humidified pre-warmed closed incubator; limit door opening, use air curtain when doors/ portholes are open

Consider use of heated mattresses or heat pads/ pre-warmed plastic wrap / addition of hat for procedures

Use of in-bed scales

Use x-ray tray where possible (therefore use only muslin linen under infant or local preference)

Humidification of gases

Pre-warming of drapes and solutions

Pre-warmed gel for ultrasound and ensure gel removed immediately afterwards

Regular replenishing of incubator humidity chamber to maintain constant temperature (large volume replacements cause incubator humidity instability)

Nappy on as soon as possible

Flexed nested position

Maintain warm room temperature and avoid draughts which lead to increased rainout in incubator

## Strategies to support neuroprotection

### **Provide neuroprotective developmentally supportive positioning and therapeutic handling:**

Infant encircled in an enclosed space, and where practicable, 360° of well-defined boundaries

Midline alignment including head position

Supported positioning to allow for spontaneous movement and provide tactile containment

Handling done slowly, and modulated according to infant response

Extremities flexed and contained during handling

Infant-responsive cares

Avoid:

Flat, extended position

Asymmetry

Head turned to one side

Extremities abducted and externally rotated

“Clustered” cares

### **Provide sensory environmental control and promote sleep:**

Positioning – improves O<sub>2</sub> saturations, reduces startles, self-soothe, improves feed tolerance, temperature regulation, supports joints and muscles

Skin-to-Skin care often and prolonged (dependant on local guidelines for periviable infants)

Nesting and provision of boundaries allowing for clear observation of umbilical lines

Changing positions with gentle, smooth handling, appropriate touching

Quiet – reduce sudden noise, move away from incubator when talking, nothing on top of incubator

Light – cover incubator, avoid direct light, provide day/night cycles

Parent Education to observe their baby – sit and watch, recognise states, advocate on behalf of baby, tell staff what they are seeing and learning about baby

Promotion of sleep and rest though monitoring of light and noise and avoidance of touching during sleep

Exposure to reassuring smells during skin-to-skin (avoidance of heavy perfumes and smoking)

Positive taste experience with small volumes breast milk i.e. mouth cares initially

<b>Strategies to promote nutrition and growth</b>
Early parental nutrition via umbilical line initially
Placement of PICC line, timing dependent on condition of skin
Breast milk as soon as available. Encourage breast milk mouth cares initially and feed as per local guidelines
Probiotics as per local guidelines
Regular blood sugar monitoring to avoid hypo and hyperglycemia



## **APPENDIX ONE – Example of Golden Hour Guide**

## **APPENDIX TWO – Example of Skin Care Guidelines**

## APPENDIX THREE - Example of an Infant Assessment Guide

Infant assessment guide
<b>Prompts to consider in the physical head-to-toe examination of the periviable infant: observation, auscultation, inspection and palpation</b>
<b>Colour</b>
<i>For example:</i> Pink; pale; jaundice; plethoric; mottled, cyanosed
<b>Vital signs/ monitoring</b>
<i>For example:</i> Notice trends, observe for variability (or lack of), recognise and refer deviations Normal values: HR: 140 – 180 bpm Resp: 50 – 70/ min Saturation: target 90 – 95% (in oxygen) BP/ MAP: multifactorial and assessed in conjunction with: gestational age, capillary refill time (CRT), vital organ perfusion, cardiac contractility and output (ECHO), PDA status, lactate, fluid balance and urine output, weight relative to birth weight (BW), medications, inotropes
<b>Medical devices (invasive and non)</b>
<i>For example (and may include the following under individual sections):</i> Umbilical lines; PICC or Longline (LL); peripheral IV (PIV); monitoring electrodes (hydrogel); ETT; CPAP mask and prongs; OGT; urinary catheter; etCO <sub>2</sub> ; temperature probe; other IVs: site inspection, extravasation, leaking
<b>Nursing care of umbilical lines (UAC and UVC):</b> <ul style="list-style-type: none"> <li>• UAC and UVC sutured in position with suture ends taped to line to secure (recommend no “bridging” taped onto skin – local variations apply)</li> <li>• Document line position at umbilical stump (each shift) – note and report any migration</li> <li>• Umbilicus visible at all times (no incubator cover over lower half body, no linen wrap covering site)</li> <li>• Bland coloured linen used</li> <li>• Keep site clean and dry: clean with cares using sterile gauze and NaCl</li> <li>• Recommend UVC access via sterile technique (local variations) and all drug administration via infusion pump</li> <li>• UAC aseptic non-touch technique access (local variations)</li> <li>• Note the following for UAC: <ul style="list-style-type: none"> <li>○ appropriate trace and scale</li> <li>○ pressure recording, pulse pressure and alarm setting</li> <li>○ transducer level and calibration</li> <li>○ whether sampling/ flushing easily</li> <li>○ any skin/ limb discolouration/ blanching noted</li> <li>○ bleeding/ ooze from insertion site (umbilical ties used only around Wharton’s jelly and not skin)</li> </ul> </li> </ul>
<b>Skin</b>
<i>For example:</i> <b>Inspection:</b> skin integrity: intact/ healthy/ poor/ lesions/ bruises/ cuts/ rash/ thrush/ breakdown (include nares, septum and bridge); etc. <b>Skin assessment tool score:</b>
<b>Thermoregulation</b>
<i>For example:</i> <b>Temperature:</b> admission temperature; trend and stability; management <b>Heat sources:</b> incubator temperature; humidity; use of: servo control; plastic wrap/ bag; heat curtain, x-ray tray, hat, transwarmer gel mattress
<b>Neurological and activity state</b>
<i>For example:</i>

<p><b>Observation and inspection:</b> tone and activity state: appropriate for gestation/ moving all limbs spontaneously/ symmetry/ wriggly or active when handled, resting posture: quiet/ settled/ agitated; response to handling; Eyes: fused/ open</p> <p><b>Palpation</b> (head, skull, scalp): AF soft/ full/ tense/ bulging; sagittal suture overriding/ slightly separated, moulding; OFC measurement; other</p> <p><b>Neurodevelopmental:</b> positioning, nesting, minimise light, noise and touch stimuli. Support and contain infant through all procedures as applicable. Minimal handling and consider absolute necessity of all procedures prior</p>
<p><b>Respiratory</b></p> <p><i>For example:</i></p> <p><b>Observation:</b></p> <p>Invasive resp support (ventilation): mode; set parameters; targeted tidal volume (PIP required to achieve); exhaled tidal volume if not on TTV; synchrony; triggering; leaks; total RR; minute volume; mean airway pressure; any indrawing on vent; ETT size and taping at lips/ nares</p> <p>Non-invasive respiratory support (CPAP/ SiPAP): type, work of breathing (WOB) evident (or not): indrawing/ recession/ relaxed; resp rate; sizes of mask, prongs, hat, snorkel</p> <p><b>Auscultation:</b> breath sounds clear; equal bilaterally/ unequal (R = L or R &gt; L or L &gt; R); crackles: fine/ coarse/ squeaky</p> <p><b>Inspection:</b> any anomalies/ other as applicable (chest drains; integrity of septum, nares, bridge)</p> <p><b>Monitoring:</b> apnoea's; bradycardias and desaturations; pulse oximetry (saturation range); etCO2</p>
<p><b>Cardiovascular</b></p> <p><i>For example:</i></p> <p><b>Observation:</b> sinus rhythm; tachycardia; active precordium</p> <p><b>Auscultation:</b> dual heart sounds heard; murmur/ no murmur audible</p> <p><b>Inspection:</b> active precordium (if applicable, but can include with observation)</p> <p><b>Palpation (including femoral pulses):</b> warm and well perfused/ CRT 2 sec centrally/ mottled/ CRT sluggish: &gt; 4 sec (and lactate if raised); femoral pulses easily palpable bilaterally (or not assessed if poor handling)</p> <p><b>Monitoring:</b> Heart rate: sinus rhythm/ tachycardia/ arrhythmia if applicable; MAP; pulse pressure; trend and variability (lack of)</p>
<p><b>Abdominal</b></p> <p><i>For example:</i></p> <p><b>Observation and Inspection:</b> flat / round/ distended (mild/ moderate/ severe)/ full (CPAP/ post-feed)/ tense/ firm/ loopy/ discoloured (describe); stoma if applicable (mucosal appearance; stoma output)</p> <p><b>Auscultation:</b> bowel sounds audible/ diminished/ absent</p> <p><b>Palpation:</b> soft/ tender/ non-tender/ guarding/ firm/ tense</p> <p><b>Umbilicus:</b> cord clean and dry/ inflamed/ pustule/ red/ ooze/ bleeding; umbilical lines in-situ</p> <p><b>Stools/ bowel motions:</b> confirm patent anus; describe stool colour, consistency and frequency</p> <p><b>Feeding:</b> trophic feeding or establishing feeding: volume; frequency; tolerating; aspirates (below)</p> <p><b>Gastric aspirates:</b> volume; trends; describe colour and consistency (esp. changes)</p>
<p><b>Renal and fluid balance</b></p> <p><i>For example:</i></p> <p>TFI: ml/ kg/ 24 hours, increased/ decreased/ unchanged</p> <p>Wet nappies/ urine output (ml/ kg/ hour)</p> <p>Current weight (relative to BW/ weight trends)</p> <p>Creatinine/ electrolytes (or include under "broader assessment")</p>
<p><b>Surgery:</b></p> <p><i>For example:</i></p> <p>NEC or perforated bowel repair; drains; stoma</p>

Further nursing responsibilities and considerations: neonatal course, perinatal history, nutrition, medications, social, tests and investigations
<b>Neonatal course and nursing handover considerations</b>
<p><i>Provide brief summary of neonatal course and use for shift handover, for example:</i></p> <p>Details of head-to-toe assessment</p> <p>Birth and perinatal history as below</p> <p>Neonatal course (earlier and current issues): respiratory support and status; haemodynamic status (incl PDA); renal; electrolytes; neurological; gastrointestinal; nutrition; skin; infection concerns; medications; antibiotics; tests and investigations, family; any other as described below</p>
<b>Perinatal history: family, maternal, obstetric, antenatal, perinatal, resuscitation, postnatal as below</b>
<b>Family history</b>
<p><i>For example:</i></p> <p>Maternal grandmother: diabetes mellitus</p> <p>Father: cardiac (aortic regurgitation)/ hypertension</p> <p>Family history: hearing impairment/ nil of note</p>
<b>Maternal history</b>
<p><i>For example:</i></p> <p>Blood group</p> <p>Age</p> <p>Include as applicable, e.g.: medical (asthma, other), substances (smoking, alcohol, other), maternal mental health, medication, other as applicable</p>
<b>Obstetric history</b>
<p><i>For example:</i></p> <p>Gravida and Para</p> <p>Previous baby issues e.g.: previous preterm birth, C/Section (reason); other</p> <p>Previous obstetric issues: e.g.: termination of pregnancy; stillbirth; other</p>
<b>Antenatal history</b>
<p><i>For example:</i></p> <p>GBS status/ other; maternal fever; antibiotics</p> <p>Gestational diabetes (insulin/ not); PET; genetic involvement</p> <p>Multiple pregnancy: twins (MCDA/ MCMA/ DCDA)/ triplets/ TTTS/ discordant growth/ TAPS</p>
<b>Perinatal history</b>
<p><i>For example:</i></p> <p>Gestation at birth</p> <p>Birth weight</p> <p>Antenatal steroids (when and how many doses)/ MgSO<sub>4</sub></p> <p>Mode of delivery: NVD; C/section (elective/ emergency &amp; reason)</p> <p>Prem labour (infection; chorioamnionitis); ROM/ PROM (how long)</p> <p>Parents; family/ whanau: discussion</p>
<b>Resuscitation history</b>
<p><i>For example:</i></p> <p>What stabilisation/ resus required (neopuff ventilation; suction; intubation; surfactant; resp effort, HR, saturation responses; humidified gases)</p> <p>Apgar's @ 1, 5 and 10 min</p> <p>Cardiac compressions; umbilical access; resuscitation fluids and drugs (blood/ adrenaline route and dose)</p> <p>Thermoregulation measures (ambient temperature, resuscitaire heat output, plastic wrap/ bag, hat, transport incubator)</p>
<b>Postnatal history</b>
<p><i>For example:</i></p> <p>Gestation</p> <p>Gender</p> <p>Birth weight</p> <p>Procedures upon admission to NICU e.g.: ventilation; umbilical access; admission temperature and vital signs; OGT; x-rays for IV line and ETT placement; bloods; other</p>

<b>Nutrition</b>
<i>For example:</i> Administer PN and Lipid as prescribed; consider triglyceride level monitoring (local policy applies) Enteral feeding: trophic feeding; colostrum/ EBM mouth cares; establishing enteral feeds Encourage expressing/ consider breast milk supply issues and refer to LC where indicated BSL management
<b>Medications</b>
<i>For example:</i> Apply the Five Rights of medication administration and administer as prescribed (utilising local policies)
<b>Parents/ whanau/ family:</b>
<i>For example:</i> Communication and integration with family; social issues (and referral where indicated); violence intervention program screening; family involvement; visiting (regular/ not regular/ no concerns)
<b>Research trials</b>
<i>List as applicable</i>
<b>Tests and investigations: blood gases; haematology, biochemistry, other</b>
Send specimen(s), follow up results and inform medical staff/ Nurse Practitioner Know baseline norms/ "acceptable norm" for infant Report any deviation/ change in results Have an awareness of implications of findings Encourage learning opportunities for new staff in observational capacity only: procedures and investigations should be performed by experienced staff to reduce risk of haemodynamic, temperature or other instability to infant <b>Recommended blood sampling techniques (local variations apply):</b> <ul style="list-style-type: none"> <li>• Heel pricks:               <ul style="list-style-type: none"> <li>○ Warm/ well perfused heel</li> <li>○ Clean with sterile water on gauze</li> <li>○ Appropriate sized lancet</li> <li>○ Optimal lancing site on heel</li> <li>○ Avoid excessive squeeze pressure</li> <li>○ Sample and minimise blood loss</li> <li>○ Wrap with sterile gauze until bleeding stopped</li> </ul> </li> <li>• UAC:               <ul style="list-style-type: none"> <li>○ Aseptic non-touch technique</li> <li>○ Minimise blood loss: sampling frequency and volume (document blood volumes sampled (for awareness only, not used as transfusion criteria)</li> <li>○ Avoid rapid sampling or flushing</li> <li>○ Minimal flush volumes (consider 0.45% NaCl if Na level high)</li> <li>○ Observe limb perfusion throughout</li> <li>○ Ensure UA trace following procedure</li> </ul> </li> </ul>
<b>Blood gases</b>
<i>For example:</i> pH; pCO <sub>2</sub> ; lactate; acid-base balance (normal/ resp/ metabolic/ mixed); respiratory support (and changes with respect to blood gases/ saturations)
<b>Haematology</b>
<i>For example:</i> FBC: Hb; Hct; WCC; platelets; coagulation studies as indicated
<b>Biochemistry/ other bloods</b>
<i>For example:</i> BSL; Na; K; creatinine; other as applicable: CRP, albumin; Ca; Mg; PO <sub>4</sub> ; TG levels; other
<b>Other investigations as ordered</b>
<i>For example:</i> Metabolic screen; genetics; septic screen (blood or urine culture, skin swab, tracheal aspirate), etc.

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