

## RESPIRATORY CARE OF THE NEONATE

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### Critical Points

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1. Provider orders for respiratory support include all settings, range of oxygen saturation, and reportable parameters. Alarms are set by the clinical RN to match saturation orders.
2. Registered Nurses (RNs) and Respiratory Care Practitioner's (RCPs) document oxygen percentage with other vital signs and PRN change.

### Procedure

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#### ASSISTING WITH INTUBATION

1. A guideline for estimating measurement at the lip is: 6 plus the weight of the infant in kg. (i.e., a 2 kg infant has a tube at the gum at 8 cm) or 1 kg, 2 kg, 3kg, 4 kg is 7 cm, 8 cm, 9 cm, 10 cm respectively.
2. Refer to table for recommended endotracheal tube size based on weight and gestational age.

**Table 1.**

Tube Size (mm) (inside diameter)	Weight (g)	Gestational Age (wks.)
2.5	< 1,000	< 28
3.0	1,000- 2,000	28-34
3.5	2,000- 3,000	34-38
3.5-4.0	>3,000	>38

3. Prior to elective intubation procedure, obtain provider order for pre-intubation medications.

**RESPIRATORY CARE OF THE NEONATE (*continued*)**

4. Safe ETT tube tip placement is between T-1 to T-2, or about 1 cm above the carina. Placement will be confirmed via x-ray by the provider.
  - Centimeter marking at the lip is documented once a shift and PRN.
  - RN and RCP are present for x-rays done for tube position to verify infant is in neutral position and the cm marking is confirmed as indicated in the EMR.
5. Oral care for intubated patients should be performed every 3-4 hours to prevent ventilator associated pneumonia (VAP). This care is done with colostrum or fresh breast milk per [Oral Care with Breastmilk Nursing Procedure](#), as available, or sterile water if no breast milk is available.
  - To remove crusty material or loose skin from lips, use a 2x2 gauze and sterile water.
  - Lips can be lubricated with a light application of Aquaphor.
6. For infants who are intubated and  $\geq 48$  weeks corrected gestation, use the Oral Care kits and refer to [Oral Care Guidelines for Pediatric Critical Care](#).
7. Separate suction systems for ETT suctioning and for oral suctioning are used. Inline suction set-up is changed daily. Oral suction set-up is changed as soiled.

**SUPPLIES**

- Stethoscope
- Endotracheal tube (ETT) of appropriate size for patient (See [Table 1](#))
- Laryngoscope with appropriate size blade
- Stylet
- Tube securement device
- Skin prep (i.e. Cavilon)
- Skin barrier (i.e. Duoderm)
- Suction catheter attached to designated ETT wall suction
- Resuscitation bag and mask ventilation system with oxygen blender
- O<sub>2</sub> saturation monitor and probe
- Disposable end-tidal CO<sub>2</sub> detector
- Rapid sequence intubation medications as ordered by provider
- Oral Care Kit (PMM: 6326100)

**INTUBATION PROCEDURE**

1. Gather and assemble all equipment for intubation on a clean surface
2. Position patient close to end of bed with neck semi-extended, in a "sniffing" position.
3. Aspirate gastric contents prior to intubation, if able.
4. Monitor tolerance to the procedure (HR, RR, O<sub>2</sub> saturations).
5. Suction airway as needed during procedure and per provider request.
6. Assist in placement of an end-tidal CO<sub>2</sub> detector to indicate the presence of CO<sub>2</sub>.
7. Once intubated, listen for equal bilateral breath sounds; assess color, heart rate, and O<sub>2</sub> saturation.
8. Assist RCP with securing ETT, confirming position of the blue line (to the left) and cm marking at lip.
9. Continuously monitor infant until x-ray is obtained and ETT is secure.
10. Assist with x-ray for ETT tip placement. Maintain head in a lateral neutral position with cm marking at lip confirmed prior to film. Remove all objects that will interfere with the x-ray and position infant flat in bed with no rotation.
11. After successful intubation, document:
  - Size of ETT
  - How infant tolerated procedure

## RESPIRATORY CARE OF THE NEONATE (*continued*)

- ETT cm marking at lip
- Presence of bilateral breath sounds.

### TAPING THE ENDOTRACHEAL TUBE

1. Verify ETT placement from the most recent x-ray. Note the most recent centimeter marking documentation of where ETT should be or when ETT was previously found to be in correct placement.
2. RN should wrap 2x2 gauze around finger. Place finger in infant's mouth and gently press tube against upper gum, or hold with thumb and index finger and place rest of fingers under chin. RCP will then remove old securement.
3. RCP should rotate ETT before securing so blue line points to infant's left side.
4. RN should focus on holding the tube and ensuring cm marking at lip does not move as RCP cleans, applies skin prep, and secures ETT.
5. Once secured, listen for equal breath sounds.
6. If using a NeoFit, pass an inline suction catheter and withdraw to ensure device does not impede suctioning.

### SUCTIONING THE ENDOTRACHEAL TUBE

1. Suctioning is done when clinically indicated and not as a routine. Normal saline use should not be routine but used only as indicated when secretions are too thick to remove.
2. Assess respiratory status, vital signs, saturations, TCM, work of breathing, chest movement, and presence of secretions to determine need for suctioning.
3. Suctioning may be performed by RCPs or RNs.
4. The 2 methods of suctioning for all patients on conventional ventilation are:
  - In-line suctioning (closed) – this is the preferred method to reduce risk of pneumonia, prevent alveolar collapse, and maintain functional residual capacity.
  - Two person suctioning using hand ventilation – for patients who do not tolerate in-line suction
5. Ensure ventilator tubing is positioned horizontally to prevent fluid from entering airway.
6. Perform oral care, including suctioning of mouth, prior to endotracheal suctioning.
7. Two Person Suctioning Procedure
  - Gather and assemble the following equipment and supplies:
    - Suction catheter kit (including sterile gloves)– appropriate size to maintain Functional Residual Capacity (FRC) and minimize tracheal damage:

Catheter Size	Tube Size
5/6 Fr	2.5 mm
5/6 Fr	3.0 mm
8.0 Fr	3.5 mm

- Sterile water for clearing the catheter
  - Resuscitation bag and mask ventilation system, turned on
  - Dedicated ETT suction system set to 60-80 mm Hg
8. Open appropriately sized suction catheter and connect to tubing.
  9. Don sterile gloves.

**RESPIRATORY CARE OF THE NEONATE (*continued*)**

10. Remove catheter from package and maintain sterility by using dominant hand to hold catheter. Using other “clean” hand, connect suction tubing to suction catheter.
11. Have person assisting disconnect infant from ventilator or flow inflating bag. To avoid contaminating ventilator circuit, place cap on circuit end.
12. Determine suction catheter depth by lining up a readable number on ETT with same number on catheter. Pass suction catheter quickly to identified number without applying suction, apply suction for 2-3 seconds and withdraw catheter.
13. Reconnect to flow-inflating bag or ventilator and ventilate until return to baseline.
14. Limit to no more than 2 suction catheter passes before allowing infant to recover.
15. Assess and document secretions obtained for color, odor, amount, and consistency.
16. If unable to pass catheter or obstruction is suspected, notify provider and:
  - Listen for bilateral breath sounds.
  - Place end tidal CO<sub>2</sub> detector in line and check for color change.
  - Attempt to suction for tenacious secretions or “plugs” using normal saline bullets as needed.

**IN-LINE (CLOSED) SUCTIONING**

1. Perform hand hygiene.
2. Determine suction depth by lining up a readable number on ETT with same number on catheter. Identify the safe suctioning depth color that lines up with the number.
3. Unlock thumb control suction valve by turning 180°.
4. Open lavage port cap and insert end of saline bullet. Use saline lavage only when necessary and then sparingly, in most cases it is not needed or beneficial.
5. Stabilize catheter and ET adapter with one hand, then advance catheter into ETT with thumb and forefinger of opposite hand.
6. Depress suction thumb control valve and hold; withdraw catheter slowly, approximately 5 seconds. Stop withdrawal when black mark is visible within window. Entire procedure should take less than 10 seconds.
7. Lavage with normal saline if indicated:
  - Advance catheter 5-8 centimeters into ETT.
  - Instill a small amount of saline through lavage port
  - Continue to advance catheter to desired depth and depress thumb control, withdraw catheter slowly.
8. Clear catheter after each use. A catheter clogged with mucus will lose effectiveness.
  - Withdraw catheter completely. Black marking on catheter tip should be completely visible within window. If left in airway, it will severely impair ventilation. When pulled back beyond window it will create a leak and “ballooning” of in-line sleeve.
  - Squeeze saline bullet into irrigation port. Simultaneously depress thumb suction control valve.
  - Continue irrigation until secretion viewing window, catheter, and tubing cleared.
  - Remove saline bullet and close irrigation port. Lift and turn thumb control valve 180° to lock position.
  - Assess the secretions obtained for color, odor, and consistency.
  - Document findings on the appropriate record.

**UNPLANNED EXTUBATION PREVENTION**

1. Assess integrity of securement device and report concerns to RCP and retape if necessary.
2. Use ETT Retaping checklist ([Appendix A](#)) prior to retaping (unless emergent situation).
3. Follow standard positioning for chest x-rays using Bedside Imaging Guide ([Appendix B](#))

**RESPIRATORY CARE OF THE NEONATE (*continued*)**

- Utilize 2 persons for high risk situations, with one person (RN/RCP/Provider) dedicated to the ETT.

**EXTUBATION CRITICAL POINTS**

- Providers qualified to re-intubate should be present in unit prior to extubation.
- Gather and set up at the bedside all supplies necessary to re-intubate. (See [Supplies](#))
- Obtain order and equipment for post extubation treatment prior to extubation.
- Ensure suction is ready for use.
- Monitor transcutaneous CO<sub>2</sub> and O<sub>2</sub> saturation during procedure.
- Plan extubation to occur just prior to next feeding time. Aspirate gastric contents as needed.

**EXTUBATION PROCEDURE**

- Gather and set up at bedside all supplies necessary to re-intubate (See [Supplies](#))
  - Intubation [Supplies](#)
  - Oxygen therapy as indicated/ordered, e.g., NCPAP, HFNC, etc.
  - Syringe for aspiration of stomach as needed.
  - Suction set ups (one for oral and one for ETT suction)
- Confirm provider qualified to intubate is within immediate area and RCP is present.
- Aspirate stomach as needed.
- Suction mouth and ETT until clear, allow infant to recover before ETT is pulled.
- Gently loosen tape from face using adhesive remover and stabilize ETT with fingers.
- After extubation, gently suction oropharynx as needed.
- Assist RCP with securing oxygen delivery system (NC, HFNC, NCPAP or SiPAP).
- Assess and document: breath sounds, skin color, respiratory rate, oxygen saturation, and any evidence of respiratory distress.
- Position as appropriate for achieving optimal ventilation while allowing close assessment.
- Observe for signs of intolerance after extubation, including grunting, apnea, nasal flaring, increased work of breathing, increased oxygen requirements, increased TCM readings, stridor, or hoarseness.
- Continue monitoring and obtain blood gases as ordered.

**CARE OF INFANT ON NASAL CPAP/SiPAP**

- CPAP (Continuous Positive Airway Pressure) improves functional residual capacity and oxygenation.
  - Bubble CPAP can be used in infants < 34 weeks gestation
- CPAP orders will include the cm of pressure to be maintained and FiO<sub>2</sub>.
- SiPAP order will include high pressure, CPAP pressure, FiO<sub>2</sub>, set rate, and inspiratory time.
- Place an OG tube, if not already in place to allow for stomach decompression and reduce abdominal distention.
- Leave OG tube open to vent after feedings. Use the smallest sized tube that can effectively vent air.
- Equipment/Supplies:
  - Nasal CPAP system
  - Appropriate size hat based on infant's head circumference

## RESPIRATORY CARE OF THE NEONATE (*continued*)

- Appropriate size nasal mask, and/or prongs (use measuring guide to measure appropriate size)
  - Consider using a pacifier or chin strap to reduce pressure loss through an open mouth
7. Change hat and straps every day and as needed.
  8. Notify RCP for loss of pressure that cannot be improved with positioning changes and adjustment of mask or prongs.
  9. Coordinate examination of skin integrity of nose and skin under CPAP hat, mask, and/or prongs with RCP at least once a shift. RN should examine skin integrity under mask or prongs every three hours and PRN. Alternate interface of device every 3 hours.
  10. Notify provider for signs of skin injury and document. Discuss with provider a change of delivery and treat injury as appropriate. Consult with Unit CNS/Wound CNS for skin injuries.

## SKIN CARE FOR NON-INVASIVE VENTILATION (CPAP/SiPAP/NAVA)

1. Refer to [Appendix C](#) for Non-Invasive Pressure Injury Prevention Guidelines.
2. Mepilex is routinely used under CPAP mask, unless interfering with seal.
3. During bathing, coordinate with RCP to minimize time off of CPAP.
4. For all skin breakdown, notify Provider, RCP, and ICN CNS/Wound CNS.
  - If breakdown advances beyond Stage 1 complete an Incident Report. See [Skin Integrity Stages](#) or [Wounds and Skin Integrity Impairment-Potential or Actual \(General\)](#)

## OXYGEN ADMINISTRATION

1. All infants on oxygen have written parameters for target saturations and monitor alarms set to match ordered target ranges.
2. Providers are notified when saturations cannot be maintained in the ordered range.

## NASAL CANNULA

1. Standard nasal cannulas are used to deliver flow of  $\leq 2$  liter/minute and are humidified.
2. Orders include flow rate, saturation, and saturation range to be maintained.
3. Equipment
  - Cannula
  - Humidifier
  - Securing device
  - Blender
4. Procedure
  - Secure cannula just below nares and ensure size is appropriate.
  - Verify flow and oxygen concentration.
  - Examine nares every 3-4 hours and prn; suction only as needed.
  - Report and document breakdown.

## HIGH FLOW NASAL CANNULA

1. Delivers higher flows ( $>2$  LPM) through a nasal cannula with high humidity ( $>95\%$ ).
2. It is helpful in preventing heat loss associated with standard cannula.
3. It allows higher flows to be delivered without patient discomfort.
4. It is proven effective in mobilizing dry or thick secretions.

**RESPIRATORY CARE OF THE NEONATE (*continued*)**

5. Water droplets may appear in the cannula and get into the patient's nares. This is not unusual and should not be a cause for concern.
6. Equipment
  - HFNC setup with warmed circuit
  - Nasal cannula, appropriate size
  - Materials for securing nasal cannula
7. Procedure
  - Apply HFNC and appropriate securing device.
  - Contact provider if saturations are not in ordered range.
  - Contact RCP for concern about amount of water in cannula.

**NON-INVASIVE NAVA**

1. Non-invasive Neutrally Adjusted Ventilatory Assist (NAVA) is a mode of ventilation that detects when the infant is breathing by using electrical sensors on a bifurcated feeding tube (Edi Catheter). The electrical sensors detect the electrical activity of the diaphragm, providing improved patient-ventilator synchronization.
2. Orders include NAVA level, PEEP, Trigger Edi, apnea time, FiO<sub>2</sub> and saturation range to be maintained.
3. Equipment
  - Appropriate size hat based on infant's head circumference
  - Appropriate sized nasal mask, and/or prongs (use measuring guide to measure appropriate size)
  - Consider using a pacifier or chin strap to reduce pressure loss through an open mouth
  - NAVA Edi Catheter
  - Ventilator
4. Procedure
  - Verify settings
  - Examine nares every 3-4 hours and prn; suction only as needed.
  - Report and document breakdown.

**SURFACTANT ADMINISTRATION**

1. CUROSURF® (poractant alfa) is an extract of natural porcine surfactant and is designed for administration by means of intratracheal suspension as indicated for treatment of primary Respiratory Distress Syndrome (RDS) in premature infants.
2. Refer to [Minimally Invasive Surfactant Treatment \(MIST\)](#) Provider Guidelines for patients who are not intubated and qualify for surfactant.
3. Attending or Fellow MD must be present at the bedside during administration.
4. Procedure:
  - RCP obtains surfactant, withdraws ordered amount and labels syringe if appropriate.
  - RCP, Attending or Fellow MD to administer surfactant after verification of ETT placement.
  - Perform baseline assessment prior to administering surfactant.
  - During administration:
    - Observe infant for need for increased/decreased respiratory device settings and FiO<sub>2</sub>.
    - Do not leave bedside during surfactant administration.
    - Document changes in EMR.

## RESPIRATORY CARE OF THE NEONATE (*continued*)

- Repeat dose(s) may be ordered after initial dose if warranted by clinical status.
- Observe and assess for complications post surfactant administration:
  - Pneumothorax: Assess for increased chest expansion; ask RCP to decrease PIP.
  - Pulmonary hemorrhage: Anticipate RCP will increase mean airway pressure (by increasing PEEP) to help stop bleeding.
  - Hypercarbia due to ETT plugging with surfactant: Assess for decreases in breath sounds, chest movement, and oxygenation, and for increases in CO<sub>2</sub>. For ETT plugging:
    - ❖ Attempt manual bag ventilation to try to clear ETT and ascertain patient is still intubated.
    - ❖ Suction airway.
- Defer suctioning as tolerated, for a minimum of one hour.
- Document response to each surfactant dose.

## References

Level of Evidence (FAME*)	Level*	Reference
	E4	Merenstein, G. B., & Gardner, S. L. (2021). <i>Merenstein and Gardner's Handbook of neonatal intensive care handbook of neonatal intensive care</i> . Elsevier.
	E4	Goldsmith, J. P., & Karotkin, E. H. (2011). <i>Assisted ventilation of the neonate</i> . Elsevier/Saunders.

\* FAME Scale details: See nursing policy [Policy, Procedure, & Competency Development, Review, & Approval](#)

## Procedure History

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Resources: ICN CNS/Educator(s), Respiratory Care

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## RESPIRATORY CARE OF THE NEONATE (*continued*)

### Appendix A: Checklist/Time-Out for Endotracheal Tube Retaping









## Intensive Care Nursery

Checklist/Time-Out for Endotracheal Tube Retaping

<p><b>#1 – COMMUNICATION</b></p> <ul style="list-style-type: none"> <li>• RT/RN identify that ETT needs to be retaped (i.e. loose on lip, tape coming apart, repositioning/adjustment of ETT, MRI scan/transports).</li> <li>• Check placement of ETT on most recent CXR, ensuring ETT is in acceptable position             <ul style="list-style-type: none"> <li>○ ETT ideally at T2 placement with chin neutral to left or right side</li> <li>○ ELBW stays midline for first 72 hours after birth</li> </ul> </li> <li>• Discuss and identify respective roles and need for more staff</li> <li>• Notify provider that retaping is about to occur. Provider should be in the unit during retaping.</li> </ul>
<p><b>#2 – EQUIPMENT SET-UP / PATIENT PREPARATION</b></p> <ul style="list-style-type: none"> <li>• Have mask, bag, intubation supplies standby readily available and functional for reintubation</li> <li>• Discuss access to and visibility of patient bed / appropriate lighting</li> <li>• Pause feeds if needed</li> <li>• Discuss activity status of infant including strategies and interventions:             <ul style="list-style-type: none"> <li>○ Swaddle baby with arms and legs tucked and readjust NG taping if it's above ETT securement device</li> <li>○ Consider medical immobilization if needed</li> <li>○ Identify appropriate sedation if needed for patient</li> <li>○ Discuss if patient has a difficult airway, history of unplanned extubation, history of needing sedation.</li> </ul> </li> <li>• Clear airway and suction if needed</li> </ul>
<p><b>#3 – PROCEDURE</b></p> <ul style="list-style-type: none"> <li>• Verify ETT placement in neutral head position prior to proceeding</li> <li>• Have RN/RT hold ETT with index finger into mouth pushed against the upper palate of baby's mouth. Have 3rd person available at bedside if needed</li> <li>• Secure ETT</li> </ul>
<p><b>#4 POST – PROCEDURE</b></p> <ul style="list-style-type: none"> <li>• RT: Document updates on blue airway card and Apex flowsheet upon completion</li> </ul>

## RESPIRATORY CARE OF THE NEONATE (continued)

### Appendix B: Bedside Imaging/Procedures for Intubated Patients

<b>Bedside Imaging/ Procedures for Intubated Patients Job Aid</b> Routine morning CXR starts at 3 am in <b>Green, Orange, Blue</b> , and ending in <b>Yellow</b> zone (Remember "GO-BY" for the order)	
<p>1 <b>Know your facts</b></p> <ul style="list-style-type: none"> <li>Review specifics about the ET tube (cm marking, tape integrity, reason for chest x-ray (CXR), etc.)</li> </ul>	
<p>2 <b>Devise a plan</b></p> <ul style="list-style-type: none"> <li>Address sedation/ containment, securement and resolve tension or torque on tubing circuit before CXR.</li> </ul>	
<p>3 <b>Positioning</b></p> <ul style="list-style-type: none"> <li>Two people with one person dedicated to ETT</li> <li>Chin neutral &amp; turned to shoulder for CXR; clavicles straight</li> <li>ETT visible and un-obstructed</li> <li>Lung fields unobstructed</li> <li>If upper extremity PICC flex arms</li> </ul> 	 <p><b>Lateral View:</b></p>  <p><b>Chin up ETT moves up</b></p>  <p><b>Chin down ETT moves down</b></p>
<p>4 <b>Be present</b></p> <ul style="list-style-type: none"> <li>RN to stay in room during procedures</li> <li>RT to assist if patient is moving</li> <li>RT &amp; RN to review CXR</li> <li>Escalate concerns to provider (NNP or Provider) immediately</li> </ul>	
<p>5 <b>Document</b></p> <ul style="list-style-type: none"> <li>RT verifies ETT location (cm at the lip) and verbalizes number to the Radiology technician</li> <li>Radiology technician repeats ETT location (#) and annotates this on the film</li> <li>RT verifies correct number annotated on film</li> <li>RT documents cm marking and patient position in cell comment in APEX</li> </ul>	<p>ETT Location at Lip Marked on Xray</p> 

\*Goal for tube repositioning order is 30 min after CXR

\*ETT adjustment done within 30 min of order

## RESPIRATORY CARE OF THE NEONATE (continued)

### Appendix C: Non-Invasive Pressure Injury Prevention

#### BUBBLE CPAP PRESSURE INJURY PREVENTION - MEASURING & FIT

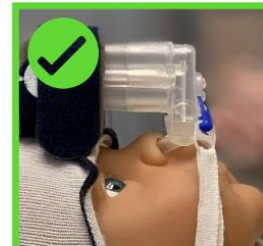
- Choose appropriate size bonnet based upon most recent head circumference.
- Use the F&P sizing guide that comes with the interface kit to properly size mask and prongs.
- Keep sizing guide at bedside to remeasure mask and prongs sizing at least once per week, and when there is new concern for pressure injury.
- Mask should fit comfortably around nose without applying pressure to the nasal septum
- Prongs should completely occlude each nare without pinching the nasal septum.
- At least 2 mm of each prong should be visible outside of infant's nare. If prongs slide all the way into the infant's nostrils, the size is too small.



The 3520 prongs are too small: the guide shows that neither nare is fully occluded.



The 4030 prongs are just right: each nare is fully occluded and the nasal septum is fully visualized.



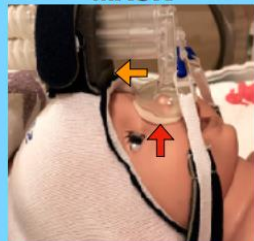
These prongs are properly sized: > 2 mm of each prong can be visualized outside of the nare.

Approved August, 2019: J. Chan, CNS; T. Griffin, RCP; E. Papp, CNS; C. Smith, CNS; D. Woolsey, RCP Clinical Specialist

#### BUBBLE CPAP PRESSURE INJURY PREVENTION - POSITIONING

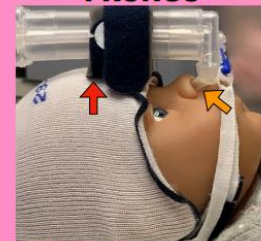
**After application and with cares, visualize infant and bubble CPAP apparatus to ensure:**

##### MASK



- ➔ Mepilex is in place and dry
- ➔ Additional foam platform is in place for mask

##### PRONGS



- ➔ Additional foam platform is removed for prongs
- ➔ At least 2 mm of prong length is visible outside of nares (if using prongs)

##### MASK & PRONGS



- ➔ Gentle and symmetrical bend is noted in the blue securement bar
- ➔ Bonnet is covering patient's eyebrows and ears and straps run from the nape of neck along jaw (not across cheeks)

##### TUBING POSITION

- ➔ Heaviest part of tubing (where temp probe attaches) is supported by blanket roll or positioning device (i.e. Bendy Bumper)
- ➔ Tubing is directed out of a lower side porthole (when possible) and there is no tension on the tubing

