

CPAP – Continuous Positive Airway Pressure Nursing Management in Newborn Intensive Care Unit (NICU)

Procedure Responsibilities and Authorisation

Department Responsible for Procedure	Newborn Intensive Care Unit
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Target Audience	Registered Nurses
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Procedure Review History

Version	Updated by	Date Updated	Summary of Changes
2	Trisha Ho	July 2010	3 yearly update
3	Leanne Baker	October 2013	Updated with new equipment and management procedures
4	Leanne Bake	March 2016	3 yearly update
5	Leanne Baker	Oct 2019	Include nursing care for babies on single-prong CPAP

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CPAP – Continuous Positive Airway Pressure Nursing Management in Newborn Intensive Care Unit (NICU)

1 Overview

1.1 Purpose

Continuous positive airway pressure (CPAP) is an effective treatment modality for providing respiratory support to spontaneously breathing infants; and CPAP is a lung protective and safe method that improves oxygenation and reduces the work of breathing by preventing atelectasis during expiration.

1.2 Scope

Waikato District Health Board (DHB) staff working in NICU

1.3 Patient group

Neonates and infants in NICU

1.4 Indications

For use in neonates/infants with any or a combination of the following:

- Any signs of significant respiratory distress (e.g. tachypnoea, nasal flaring, grunting, retractions, indrawing, cyanosis)
- Diseases with low functional residual capacity (e.g. Respiratory Distress Syndrome, Transient Tachypnoea of Neonates, pulmonary oedema)
- Chronic lung disease
- Bronchiolitis
- Meconium aspiration syndrome
- Apnoea and bradycardia of prematurity
- Weaning from mechanical ventilation
- Tracheomalacia

1.5 Definitions

Continuous Positive Airway Pressure (CPAP)	CPAP refers to spontaneous respiratory support with a positive pressure that is maintained throughout the respiratory cycle. CPAP provides alveolar distension thereby increases functional residual capacity, improves lung compliance and improves gas exchange.
WOB	Work of breathing
FiO₂	Oxygen percentage (Fraction of inspired Oxygen)
F&P prongs or masks	Infant nasal prongs or nasal masks used in combination of the FlexiTrunk™ Infant Interface and F&P Bubble CPAP system to deliver CPAP.

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Single prong	An endotracheal tube that has been cut and shortened at the connector end and inserted via the nostril into the nasopharynx. (A small red tape must be wrapped around the tube to distinguish it from an ETT).
ETT	Endotracheal tube
F&P	Fisher & Paykel™

2 Clinical Management

2.1 Competency required

Registered Nurse who has completed CPAP orientation

2.2 Equipment

- Oxygen blender and flow meter
- Oxygen (O₂) analyser
- Oxygen tubing (green)
- Humidifier with temperature probes and wires
- 1 litre bag of sterile water
- Bottled sterile water (250 or 500ml)
- CPAP record sheet
- Fisher & Paykel™ Bubble CPAP infant delivery system
- **Fisher & Paykel™ CPAP**
- CPAP prong/mask hat, trunk, chin strap
- Measuring tape

Single Prong CPAP (as above replacing last 2 with below):

- *Portex Ivory Endotracheal tube* of appropriate size pre-cut length to ensure external space of 4-5cm once single prong is inserted (i.e. from nare to manifold)

Weight of Neonate	ETT Size	Length Inserted (Tied at)
<750g	2.5mm	3cm
750g-2000g	3mm	3-4cm
2000g-3500g	3.5mm	4cm
>3500g	4mm	5cm



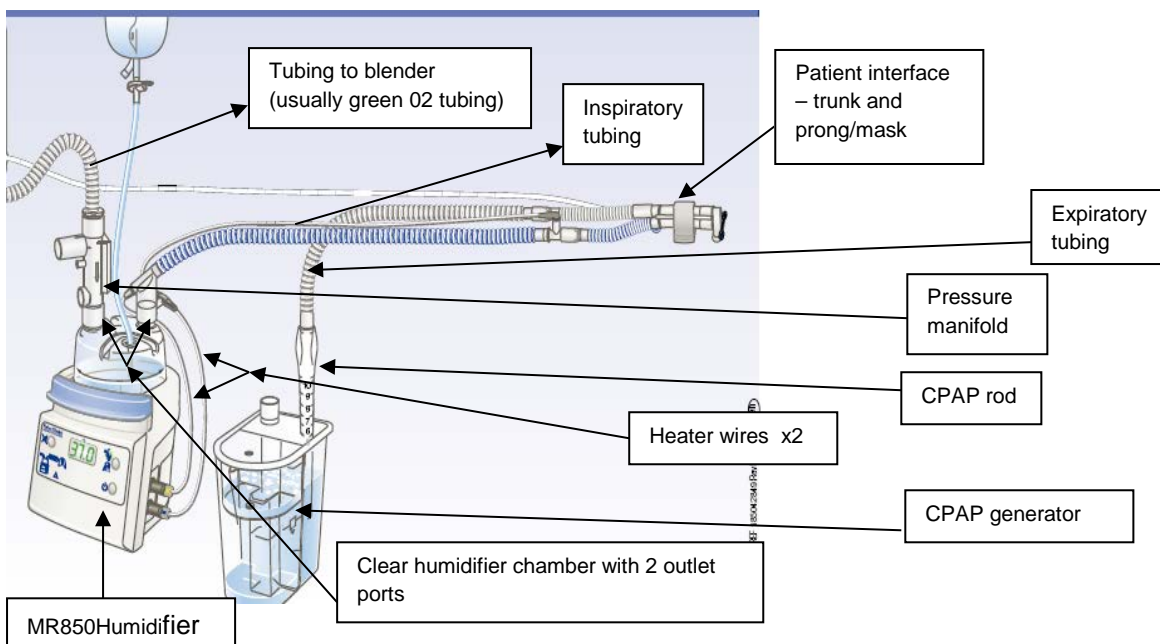
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- Connector for connecting inspiratory & expiratory (the swivel disc connector from a new ventilator tubing set – in Technician's workroom)
- Silk tie
- Brown tape/Leukoplast™ tape: 2 pieces each cut into "trouser legs"
- Lubricating gel or use infant's saliva as lubrication
- Comfeel™ protectant wafer: 2 pieces each cut to fit under tapes on infant's cheeks
- Gauze and sterile water (10ml vial): to clean face and dry
- ET chart for documenting length of single prong and for suctioning

2.3 Procedure

2.3.1 Setting up CPAP system – refer to diagram below for correct set up

- Temperature probes and green tubing - in technician's workshop
- BC161-10 CPAP pack – in store room (on a shelf next to the door)
- Water for injection 1000ml bag and bottle – in medication room
- Prong /mask /trunk /hat /chinstraps / measuring tapes – on trolleys in nurseries



2.3.2 Providing airway humidification

- Fit the humidifier chamber by sliding onto the MR850 humidifier base.
- Remove the blue plastic cover from 2 humidifier chamber outlet ports and discard.
- Attach the water feed set to the sterile water bag and hang from pendant hook above blender

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- Connect the white pressure manifold to either of the humidification chamber inlet ports.
- Attach the green oxygen tubing from the manifold to the flow meter of the oxygen/air blender.
- Use a blended gas source to provide accurate delivery of oxygen concentration to maintain SpO₂ within the appropriate range for infant's weight and gestation.
- Calibrate the oxygen analyser to room air on each shift.
- Connect the blue inspiratory tubing to the second humidification chamber port.
- Plug the short heater wire (yellow plug) to the humidifier base and the white plug at end of the blue inspiratory tubing.
- Plug long heater wire (blue plug) into humidification base, side and top ports of blue inspiratory tube.
- Turn humidifier on.

2.3.3 Set up CPAP generator

- Slide the plastic CPAP generator onto the mounting bracket (on pendant arm).
- Connect the clear expiratory tubing to the top of CPAP rod and set the desired CPAP pressure by pulling out or pushing in the rod. The number directly above the lid of the generator indicates the CPAP pressure in cm H₂O (usually 6-8cm).
- Note: keep the clear elbow connectors joining the ends of the inspiratory and expiratory tubes – place in container in pendant drawer.
- Fill the CPAP generator with sterile water until water reaches the maximum level as printed on the side.
- Empty overflow container regularly and PRN.
- Turn on the flow from the oxygen/air blender, starting at 6L/min. The flow can be increased to a maximum of 10L/min to achieve effective CPAP with medical confirmation.
- Note: A flow of 5 to 10 litres will provide adequate pressure to wash out CO₂ in the system, compensate for the normal air leakage and generate adequate CPAP pressure.

2.3.4 Testing circuit

- Test circuit for occlusions or pressure leaks before connecting to the infant to ensure correct setting up of the delivery system before connecting to infant:
- Connect the flow test elbow (□ clear elbow connector) to the inspiratory and expiratory tubing to obtain a closed system for checking air leaks.

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- Once elbow is in place and flow from blender is on – continuous bubbling should start in generator.
- If system is bubbling, delivery circuit can be connected to the infant CPAP interface.
- Final check for proper functioning before application: before applying the CPAP to the infant, check for bubbling again by occluding the nasal prong with fingers.
- Keep the flow test elbow in a container with blue cap. The test elbow can be used to keep circuit clean when infant is cycling off CPAP.

2.3.5 Application of CPAP – 2 nurses

Infant interface equipment for effective CPAP:

- **Hat/head gear** – measure the infant's head circumference. The correct sized hat should fit snugly. The hat should completely cover the ears and with the back edge at the base of the neck. The front edge should sit above the eyebrows with the foam pad sitting mid forehead. A snug fitting hat is important for fixing the trunk and prongs to the hat and reducing movements of trunk and prongs.
- **Trunk** – The trunk length should sit between the nares and the highest point of the head – 70 -100 will be the most common. The trunk should be positioned parallel to the infant's face when using prong and on a slight upward angle when using mask. The trunk has 2 extra forehead foam pieces which can be torn off or added to achieve this correct position (keep spare foam in container with elbow and blue cap).



For infant < 1.0 kg consider use of the 50mm trunk, this must allow movement of the forehead foam both upward and down – if in doubt use a 70mm (50 mm trunks are kept in the storeroom).

- **Prongs** – use the prong sizing guide (found in trunk package) to choose the correct prongs. Prongs should fill the nares completely without stretching the skin or putting undue pressure on the nares. Use the biggest possible size and the closest septum width. Blanching around the rim of the nostrils suggests that the prongs are too large; however, some mild blanching is acceptable for up to 30 minutes. Too small prongs cause increased airway resistance making it harder for the infant to breathe, and allow more air to leak from the system making it difficult to maintain the correct pressure.

REMEMBER: larger prong will deliver lower resistance = optimum CPAP

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- **Mask** – use mask sizing guide to select appropriate size mask, small, medium and large available – medium and large most suitable for our babies. Must be used with two pieces of forehead foam to minimise pressure on bridge of nose. Ensure a 2-5mm gap is present around edge of mask and outer edge of baby’s nose refer diagram on page 12 (section 2.3.4).
- Note: current medium mask is suitable for babies down to approximately 600g, sizing being reviewed by F&P).
- **Nasal Patch and Foam accessories** – These are available as second line adjuncts to be used if unable to obtain continuous bubbles, e.g. post extubation nares of different size or nasal trauma due to prongs riding fully into the nares and causing friction. Use your assessment and try alternative sizes and positioning before using these adjuncts.

(Refer to Appendix A: making of the foam pad, if needed after assessment)

- Document assessment and rationale for use in the care plan.
- All babies must start CPAP therapy using prongs unless otherwise directed by medical team
 - A mask may be introduced once baby is stabilised on CPAP with decreasing FiO₂.
- **Chin strap**
- **Neck “roll”** – use flannel folded in three under infant’s shoulders to provide gentle extension of the head without pressure on neck)
- Gastric tube & syringe if venting stomach air

2.3.6 Initiation of nasal CPAP

- On admission assessment and measurements should be done with the minimum delay to ensure CPAP is initiated/maintained ASAP.
- Commence continuous cardio-respiratory and SpO₂ monitoring on arrival in NICU.
- Assess and observe infant's:
 - Respiration - rate, pattern, work of breathing such as grunting, nasal flaring, sternal indrawing or rib retractions
 - SpO₂, and oxygen requirement
 - Cardio-vascular system - colour, cyanosis, heart rate
 - Temperature
- Place the selected hat on the infant’s head. The correct sized hat should fit snugly. Too loose: increase movement of trunk and prong, increasing the risk of nasal trauma. Too tight: potential for head moulding / pressure areas
- Use prongs for CPAP delivery in new admissions.

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- All babies must start CPAP therapy using prongs unless otherwise directed by medical team – the mask may be introduced once baby is stabilised on CPAP with decreasing FiO₂.
- Attach the selected prongs to the selected trunk. Ensure that the prongs are locked securely to the trunk (use rolling motion to fit prong to trunk interface).
- Connect the infant interface to the delivery circuit.
- Place a neck roll/pad under the infant's neck/ shoulder: Slight neck extension to keep airway optimal.
- Position the infant with the bed elevated to 30°. The elevated bed may decrease intracranial pressure and pressure on the diaphragm.
- Gently suction the mouth, nose and pharynx as necessary prior to commencing CPAP. Secretions may block the airway, increasing airway resistance and worsen the symptoms of respiratory distress, and/or cause apnoea and bradycardia.
- Use the largest sized catheter that can be passed into the nose without significant resistance.
- Insert the nasal prongs curve down into the infant's nose so that it sits well inside the nose with at least a 2mm gap between prongs and nasal septum.
- To avoid trauma to nasal septum, the prongs should not be pressed hard against the septum.
- If the infant is active, an assistant may help to hold the prong/ trunk in place while this is being secured to the hat.
- The foam block of the trunk should sit at the centre of the blue Velcro strap of the hat. Gently tighten the strap over the foam to hold the trunk securely in place. Do not overtighten as this may change the angle of the trunk and contribute to pressure areas on the forehead.
- Apply the chin strap to reduce air leak and pressure loss via the mouth.
- Position the chin strap directly under the chin and not further back towards the neck because too far back can occlude airway.
- Appropriate CPAP is indicated by constant gentle bubbling in the plastic CPAP generator – bubbles MUST be present at all times to ensure prescribed pressure is being delivered.

2.3.7 Infant assessment throughout each shift

1. Physiologic assessment

- Respiratory efforts: rate, breath sounds, WOB, FiO₂ requirement, auscultation
- Cardio-vascular system: central and peripheral perfusion, blood pressure as indicated
- Central nervous system: tone, response to handling and stimulation, activity.

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- Gastro-intestinal system: abdominal distension, visible bowel loops, bowel sounds, feed tolerance, and colour of aspirates.
- Axilla +/- peripheral temperatures
- Continuous SpO₂ and cardio respiratory monitoring and hourly recordings

2. Full infant interface assessment **MUST** be done, changes handed over to next shift and documented each shift:

- Hat, trunk, prong / mask size and fit
- Use of accessories, e.g. patch or foam
- Tubing placement and support
- Baby positioning
- Suction
- Nasal assessment
- Head assessment
- Calibrate the oxygen analyser to room air each shift to ensure accurate delivery of blended oxygen

3. Assess head shape

- Remove the hat 4-6 hourly during cares, gently massage and assess head shape.
- Note skin integrity and pressure areas such as forehead from pressure from foam piece and weight of trunk, and behind the ears and the neck folds for skin breakdown.
- Gentle massage will help to encourage normal head shaping.
- Parents can be involved in this aspect of care.
- Document findings.

4. Observation and assessment of nasal integrity:

- Hourly observation of position of prongs and integrity of the nasal septum to ensure correct prong position is maintained. Tissue will break down if it is subjected to continuous pressure, friction, and/ or moisture.
- Leave a minimum 2mm gap between nasal septum and the bridge of prongs
- During care time remove the prongs; clean the area around the nose and the nasal prong with water-moist gauze before replacing the prong.
- Ensure baby is off CPAP for minimum time during cares – use Neopuff to maintain CPAP during prolonged periods off, handling/changing of circuits or for parental cares

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- Once a duty perform nasal assessment with otoscope for signs of trauma such as redness, broken mucosa, bleeding. Document findings on shift assessment form and clinical notes.
- Inform NNP/CNS/Registrar about the nasal trauma if severe - in conjunction with the medical team, consider use of single-prong CPAP to allow trauma to heal.

5. Blood gas monitoring

- Monitoring of blood gases as indicated by the infant's condition or according to medical orders. Report and document results on NICU *Respiratory Care and Flow Sheet* (A1743HWF).

6. Assessment of abdominal distension/ CPAP belly:

- Assess abdominal distension with cares and report changes in colour, tightness, tenderness, and visible loops of bowels or increased distension.
- Some mild abdominal distension is expected during CPAP due to swallowed air; careful assessment to differentiate benign CPAP belly from pathophysiological changes.
- A recent feed on an already distended stomach may increase pressure on the diaphragm or result in reflux with aspiration. Place a size 6Fr oro-gastric tube in situ to aspirate and vent excess air as needed.
- Observe and document feed tolerance and aspirates. Aspirate excess air before feed helps relieve distension.
- Placing the infant prone (provided there are no umbilical lines) may relieve pressure on the diaphragm, improve feed tolerance and encourage the passage of stools and flatus. Ensure parents are aware of *Back to sleep* recommendations.

7. Checks during operations:

- Regularly observe that the water is feeding into the humidification chamber.
- Should the water level exceed the maximum level marked on the humidification chamber, replace the chamber.
- Check that all connections are tight before use and after any adjustment.
- Ensure air flow is present at all times.
- If air flow is interrupted, turn off the humidifier. Turn the humidifier back on after issues are resolved.
- Drain condensate from the circuit regularly and PRN
 - to ensure delivery of effective CPAP,
 - to prevent backflow into the baby's nose

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- to reduce noxious noise stimuli
- Regularly observe the CPAP generator for bubbling. If bubbling is not observed, check for and minimise air leaks in the system and the patient.
- Regularly observe the water level in the CPAP generator and overflow container. Refill the CPAP generator if the water level drops below the minimum water level line.
- **Check and empty the overflow container once every shift or as needed.**

2.3.8 Care of infants on CPAP

1. Developmental care

- Provide neuro-developmental supportive care to minimise stress and maintain baby's physiological stability.
- “Hands on” intervention should be cue-based if possible.
- Initially some fine tuning of the CPAP system may be necessary but limit handling to essentials such as suctioning and core temperature monitoring.

2. Infant's positioning

- Encourage flexion with nesting to promote containment and reduce stress.
- Change infant's position regularly, e.g. 4-6 hourly, facilitates the clearing of secretions.
- Use of positioning aids, rolls and skin to skin as needed to promote infant comfort.
- Encourage flexion with nesting to promote containment and reduce stress.
- Document any individualised positioning needs in the care plan.

3. Regular condensate clearance:

Note: Excess moisture in trunk and tubing can narrow lumen and interfere with flow delivery and cause noxious noise stimuli.

- If excess condensate is accumulating in trunk, remove the prong and trunk and shake out the condensate onto paper towels.
- Drain excessive condensate collected in both the inspiratory and expiratory tubing's frequently to avoid fluid lavage into nares with movement.

4. Weekly circuit change: 2 nurses

- Change the entire CPAP circuit and patient interface weekly on night shift.
- Set up CPAP circuit as step 2.3.1
- One nurse uses the Neopuff™ to provide continuous CPAP to the baby.

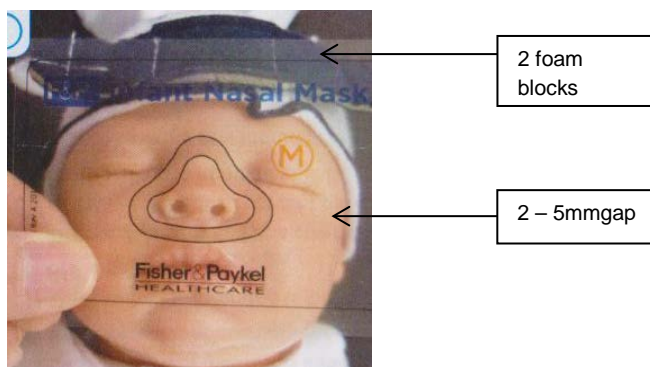
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- The other nurse removes the old circuit and patient interface, and replaces it with the new circuit.
- Check the CPAP system that it is correctly setup and delivering the prescribed CPAP.
- Place sticker with date due for change on generator.
- Dispose of used circuits and interface to rubbish bin.

2.3.9 Use of Mask CPAP

1. Following steps in sections 2.3.1-2.3.8 for care of the infant on nasal prongs.
2. Set up, assessment, observation and infant monitoring of infant on mask CPAP is same as on prong
3. When fitting the mask ensure a 2-5mm gap is present between inner edge of mask and outer edge of nose (refer diagram below) to avoid pressure on outer edge and tip of nose due to tight fit.



- a. Ensure lower edge of mask is above upper lip line to avoid excess pressure on area across philtrum, upper lip and gum.
- b. Always add extra foam block to forehead pad to alter angle of mask away from bridge of nose to avoid risk of pressure areas across bridge of nose and excess pressure on tip of nose due to angle of mask.

Do not use duoderm to bridge of nose unless skin is broken.

4. Alternate mask and prong as per infant care times up to maximum of 4-6 hour continuous mask use.

Note: International guidelines recommend 4 hr alternating cycles on prong and mask to minimise inner and outer injury to the nose and avoid pressure area development.

5. Remove mask with cares and wipe skin under mask with sterile water then massage infant skin to clean skin and restore circulation to areas of pressure under mask.

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6. Assess skin integrity and document and report red or broken - duoderm thin may be applied to broken skin. Document and report duoderm application time and date of placement.
7. Mask CPAP runs on flow and pressure parameters same as for nasal prong.
8. Appropriate CPAP is indicated by constant bubbling in the plastic CPAP generator – tighten interface with Velcro straps using the **minimum** pressure required to achieve bubbling.

2.3.10 Single prong CPAP

1. Determining the CPAP interface to be used FlexiTrunk™ prong/mask system or single prong

The decision of whether to use a single prong or FlexiTrunk™ is a combined medical and nursing decision. If there are specific clinical indications for a particular interface, medical staff should document this on the CPAP order.

Preferred interfaces:

Clinical Situation	Preferred Interface	Rationale
Premature lung disease	FlexiTrunk™, alternate between nasal prongs and mask Consider nasal flow if appropriate Single nasal prong	Avoids nasal trauma Reduces attenuation of pressure
Nasal injury related to long term bi-prong CPAP use		Better tolerated
CPAP greater than 8cmH ₂ O is required, e.g. post extubation in an infant with congenital diaphragmatic hernia or meconium aspiration syndrome	Single nasal prong	Better continuity of CPAP
Oesophageal surgery/injury	Avoid CPAP (particularly higher settings) if possible. Consider nasal flow. If used SNP may be better tolerated in older infants.	CPAP may increase risk of oesophageal leak particularly if tissues friable

Important Note:

In neonates with upper airway obstruction e.g. neonate with Pierre Robin Sequence (PRS), insertion length differs in that the tube bypasses the obstruction. Consult medical staff for clarification if required. A SNP inserted too deeply will cause the infant to or will produce bradycardic episodes from vagal stimulation.

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1. Application:

- Prepare endotracheal tube, cut to length and cotton ties tied at the correct length add patient swivel disc connector.
- Place Doderm™ on neonate's cheeks.
- Lubricate the single prong with infant's saliva or lubricating gel.
- Suction nasopharyngeal and oropharyngeal passages to clear secretions.
- Gently insert the single prong and secure with strapping as per securing an endotracheal tube.
- Connect to CPAP system – checked, set up correctly and delivering the prescribed CPAP.
- Cut a small piece of the red medication label to make a red tape.
- Wrap the piece of red tape around circuit manifold (where ventilator tubing connects to single prong) to identify the tube as cut and shortened to become a single prong.

Note:

The single prong must be removed prior bagging during resuscitation because it is a naso-pharyngeal prong, not an ET tube.

2. Ongoing care and considerations:

- Respiratory assessment:
 - Blood gases as required (determined by clinical condition and previous blood gases)
 - Respiratory rate
 - Heart rate
 - Chest rise and fall
 - Work of breathing
 - Oxygen requirements
 - Pulse oximetry
 - Capillary refill time
- Ensure patency of single prong: suction as necessary.
- Prong not routinely changed.
- Consider elective tube changes if secretions are thick or copious, if the single prong strapping becomes loose and the single prong is no longer secure or becomes mobile.
- Alternate sides if possible when replacing tube – avoids over stretching of one nare.
- Withhold feeds prior to single prong tube change and aspirate stomach.

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- Do not put a sodium chloride 0.9% lavage into a single prong as this will result in aspiration of fluid which cannot be removed from the lungs by suctioning the single prong.
- Enteral feeds can be administered via naso/oro gastric tube, however due to the increased risk of abdominal distension, ensure increased venting/aspiration of naso/oro gastric or other gastrostomy tubes, including when on continuous feeds.
- Ensure gastric decompression with naso/oro gastric tube in situ and open for venting.
- Infant assessment and monitoring: refer to steps 2.3.7.
- Care of babies on CPA: refer to steps in 2.3.8
- Change circuit weekly: refer to step 4 in 2.3.8
- Adequate attention to pressure area care: especially to nostrils and nasal septum:
- Avoid nasal trauma/erosion by ensuring single prong is always secure and strapping is not loose.
- Position the single prong in a downward arch to avoid pressure on the nares, ensure CPAP circuit tubing appropriately supported/secure; use of circuit holders/devices to prevent tension on the single prong.
- Consider using alternate nostrils when changing the single prong to avoid pressure area development.

2.3.11 Suction to maintain clear airway:

1. Equipment

- Non sterile gloves
- Sodium chloride 0.9 %
- 1ml syringe
- Gauze
- Suction catheters size 5/6Fr and 8Fr as appropriate
- Bedside suction unit set \leq 100mmHg
- Otoscope for nasal assessment

2. Indications for suction:

- Increased secretions
- Increased respiratory effort
- Increased oxygen requirement
- Increased respiratory distress
- Increased apnoea

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Infants on CPAP must be suctioned a minimum of 4-6 hourly or PRN to ensure a patent airway. Some older stable babies on CPAP with scant secretions may be considered for a variance from the recommendation. ***This must be discussed with the NNP/CNS/medical team and clearly documented in the infant care plan.***

Note: When midline CPAP is discontinued, suctioning will be required at least **6 hourly OR** more frequently if symptomatic, for the first 24 hours then as required to maintain a clear airway.

3. Suctioning baby on F&P prongs and mask

- Suction 4-6hourly with cares.
- Collect equipment and perform hand hygiene
- Use the largest sized catheter able to be passed into the nasopharynx without significant resistance.
- Very preterm infant: use Fr size 5/6 catheter for nares and Fr size 8 for mouth.
- Larger babies: use 8Fr for both.
- A size 10Fr may be necessary for very thick sticky oral secretions.
- If bleeding is seen or nose is traumatised and does not permit suctioning with catheter, do “hub” suctioning
- Ensure Neopuff™ /anaesthetic bag is within reach if needed. Consider a two-person procedure for Low Birth Weight or unstable infants.
- If baby is very unstable consider removing only one side of the CPAP prong at a time to continue positive pressure during suctioning.
- Position infant supine or slightly lateral to face you. Wrapping may assist to maintain position and gently hold baby’s head as you insert catheter.
- Measure from nose to tragus, and then add approximately half that distance to measurement already obtained.
- Insert catheter directing gently toward back of nare on a slight upward angle - ensure the catheter passes to the back of nasopharynx to clear secretions.
- **Apply suction only during withdrawing catheter**
- Gently suction the mouth first then nose and pharynx.
- Sodium chloride 0.9% instillation is only used if secretions are deemed to be thick and tenacious on individual assessment.
- Sodium chloride 0.9% instillation is a noxious procedure and should only be used if indicated.
- Note and document the amount, colour and tenacity of the secretions.
- Dispose of used equipment in the appropriate rubbish container and rinse suction tubing with a saline ampoule.

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4. Suctioning baby on single prong

- Measure suction catheter to length of nasal prong and document on single prong chart (same as ET intubation chart)
- If necessary, can use baby's saliva to lubricate the suction catheter before putting in the nares.
- Pass suction catheter to pre-measured length, apply suction to finger control and withdraw steadily – suction catheter should be able to easily pass through the tube without fully occluding it but must be large enough bore to remove thick secretions
- If baby exhibiting labile SpO₂ and unable to obtain secretions via suctioning prong, remove prong, suction nares as above and replace with new prong.
- Note colour, type and amount of secretion on observation chart.
- Dispose of used equipment in the appropriate rubbish container and rinse suction tubing with a saline ampoule.

2.3.12 Trouble-shooting CPAP

Note: Ask another nurse to help and use Neopuff to provide CPAP during troubleshooting

1. CPAP not bubbling:

Note: No bubbling indicates loss of air flow or a leak in pressure in the system.

To differentiate “circuit” or “infant” problem, remove the prongs/mask from the nose and occlude with fingers, if system does not bubble, this indicates circuit problem. If system does bubble, this indicates pressure leak from the infant.

- Systematically check the circuit from the infant end to the O₂ blender including:
- Prongs/mask fitting snugly in/around the nose
- Correct placement of chinstrap
- Is the trunk connected to the circuit tubing?
- Check pressure probe port on trunk is closed because there is a little plug on there that's never used but sometimes comes open.
- Connections from the humidifier, temperature probe and O₂ analyser well fitted?
- Adequate flow – 5-10L/min?
- Generator filled with water and pressure rod set at the correct pressure?
- Humidifier connected to a water bag and turned on?
- After the above actions and bubbling resumes, reposition the prongs/mask and recommence the CPAP.
- If still no bubble consider using a patch?
- If no bubbling after the above actions and unable to track problem, ask for help.

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2. Inaccurate oxygen analyser:

- Remove oxygen analyser and calibrate in room air and in 100% O₂.
- Replace with new batteries if needed or analyser shows 'Low battery'.
- Acceptable range of variation is $\pm 3\%$ between the O₂ blender and the O₂ analyser, e.g. blender dial 30%, analyser reading 27%.
- Replace unit if unable to calibrate to within $\pm 3\%$.

3. Humidifier overheating

Note: Delivery of gas at core temperature and saturated with water vapour maintains secretions quality and maximises mucociliary transport, facilitating removal.

Optimal humidity preserves gas exchange and helps prevent infection.

- The humidifier warms and saturates the gas to a temperature of 37°C. At times the humidifier heats up to > 39°C to achieve this (depends on the room or incubator temperature, the cooler the ambient temp, the higher the humidifier temp).
- Acceptable range of humidifier temp > 36°C to 40°C.
- If humidifier temperature reads >40°C, dry temperature probe with gauze.
- If problem is not resolved, change temperature probe.
- Drain all excess rainout from the inspiratory tubing.
- If problem is still not resolved, remove humidifier from use.
- Ensure **blue tubing exits from the top incubator exit port and clear tubing exits from lower port** to facilitate drainage of condensate in clear tube.

4. The prongs/mask won't stay in place

Note: Select correct size nasal prong/mask with correct septum width.

The hat anchors the trunk and prong/mask, a loose hat will allow movement of the interface when head moves

- Is the prong/mask a snug fit?
- Is the hat a snug fit?
- Is the trunk the correct length?
- Is the trunk firmly fixed on the forehead and at correct angle?
- Is there rotating pressure on the prongs/mask causing them to twist out of the nares?
 - To release the rotating pressures disconnect the trunk from the circuit tubing, reposition the prong/mask and trunk.
 - Support the tubing with a roll to minimise drag and weight allowing tubing to sit naturally.

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5. The baby won't settle

Note: The prongs can cause some discomfort at times due to friction on delicate nasal tissue

- Does the infant needs suctioning?
- Try the calming techniques of containment, nesting, swaddling, pacifier, etc.
- Consider using a foam to prevent the prong riding fully up into the nares
- Aspirate excess gastric air and leave to vent.
- Try positioning the infant prone.

6. Nasal trauma and septal damage

Note: *Sub-optimal prong position causes friction and excoriation of nasal tissue.*

Pressure on the nasal tissue reduces perfusion and causes pain and further trauma.

- **Vigilant, frequent observations and correct application is the key to prevention.**
- Use correct size prongs, mask hat, trunk as outlined above (in the application instructions).
- Discuss with medical team variation to time on mask while nares are healing.
- Individualised planning of care in specific circumstances may be indicated.
- For infant under phototherapy, make sure that the eye pad does not obscure your view of the septum and prong position.
- Hourly observations to ensure prongs are not pushed hard up against the septum, reposition prongs as required. Consider foam pad.
- Use rolls to support weight of trunk and tubing, check that tubing is not twisted and no upward or lateral pressure on the nares.
- Use saline drops/baby's saliva to moisten the nares for initial prong insertion or during suctioning if indicated.
- **Do not use any other cream, gel, or ointment unless prescribed.**

2.3.13 Trialling off CPAP

- It is a medical decision when to trial the infant off CPAP.
- Nursing staff should have an input in this decision: Nurses report how the infant handles and tolerates without CPAP.
- **Use the clear test elbow to connect the inspiratory and expiratory tubing to maintain a closed circuit.**
- Reduce the flow to 2L/ min to maintain a flow through the closed circuit reduces risk of infection in the tubing

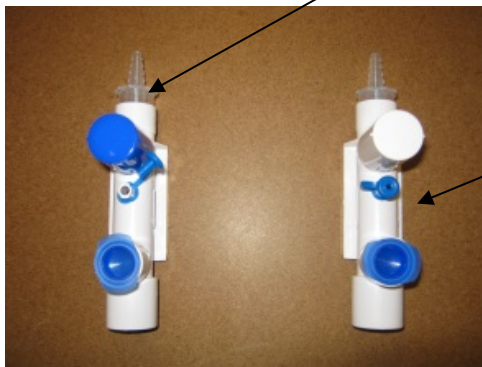
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- Turn off the humidifier.
- Disconnect the trunk from the circuit tubing and place the circuit **outside the incubator/cot** to prevent inadvertent administration of oxygen for babies and avoid oxygen toxicity.
- The infant should not have any other treatment changes for 24hrs while trialling off, e.g. no feed increases, bathing, change from cot to incubator, etc. Too many changes at once may tire the infant – need to assess the infant's tolerance off CPAP without other potential reasons for tiring

Note: If cycling between CPAP and humidified nasal flow ensure the correct manifold is used:
 White CPAP pressure relief valve (17cm/H₂O at 8L flow)
 Blue HNC pressure relief valve (45cm/H₂O)

Manifold with blue cover: Humidified Nasal Cannula (HNC)



Manifold with white cover: CPAP

2.4 Potential complications

- Ineffective ventilation
- Nasal obstruction
- Pneumothorax
- Variable pressure delivery due to air leak from mouth
- Erosion of septum
- Nasal trauma from prolonged CPAP therapy
- Gastric distension
- Head moulding

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2.5 After care

- Empty water from the pressure generator and water bag and dispose the used circuits and accessories into rubbish bin. Leave the spike in the water bag to prevent injury to any staff handling the rubbish.
- Place the temperature probes in the Cleaning Room for NICU Healthcare Assistant/ Housekeeper for cleaning.

3 Audit

3.1 Indicators

- All CPAP equipment is setup as per 2.3.1
- The choice of infant interface equipment ensures effective CPAP – see 2.3.5
- A documented assessment is available for all infants on CPAP for every shift – see 2.3.7

4 Evidence base

4.1 References

- Fisher & Paykel Healthcare (2011). Bubble CPAP system set up guide. Auckland: Author. Retrieved on June 20, 2019 from <https://resources.fphcare.com/resources/corporate/media/resources/resources/pm-185034215-a.pdf>
- Fisher & Paykel Healthcare (2016). *Bubble CPAP Clinical Paper Summaries*. Auckland: Author. Retrieved from <https://resources.fphcare.com/resources/corporate/media/resources/resources/pm-185034215-a.pdf>
- Lista, G., et al. (2010). Nasal continuous positive airway pressure (CPAP) versus bi-level nasal CPAP in preterm babies with respiratory distress syndrome: a randomised control trial. *Arch Dis Child Fetal Neonatal Ed.* 95,2, F85-F89.
- Kenner, C. and Lott, J. W. (2014). *Comprehensive Neonatal Nursing Care* (5th Ed.) New York: Springer Publishing Company. (eBook)
- Roberts et al. (2011). Trends in use of neonatal CPAP: a population-based study. *BMC Pediatrics* 2011, 11:89. Retrieved on June 20, 2019 <http://www.biomedcentral.com/1471-2431/11/89>

4.2 Associated Waikato DHB Documents

- Waikato DHB NICU Medical Guideline: Respiratory support clinical guideline: Premature infants <36 weeks in Waikato NICU (2760).
- Waikato DHB NICU Medical Protocol: Oxygen therapy (2769).

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- Waikato DHB NICU Nursing Procedure: Admission to Level 3 intensive care nursery (4571).
- Waikato DHB NICU Nursing Procedure: Endotracheal Suctioning in Newborn Intensive Care Unit (NICU) (5962).

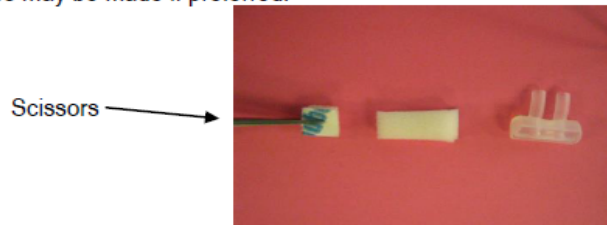
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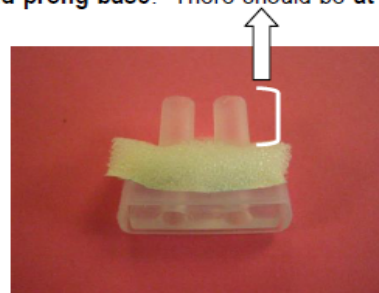
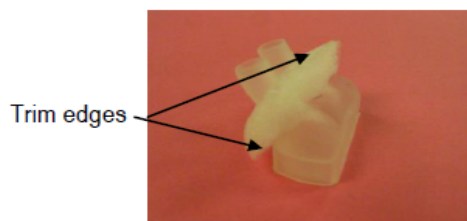
Appendix A: Instructions for making the foam pad

Instructions for Making the Foam Pad

- Using a piece of foam for peripheral temp probes, cut a thin strip approx equal to size of prong. Fold in half and make a slit through the middle – make sure it's wide enough to accommodate prong. Holes may be made if preferred.



- With adhesive paper facing away from baby, insert the prong through the slit and peel off backing paper. **Trim foam pad to fit only around prong base.** There should be **at least** half of the prongs length visible through the foam.



- Attach prong to trunk in usual manner. Then insert into baby's nose and fasten as usual, take care not to fasten too tight as visualisation of the nose tip is limited.



- Application hints:

- Keep the foam piece as small as practical to allow observation of nose
- Compress foam to enable maximum length of prong is available to insert into nose
- Change pad each time cares are done – to maintain hygiene around nares
- Don't have too large that foam pad sits over lips – possible abrasion potential
- Careful observation of prong position at least hourly (foam reduces insertion depth of prong into the nares which can cause prong to pop out more easily which may be difficult to see)
- This is another tool for your CPAP management – not aimed at replacing Duoderm as there may be times that more than one “tool” may be required to achieve a good seal, good bubbles and avoid the prong riding up fully into the nares.

Thank you,
Leanne (on behalf of the Respiratory Care Team)
 Acknowledgement to Marion Morris for this idea.

December 19th 2012

Foam Pad for CPAP Prongs



Aim: To stop the prong riding fully into the nares and injuring both the internal tissue and causing pressure on the external nasal septum.

May be used alone or in conjunction with a patch.

NB: Watch carefully for signs of “snubbing” of the nose during use, ie: nose becoming creased and tilted back toward face due to pressure. Discontinue use of foam if this is a problem.



NB: Good seal and bubbling must be achieved using this foam pad to ensure good CPAP pressure is achieved.