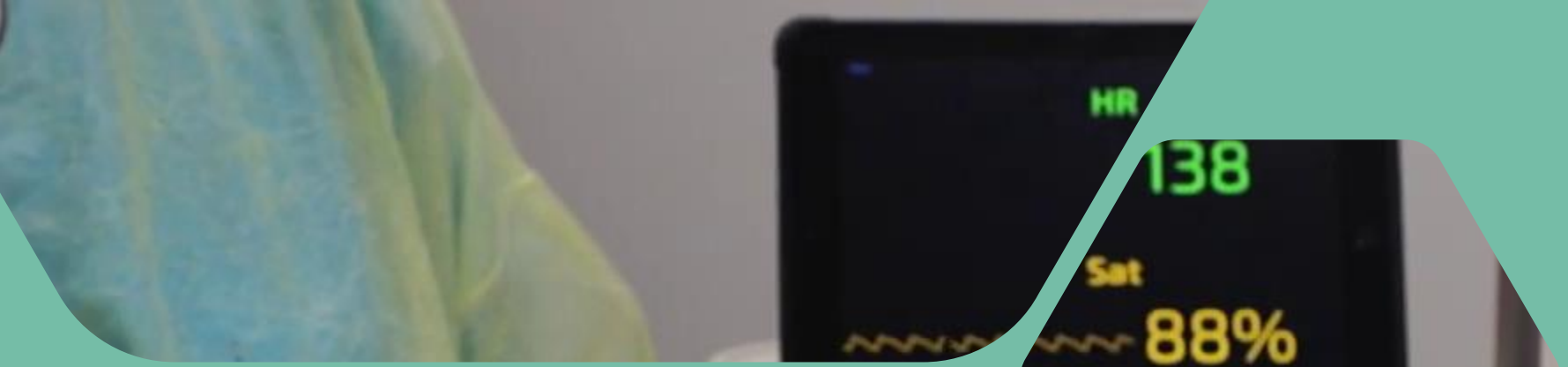
NRP Skills Review: Station 1

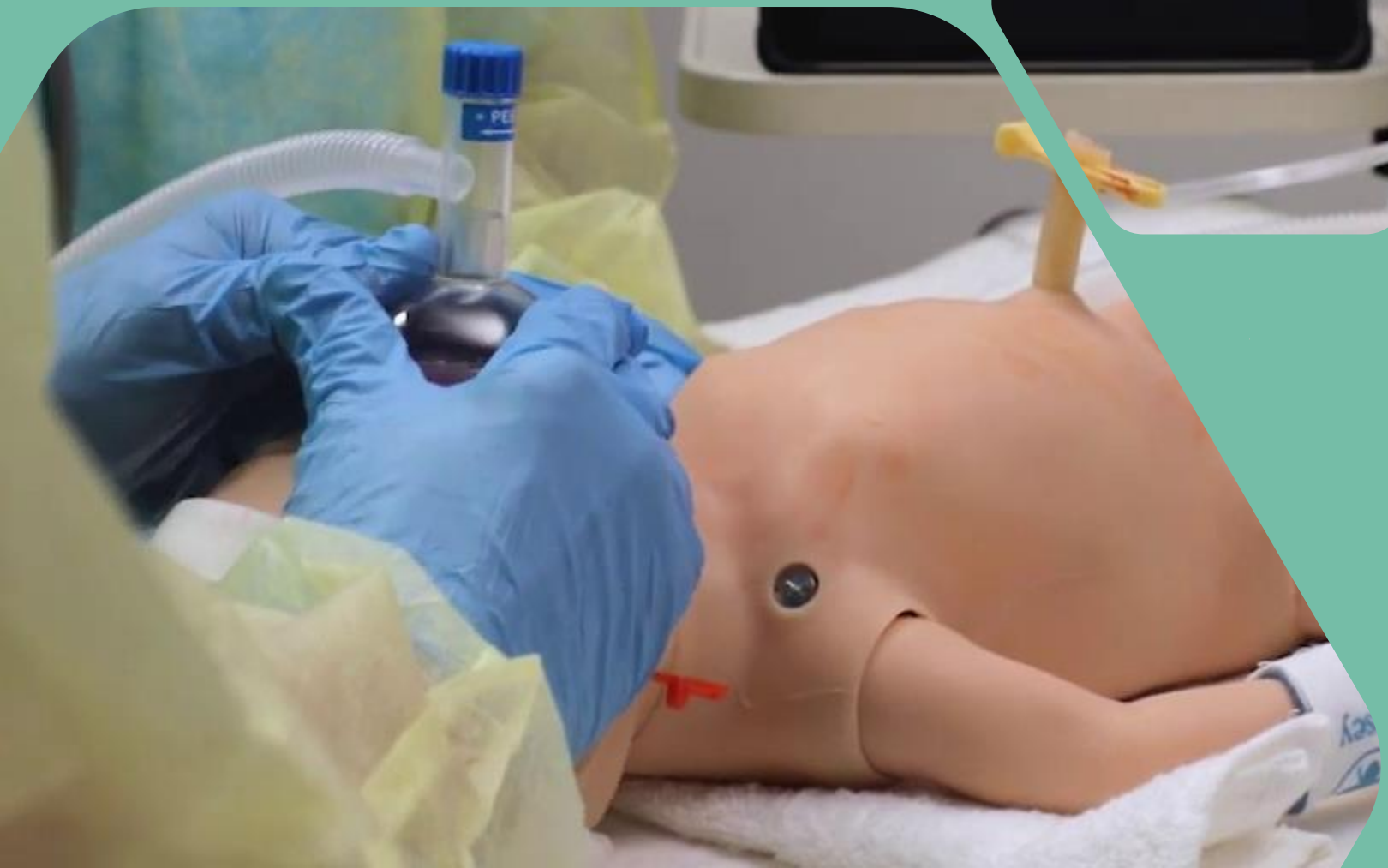
CPAP

PPV

Intubation

Compressions





CPAP

CPAP

- Method of respiratory support that uses a continuous low gas pressure to maintain end expiratory pressure and prevent alveolar collapse in a spontaneously breathing infant
- May be considered in infants breathing spontaneously, with a heart rate at least 100 bpm, but has labored respirations or low O2 saturations (despite 100% O2)
- Not appropriate for apneic or gasping infants, of if HR < 100 bpm
- May be helpful for infants whose lungs are surfactant deficient
- Early use in preterm infants may avoid need for intubations and mechanical ventilation
- Use with caution as excessive pressure may lead to decrease in cardiac output, pneumothorax, and interfere with O2 transport

Methods for CPAP Administration: During Initial Stabilization Period

Flow Inflating Bag

T Piece Resuscitator

Self [illegible] Op[illegible]voir

CPAP

- PEEP set at 5-6 cm H2O pressure and tested before applying to infant
  - You may adjust the CPAP depending on the infant's work of breathing
  - Do not use more than 8 cm H2O
- If heartrate cannot be maintained at ≥ 100 bpm, give PPV instead
- Orogastric tube should be placed if CPAP is administered more than several minutes
- If prolonged CPAP administration is needed
  - Use nasal prongs or nasal mask
  - May be administered with a bubbling water system, dedicated CPAP device, or mechanical ventilator

Methods for CPAP Administration: Prolonged Use

Ventilator CPAP

Nasal CPAP via mask

Bubble CPAP

Nasal CPAP via RAM Cannula

Positive Pressure Ventilation

Ventilation is the single most important and most effective step in neonatal resuscitation!

PPV

Indications: apnea; poor breathing effort/gasping; appears to be breathing but HR <100 bpm

Consider trial for hypoxia, saturations below target range, in a breathing infant with HR >100 bpm, despite 100% O2 or CPAP

When indicated, PPV should be started within 1 minute of birth

Methods for PPV Administration

Flow Inflating Bag

T Piece Resuscitator

Self Inflating Bag: Open Tail Reservoir

Self Inflating Bag: Closed Reservoir

Positive pressure ventilation (PPV)

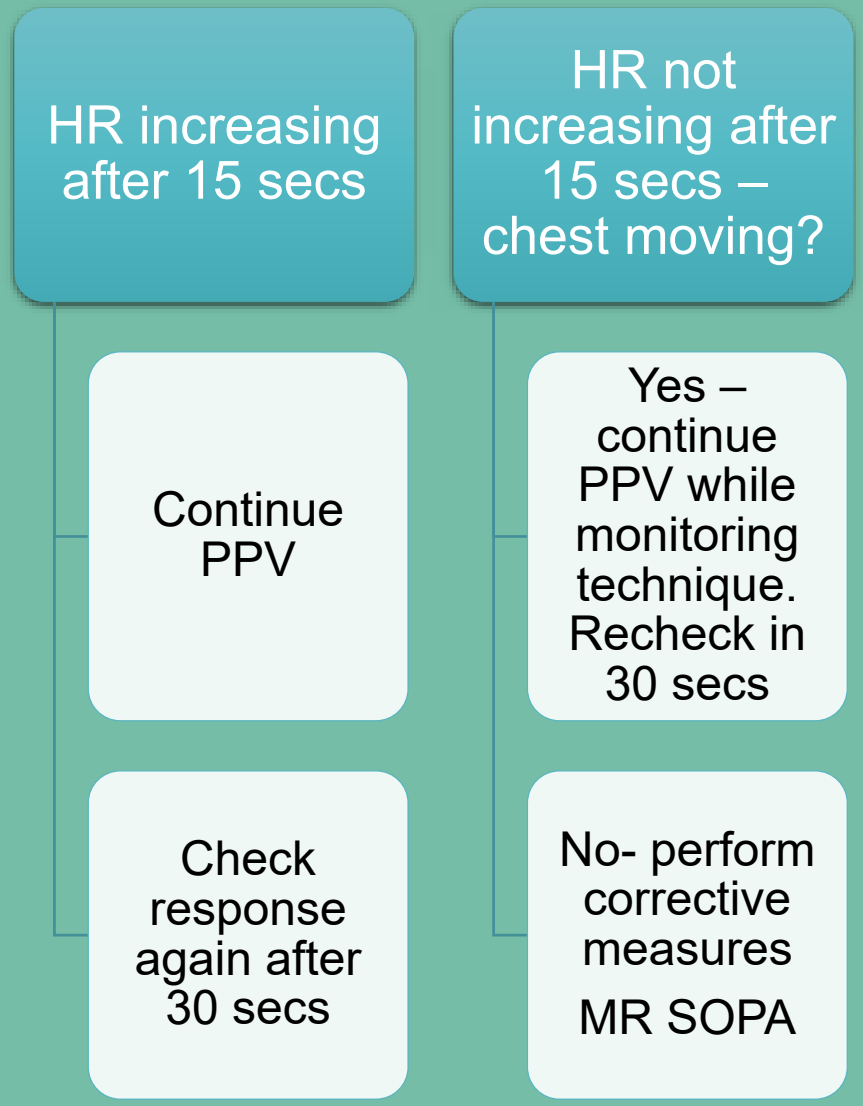
- Initial oxygen concentration:
  - Newborns greater than 35 weeks is 21% oxygen
  - Newborns less than 35 weeks is 21-30% oxygen
- Set flowmeter to 10L/min
- Ventilation rate 40-60 breaths per minute
- Initial ventilation pressure (PIP) 20-25 cm H2O
- Initial PEEP setting 5 cm H2O
- PPV of a preterm newborn should be administered with a device that can give PEEP
- Orogastric tube should be placed if PPV is administered more than several minutes

What is the most important indicator of successful PPV?

A rising heart rate!

PPV and Heart Rate

- Within the first 15 seconds of PPV, HR should be increasing
- Within 30 seconds of PPV, HR should be > 100 bpm
- Initial HR assessment may be performed with stethoscope
- Pulse oximeter should be placed to monitor HR and O2 sats
- Consider cardiac monitor to prevent unnecessary chest compressions from inaccurate HR assessment
- HR not increasing and no chest movement: begin ventilation corrective steps (MR SOPA)



Endotracheal Intubation

Indications for Endotracheal Intubation

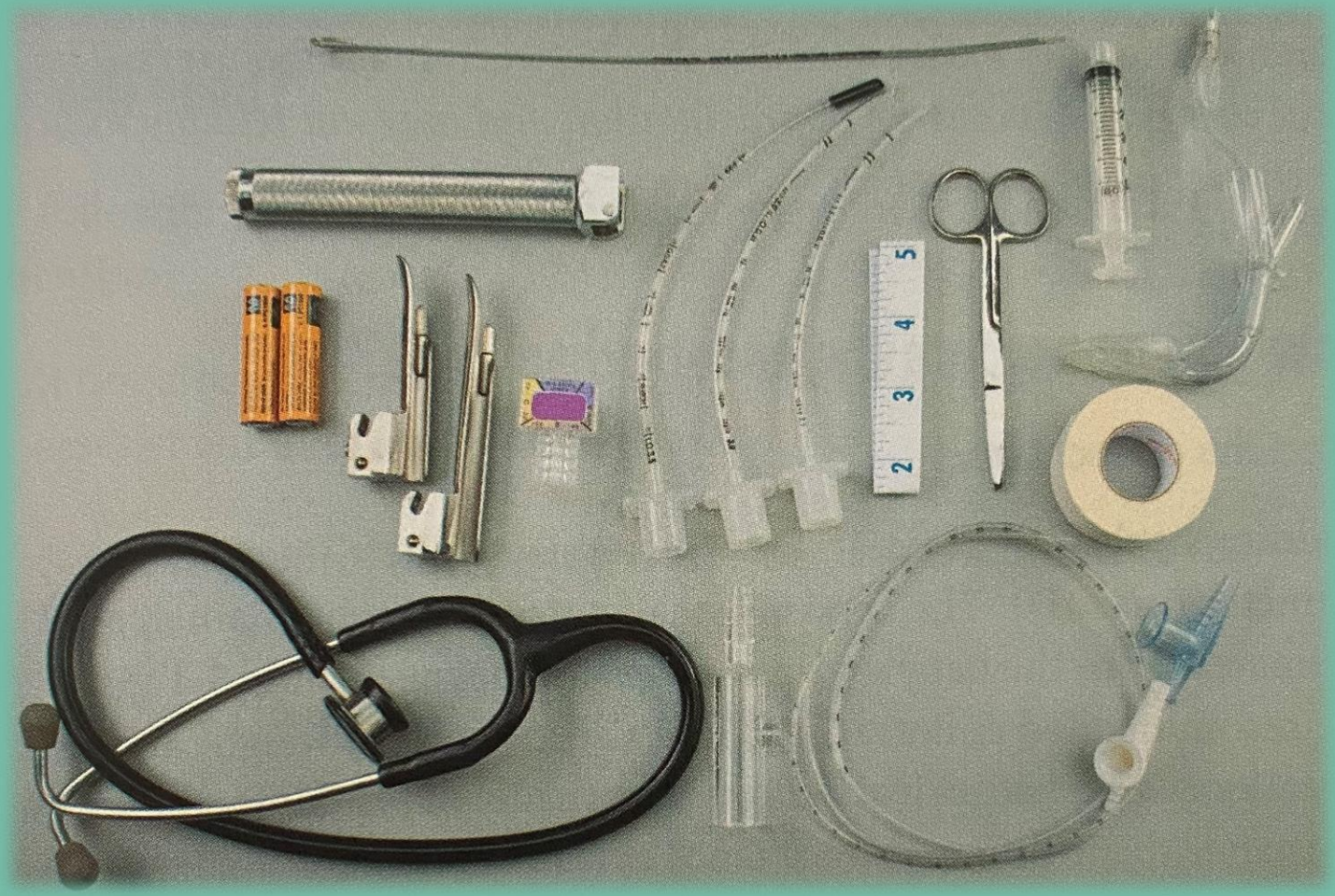
- Insertion of endotracheal tube is strongly recommended:
  - If HR remains < 100 bpm and does not increase after PPV with face mask or laryngeal mask
  - Before starting chest compressions
- Endotracheal tube should be inserted for:
  - Direct tracheal suction if trachea is obstructed by thick secretions
  - Surfactant administration
  - Stabilization of a newborn with a suspected diaphragmatic hernia
- If PPV is prolonged, an ET tube may be considered to improve efficacy and ease of ventilation

Intubation Procedure

- Procedure should ideally be completed within 30 seconds
- Use appropriate size laryngoscope blade for gestational age
- Primary methods of confirming ET tube insertion within the trachea:
  - Demonstrated exhaled CO2
  - Rapidly increasing heart rate
- ET tube insertion depth can be estimated using the nasal-tragus length (NTL) or infant's gestational age
  - Should be confirmed by auscultating equal breath sounds
  - Obtain chest x-ray for final confirmation if tube is to remain in place

Intubation Supplies and Equipment

Each delivery room, nursery, and emergency department should have at least 1 complete set of the following items:



Intubation Supplies and Equipment

Laryngoscope Handle	Blades (straight Miller)	Uncuffed ET tubes	Suctioning device w/catheters
• Extra batteries and bulb	• No.1 (term) • No.0 (preterm) • No.00 (VLBW)	• 2.5 mm • 3.0 mm • 3.5 mm	• 10F or > • 8F • 5F or 6F

Stylet	CO_2 detector	Waterproof adhesive tape ½ - ¾ inch	Measuring tape & ET tube insertion depth table	Scissors

Tracheal aspirator	Stethoscope	PPV device & tubing for blended air/O_2	Laryngeal mask size 1

Preparing Endotracheal Tube

- Select the correct size
  - Estimated from infant's weight or gestational age
  - Size 2.0 mm and 4.0 mm, and tubes with inflatable cuffs are not routinely used during neonatal resuscitation
- Consider using a stylet
  - Secure with a plug or bend at the top to prevent tissue trauma from advancing too far

Weight	Gestational Age	ET Tube Size
< 1 kg	< 28 weeks	2.5 mm ID
1-2 kg	28-34 weeks	3.0 mm ID
> 2 kg	> 34 weeks	3.5 mm ID

Preparing Laryngoscope, Suction, & Additional Supplies

ET Tube Size	Suction Catheter Size
2.5 mm ID	5F or 6F
3.0 mm ID	6F or 8F
3.5 mm ID	8F

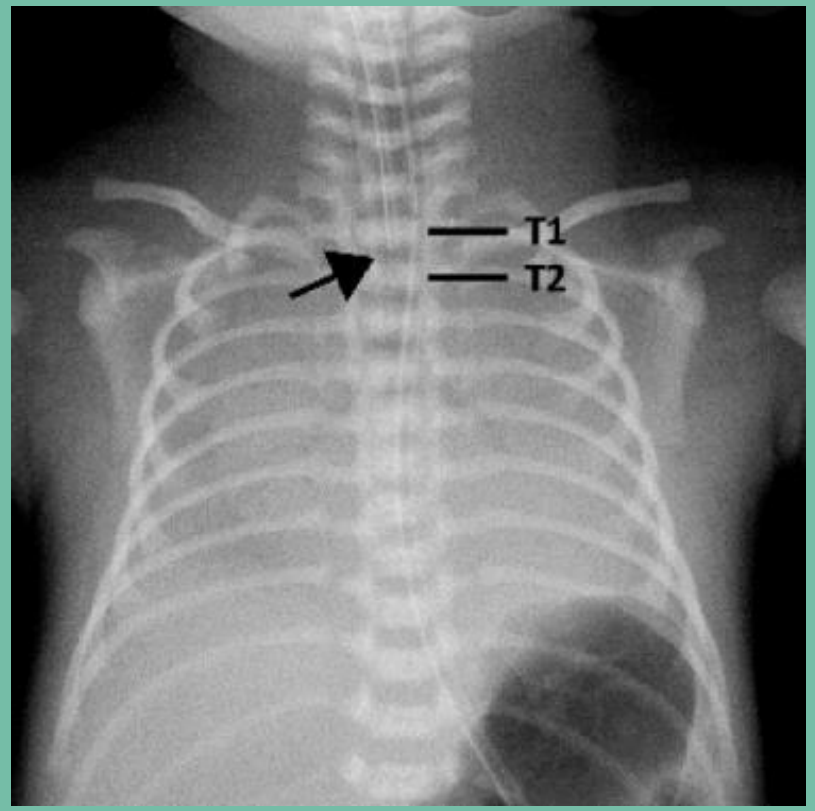
- Ensure cardiac monitor leads attached
- Select appropriate laryngoscope blade and attach to handle
- Verify batteries and light are working by clicking blade into open position, replace bulb/batteries PRN
- Prepare suction equipment
  - 80-100 mmHg
  - Connect 10F suction catheter to remove secretions from mouth and pharynx
  - 8F, 5F or 6F should be available to remove secretions from ET tube
  - Tracheal aspirator can be attached to the ET tube directly
  - Some tubes can be attached directly to suction tubing/do not need aspirator
- Prepare PPV device with mask to ventilate between intubation attempts
- CO2 detector, stethoscope, measuring tape, adhesive tape, and scissors in reach

Intubation Procedure

- Position the infant for intubation
  - Head midline, neck slightly extended in sniffing position, body straight
  - Consider shoulder roll to maintain slight neck extension
- Insert laryngoscope, and endotracheal tube
- Confirm tube placement (CO2, HR, breath sounds, chest movement, no air leaks from mouth, little to no air entry over stomach)
- Ensure appropriate insertion depth
- Secure tube
- Ventilate through tube

Estimating Endotracheal Tube Insertion Depth

- NTL + 1 cm
- Gestational age
- Auscultate breath sounds



Weeks Gestation	ET Tube Insertion Depth at Lips	Infant's Weight
23-24	5.5 cm	0.5-0.6 kg
25-26	6.0 cm	0.7-0.8 kg
27-29	6.5 cm	0.9-1 kg
30-32	7.0 cm	1.1-1.4 kg
33-34	7.5 cm	1.5-1.8 kg
35-37	8.0 cm	1.9-2.4 kg
38-40	8.5 cm	2.5-3.1 kg
41-43	9.0 cm	3.2-4.2 kg

How Can I Assist with Intubation?

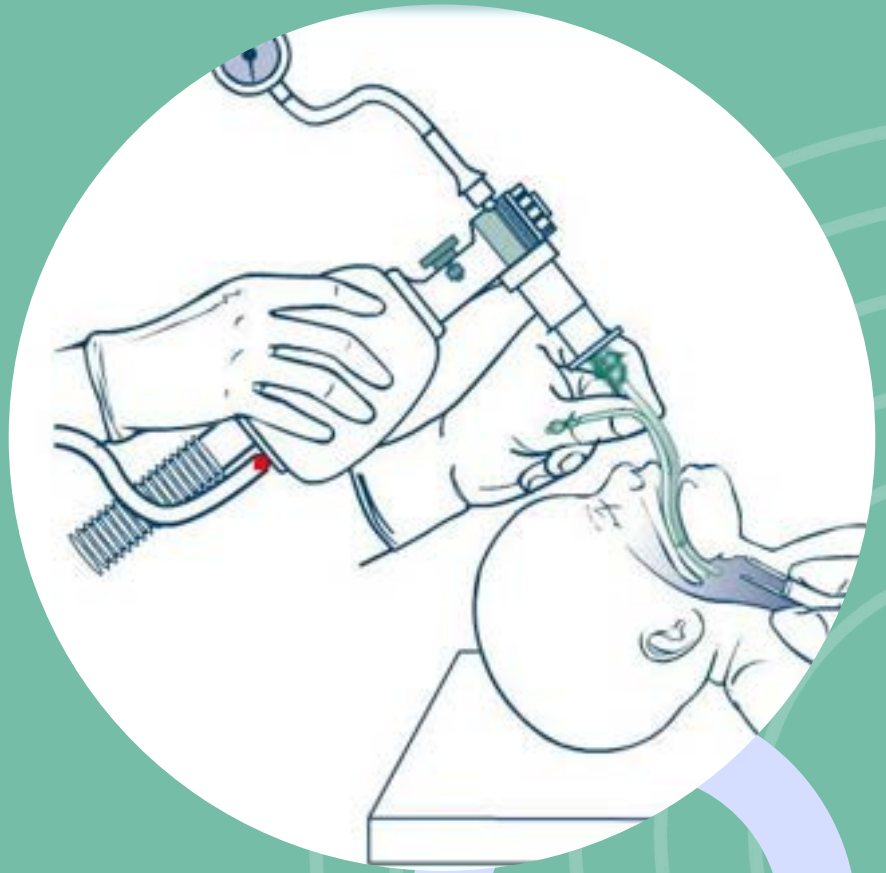
- Prepare and test equipment
- Cardiac monitoring
- Maintaining good positioning throughout the procedure
- Provide thyroid/cricoid pressure as directed
- Hold/pass equipment
- Monitoring HR and intubation attempt length
- Removal of stylet
- Attaching CO2 detector and PPV device
- Verify tip to lip insertion depth
- Auscultate lungs
- Securing tube

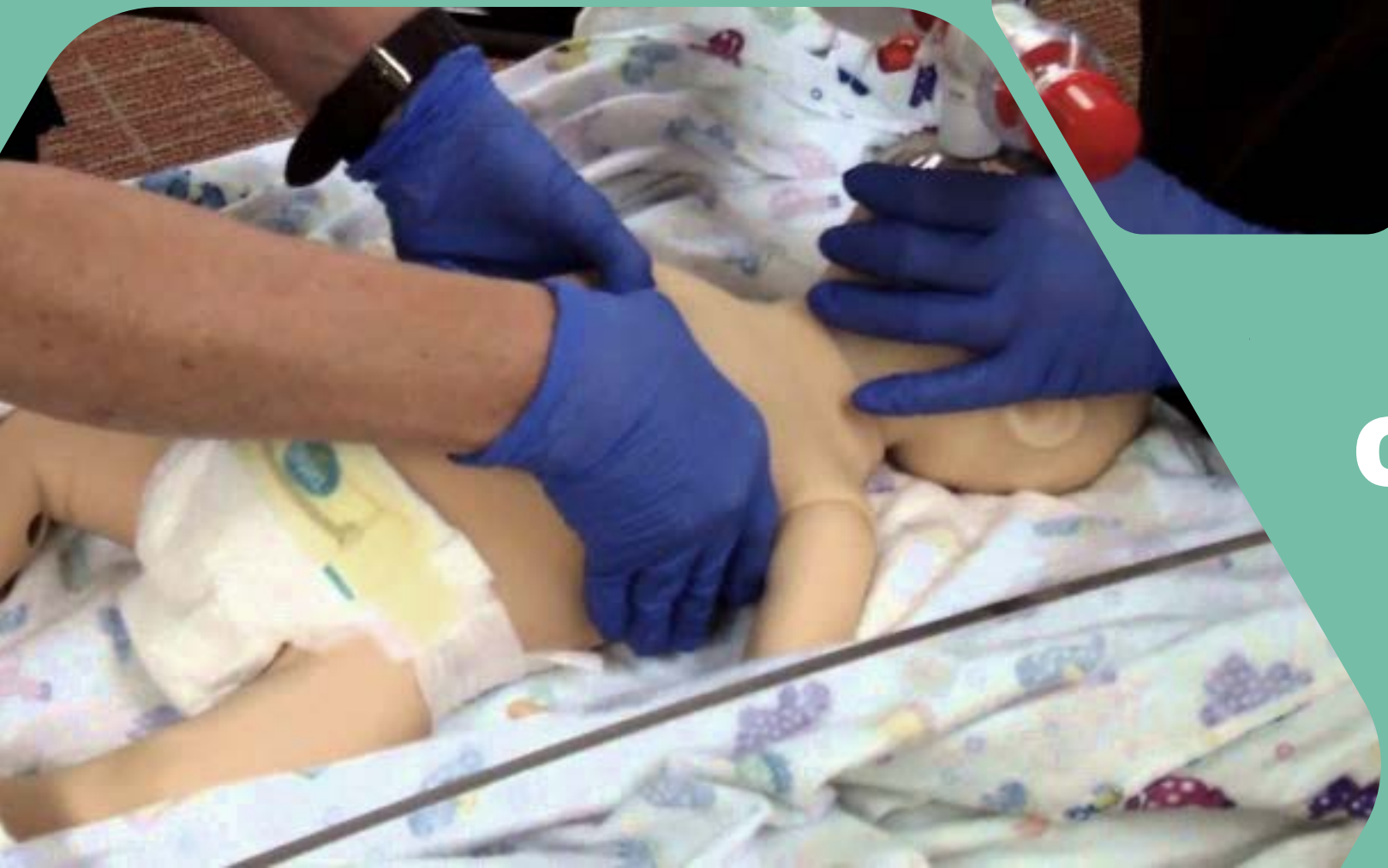
Troubleshooting Endotracheal Intubation

- If a correctly inserted ET tube does not result in PPV with chest movement, suspect airway obstruction and suction the trachea with a suction catheter or tracheal aspirator
- If the infant's condition worsens after ET intubation consider "DOPE":
  - **D**isplaced endotracheal tube
  - **O**bstructed endotracheal tube
  - **P**neumothorax
  - **E**quipment failure

Laryngeal Mask

- Small mask attached to an airway tube, inserted into the mouth, and advanced to the throat until a seal is made over the glottis
- Makes a better seal than a face mask and may improve ventilation effectiveness
- No additional instruments are needed and vocal cords do not need to be visualized
- May provide an effective rescue airway if intubation unsuccessful or unfeasible
- Limited in preterm infants due to size constraints
- Use cardiac monitor for accurate assessment of HR after placement





Chest Compressions

Before Starting Compressions...

- Inaccurate HR assessment can result in unnecessary chest compressions
- If HR is not rising *and* chest is not moving with PPV, the lungs have not been inflated and chest compressions are not yet indicated
  - Continue focusing on achieving effective ventilation
- Monitor with cardiac leads (ideally once PPV starts)
  - Supplement with auscultation and pulse oximetry

Chest Compressions

- Indicated when HR remains < 60 bpm despite at least 30 seconds of PPV that inflates the lungs, ideally through endotracheal tube or laryngeal mask
- Intubation is strongly recommended prior to beginning chest compressions
- Oxygen concentration:
  - Initial: 100% FIO2 until HR > 60 bpm and pulse oximeter has reliable signal
  - Adjust FIO2 to meet target range
- Compression and ventilation ratio 3:1
  - 90 compressions/minute; 30 breaths/minute
  - “One & two & three & breathe”
- Use two thumb technique on the center of the sternum
- Move to the head of the bed once endotracheal tube or laryngeal mask secured
- Use enough pressure to depress sternum approx. 1/3 of the anterior posterior (AP) diameter of the chest

Assessing Chest Compressions

- Check HR after 60 seconds of chest compressions and ventilation, preferably with cardiac monitor
- Color change in CO_2 detector, which remained unchanged with PPV, may also indicate improving cardiac function
- If the HR is $\geq$ 60 bpm:
  - Discontinue compressions
  - Resume PPV
  - Monitor pulse oximetry
  - Titrate O_2
- If the HR remains < 60 bpm
  - Troubleshoot with team using CARDIO
  - Administer medications
  - Establish vascular access

Troubleshooting Chest Compressions when Heartrate Remains < 60 bpm

Chest movement	Is the chest moving with each breath?
Airway	Is the airway secured with an ET tube or laryngeal mask?
Rate	Are 3 compressions coordinated with 1 ventilation being delivery every 2 seconds?
Depth	Is the depth of compressions 1/3 of the AP diameter of the chest?
Inspired Oxygen	Is 100% oxygen being administered through the PPV device?

(Adapted from American Academy of Pediatrics, 2021, p. 169, table 6-1)

Resuscitation after the Immediate Newborn Period

Where is resuscitation of the neonate recommended outside of the delivery room?

Where infant receives routine care

Resuscitation in the Postpartum Unit

- Physiologic principles and basic steps discussed remain the same
- Ventilation of the lungs is the initial priority for resuscitation
- Investigate cause – consider SUPC
- Considerations:
  - Thermoregulation: resuscitate under radiant warmer, hat, warm blankets
  - Clearing secretions from airway: use bulb syringe if vacuum suction not available
  - Ventilation: self-inflating bag/mask readily available
  - Assessing HR: 2nd responder assess with stethoscope until pulse oximeter and cardiac monitor available
  - Alternative airway may be needed if face-mask ventilation ineffective
  - Chest Compressions: same 3:1 ratio, coordinated with ventilations and 100% oxygen
  - Vascular access: UVC may be successful during first week of life; > 1 week of life - IO

NRP Skills Review: Station 2

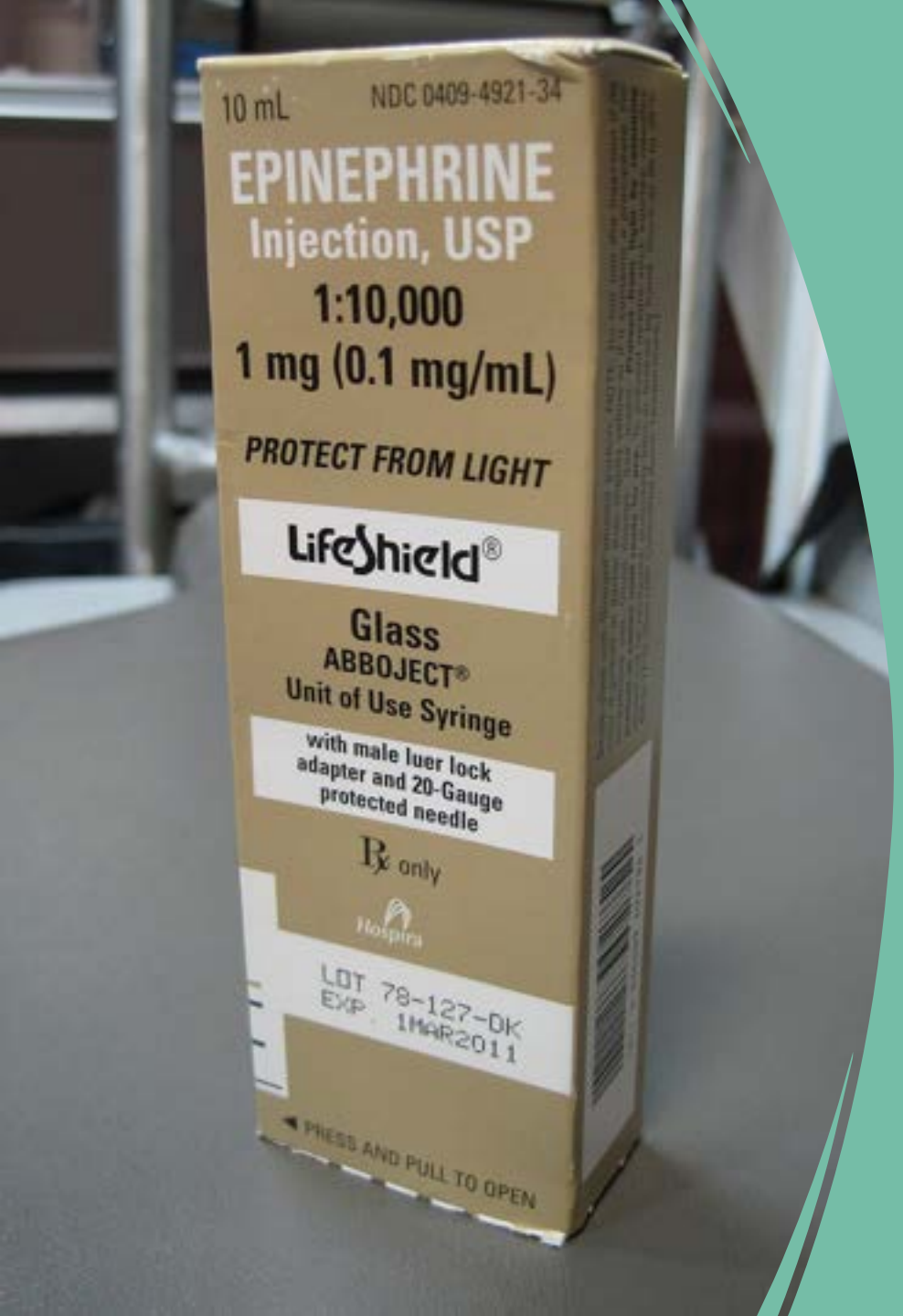
Medications

Fluid Resuscitation

Medications

Emergency Medication Considerations

- Ensure accuracy of HR assessment and effectiveness of ventilation and compressions before administering medications
- Use closed loop communication
  - Agree on estimated weight
  - Give/receive order including drug name, concentration, dose, and route
  - Communicate when completed
- Have a weight-based chart readily available for easy dose reference



Epinephrine

- Indicated if the infant's HR remains < 60 bpm after:
  - At least 30 seconds of PPV (most cases through ETT or laryngeal mask) that inflates the lungs (chest movement)
  - Another 60 seconds of chest compressions coordinated with PPV using 100% oxygen
- Concentration: 0.1 mg/ml = 1 mg/10 ml
- Route: IV or IO
  - Umbilical venous catheter (UVC) is preferred for infants requiring vascular access at delivery
  - One ET dose may be considered while vascular access is being established

Epinephrine Preparation and Dose

Preparation

- IV or IO: 1 ml syringe labeled “epinephrine – IV”
- Endotracheal: 3-5 ml syringe labeled “epinephrine – ET ONLY”

Dose

- IV or IO: 0.02 mg/kg (0.2ml/kg)
  - Range: 0.01 – 0.03 mg/kg (0.1 – 0.3 ml/kg)
  - Rate: rapidly
  - Flush: with 3ml saline
  - May repeat Q 3-5 minutes
- ET: 0.1 mg/kg (1 ml/kg)
  - Range: 0.05 – 0.1 mg/kg (0.5 – 1 ml.kg)
  - Follow with PPV breaths
  - Subsequent doses IV or IO

Neonatal Code Medications Chart

Neonatal Resuscitation Program®, 8th Edition - Neonatal Code Medications Card

The most important and effective step in neonatal resuscitation is ventilation of the baby's lungs.

Neonatal Code Medications

Drug	Dose*	0.5 kg	1 kg	2 kg	3 kg	4 kg	Administration
Epinephrine IV/IO Concentration: 0.1 mg/mL 1 mg/10 mL	0.02 mg/kg Equal to 0.2 mL/kg	IV Dose: 0.01 mg Volume: 0.1 mL	IV Dose: 0.02 mg Volume: 0.2 mL	IV Dose: 0.04 mg Volume: 0.4 mL	IV Dose: 0.06 mg Volume: 0.6 mL	IV Dose: 0.08 mg Volume: 0.8 mL	IV/IO rapid push Flush with 3 mL NS Repeat every 3-5 minutes if heart rate less than 60 bpm
Epinephrine ETT Concentration: 0.1 mg/mL 1 mg/10 mL	0.1 mg/kg Equal to 1 mL/kg	ET Dose: 0.05 mg Volume 0.5 mL	ET Dose: 0.1 mg Volume 1 mL	ET Dose: 0.2 mg Volume 2 mL	ET Dose: 0.3 mg Volume 3 mL	ET Dose: 0.4 mg Volume 4 mL	May administer while vascular access is being established ETT rapid push No need for flush. Provide PPV breaths to distribute into lungs.
Normal Saline IV 0.9% NaCl	10 mL/kg	5 mL IV	10 mL IV	20 mL IV	30 mL IV	40 mL IV	Give over 5-10 min

*The recommended dose range for intravenous or intraosseous administration is 0.01 to 0.03 mg/kg (equal to 0.1 to 0.3 mL/kg).
The recommended dose range for endotracheal administration is 0.05 to 0.1 mg/kg (equal to 0.5 to 1 mL/kg).

These suggested epinephrine doses are based on a desire to simplify dosing for educational efficiency and do not endorse any particular dose within the recommended dosing range. Additional research is needed to ascertain the ideal epinephrine dose.

After Epinephrine

- Continue PPV with 100% O2 and chest compressions
- Assess heartrate 1 minute after epinephrine administration
- If HR < 60 bpm continue ventilation and compressions
  - Repeat epinephrine administration every 3-5 mins
    - Do not need to wait if first dose was ET – give repeat dose IV or IO ASAP
  - Consider increasing subsequent doses, if first dose was ≤ 0.02mg/kg (≤ 0.2ml/kg)
  - Consider other causes including hypovolemia and tension pneumothorax

Volume Expander

- Indicated if infant is not responding to steps of resuscitation and signs of shock or history of acute blood loss are present
  - Persistently low HR that does not respond to effective ventilation, chest compressions, and epinephrine
  - May have pallor, delayed capillary refill, and/or weak pulses
- Should not be given routinely during resuscitation without indication
- Use with caution in preterm infants < 32 weeks gestation

Volume Expander

- Solution: normal saline (0.9% NaCl) or type O rh- blood
  - LR is acceptable alternative
  - Donor unit of PRBC can be cross-matched to mother if fetal anemia diagnosed before birth
- Route: IV or IO
- Preparation: 30-60ml syringe – labeled “NS” or “O- blood”
- Dose:
  - 10ml/kg
  - Repeat with additional 10ml/kg if no improvement
- Rate: over 5-10 minutes

What to do if infant is not improving after administering IV epinephrine and volume expander?

- Reassess quality of ventilation and compressions
- If an alterative airway is not inserted, should be performed now
- STAT chest x-ray may provide valuable information
- Consult additional expertise

Chest movement	Is the chest moving with each breath?
Airway	Is the airway secured with an ET tube or laryngeal mask?
Rate	Are 3 compressions coordinated with 1 ventilation being delivery every 2 seconds?
Depth	Is the depth of compressions 1/3 of the AP diameter of the chest?
Inspired Oxygen	Is 100% oxygen being administered through the PPV device?
Was correct dose of epinephrine given?	
Is the UVC or IO needle in place or dislodged?	
Is a pneumothorax present?	

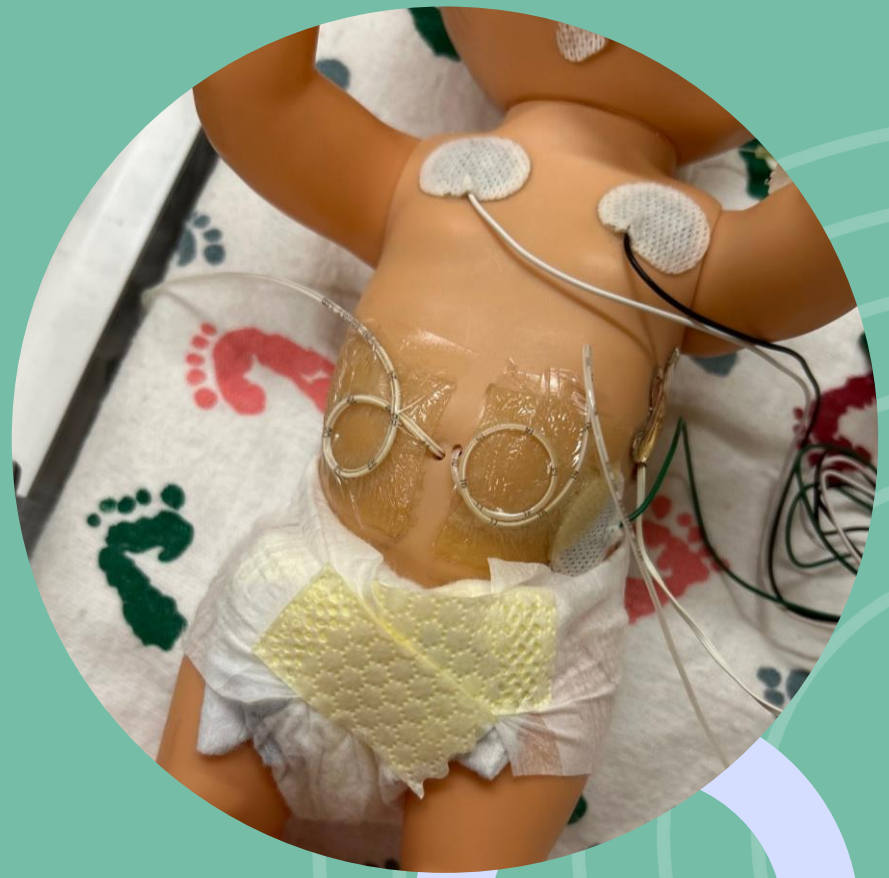
Emergency Vascular Access

Umbilical Venous Catheter

- If use of epinephrine is anticipated, team should prepare to insert UVC while PPV and compressions continue
- Supplies:
  - 3.5F or 5F single lumen umbilical catheter
  - Syringe filled with normal saline (3-10ml)
  - Stopcock
  - Cord tie
  - Antiseptic solution
  - Scalpel

UVC Considerations

- Tip of catheter should be located only a short distance into the vein, just until blood can be aspirated
- Insertion site should remain uncovered and visible
- Hold catheter in place until it is either secured or removed
- Can be temporarily secured with clear adhesive dressing
- Discontinue UVC by removing slowly and controlling bleeding



Documentation