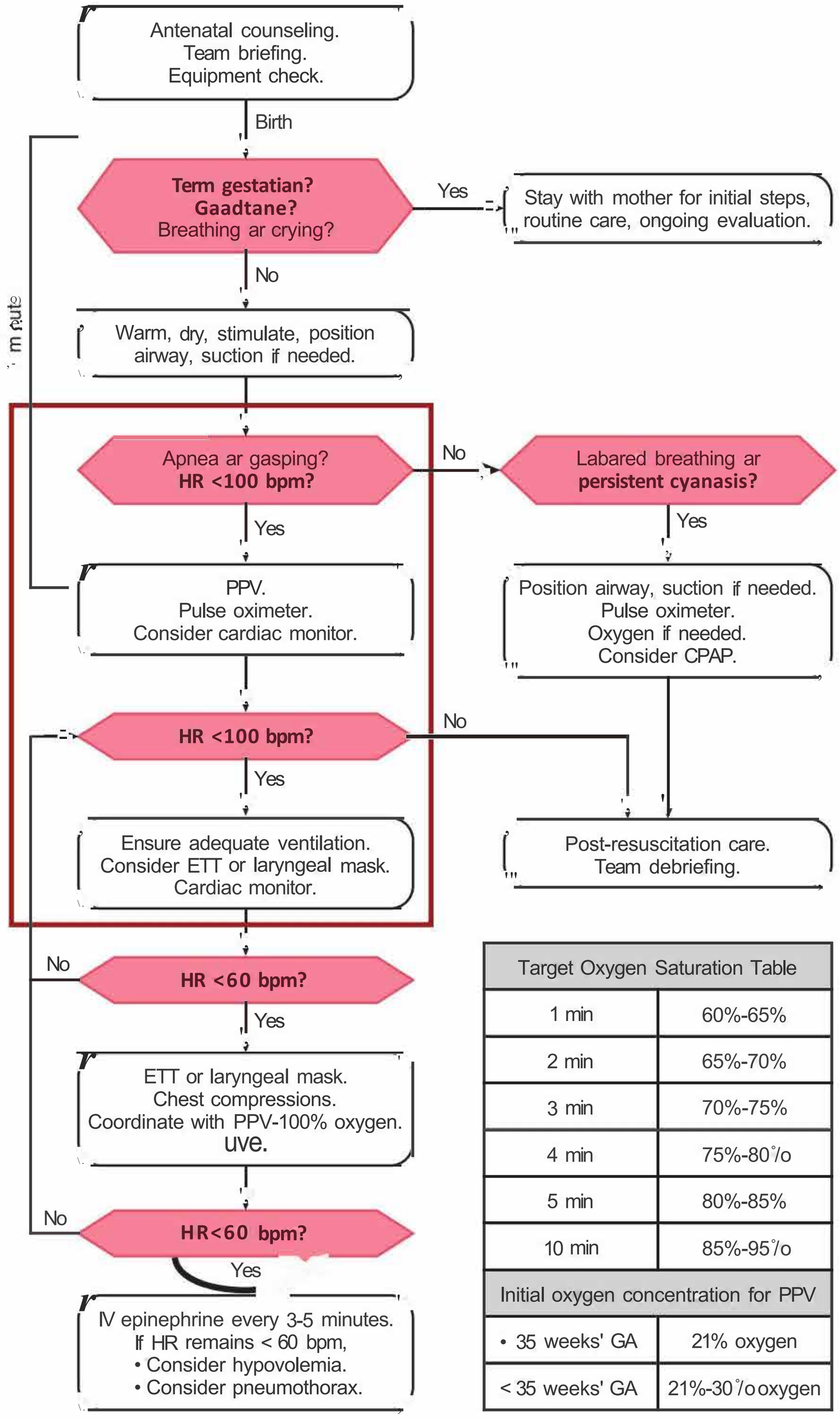
4

Positive-Pressure Ventilation

What you will learn

- The characteristics of self-inflating bags, flow-inflating bags, and T-piece resuscitators
- When to give positive-pressure ventilation
- How to position the newborn's head for positive-pressure ventilation
- How to place a resuscitation mask on the newborn's face
- How to administer positive-pressure ventilation and assess effectiveness
- How to use ventilation corrective steps
- How to insert a laryngeal mask for positive-pressure ventilation
- How to administer continuous positive airway pressure
- How to insert an orogastric tube



Target Oxygen Saturation Table	
1 min	60%-65%
2 min	65%-70%
3 min	70%-75%
4 min	75%-80°/o
5 min	80%-85%
10 min	85%-95°/o
Initial oxygen concentration for PPV	
• 35 weeks' GA	21% oxygen
< 35 weeks' GA	21%-30°/o oxygen

Key Points

O Ventilation of the newborn's lungs is the single most important and most effective step in neonatal resuscitation.

f) After completing the initial steps, positive-pressure ventilation (PPV) is indicated if the baby is not breathing, OR if the baby is gasping, OR if the baby's heart rate is less than 100 beats per minute (bpm).

E) During PPV, the initial oxygen concentration (Fro_2) for newborns greater than or equal to 35 weeks' gestation is 21%. The initial Fro_2 for preterm newborns less than 35 weeks' gestation is 21% to 30%.

9 The ventilation rate is 40 to 60 breaths per minute and the initial ventilation pressure is 20 to 25 cm H_20 .

0 The most important indicator of successful PPV is a rising heart rate.

O If the heart rate is not increasing within the first 15 seconds of PPV and you do not observe chest movement, start the ventilation corrective steps.

O The ventilation corrective steps *(MR. SOPA)* are:

a. Mask adjustment.

b. Reposition the head and neck.

c. Suction the mouth and nose.

d. Open the mouth.

e. Pressure increase.

f. Alternative airway.

0 If the baby cannot be successfully ventilated with a face mask and intubation is unfeasible or unsuccessful, a laryngeal mask may provide a successful rescue airway.

f) If the heart rate remains less than 60 bpm despite at least 30 seconds of face-mask PPV that inflates the lungs (chest movement), reassess your ventilation technique, consider performing the ventilation corrective steps, adjust the Fro_2 as indicated by pulse oximetry, insert an alternative airway (endotracheal tube or laryngeal mask), and provide 30 seconds of PPV through the alternative airway. After these steps, if the heart rate remains less than 60 bpm, increase the $F10_2$ to 100% and begin chest compressions.

4D) If you continue face-mask PPV or continuous positive airway pressure (CPAP) for more than several minutes, an orogastric tube should be inserted to act as a vent for gas in the stomach.

Case: Resuscitation with positive-pressure ventilation using a resuscitation bag and mask

Your team is called to attend the birth for a woman at 36 weeks' gestation whose pregnancy and labor are complicated by preeclampsia, intrauterine growth restriction, and a Category II fetal heart rate pattern. The amniotic fluid is clear. You complete a pre-resuscitation team briefing and prepare your supplies and equipment. After birth, the obstetrician dries and stimulates the baby, but the baby remains limp and apneic. The umbilical cord is clamped and cut, and the baby is moved to the radiant warmer.

You finish drying the baby, provide brief additional stimulation, and position and clear secretions from the airway, but the baby is still not breathing. Within 1 minute of birth, you start positive-pressure ventilation (PPV) with 21% oxygen (room air). An assistant reports that the baby's heart rate is 70 beats per minute (bpm), not increasing, and the chest is not moving. Another team member places a pulse oximeter sensor on the baby's right hand, places cardiac monitor leads on the baby's chest, and attaches the sensor and leads to the monitors. Another team member documents the events as they occur.

You initiate the ventilation corrective steps. First, you reapply the mask to the face and reposition the baby's head and neck. You restart PPV while your assistant watches the newborn's chest. After several breaths, the assistant reports that there is still no chest movement. You suction the mouth and nose and open the baby's mouth. Again, you start PPV, but there is still no chest movement. You gradually increase the inflation pressure and the assistant calls out, *"The chest is moving now:'* Within 30 seconds of achieving ventilation that inflates the baby's lungs, the baby's heart rate is greater than 100 bpm and oxygen saturation is 64%. The assistant adjusts the oxygen concentration ($F10_2$) to maintain the baby's oxygen saturation within the target range.

You continue PPV while monitoring the baby's respiratory effort. The baby begins to breathe, and you gradually decrease the ventilation rate. When the baby is 4 minutes of age, there is good spontaneous breathing effort, the heart rate is 140 bpm, and oxygen saturation is 85%. You discontinue PPV and monitor the baby's oxygen saturation. While your team prepares to move the baby to the nursery for post-resuscitation care, you explain the next steps

to the mother. Shortly afterward, you meet with your team and conduct a debriefing to evaluate your preparation, teamwork, and communication.

Why does the Neonatal Resuscitation Program® focus on positive-pressure ventilation?

Ventilation of the newborn's lungs is the single most important and effective step in neonatal resuscitation. Learning how to provide PPV is the foundation of neonatal resuscitation. This lesson focuses on assisted ventilation through a face mask and laryngeal mask. The next lesson describes how to provide ventilation through an endotracheal tube.

What is the common terminology used to describe positive-pressure ventilation?

Several terms and abbreviations are used to describe PPV (Figure 4.1).

- *Peak inflation pressure (PIP):* The highest pressure administered with each breath
- *Positive end-expiratory pressure (PEEP):* The gas pressure maintained in the lungs between breaths when the baby is receiving **assisted breaths**
- *Continuous positive airway pressure (CPAP):* The gas pressure maintained in the lungs between breaths when a baby is **breathing spontaneously**
- *Rate:* The number of assisted breaths administered per minute
- *Inflation time (IT):* The time duration (seconds) of the inflation phase of each positive-pressure breath
- *Manometer:* A gauge used to measure gas pressure

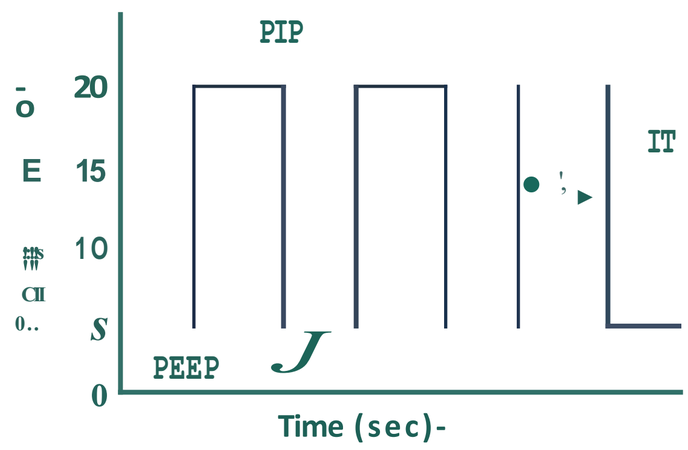


Figure 4.1. Pressure tracing during 3 positive-pressure breaths. PIP = peak inflation pressure, PEEP = positive end-expiratory pressure, IT = inflation time.

Figure 4.2. Self-inflating bag

Figure 4.3. Flow-inflating bag

Figure 4.4. T-piece resuscitator

What are the different types of resuscitation devices used to ventilate newborns?

Three types of devices are commonly used for ventilation.

- A ***self-inflating bag*** fills spontaneously with gas (air, oxygen, or a blend of both) after it has been squeezed and released (Figure 4.2).

- A ***flow-inflating bag*** (also called an anesthesia bag) only fills when gas from a compressed source flows into it and the outlet is sealed (Figure 4.3).

- A ***T-piece resuscitator*** continuously directs compressed gas toward the baby. Pressure increases when an opening on the top of the T-shaped device is occluded (Figure 4.4).

Find out what kind of resuscitation device is used in your hospital. If your hospital uses flow-inflating bags or T-piece resuscitators, you should still learn how to use a self-inflating bag. A self-inflating bag should be readily available as a backup wherever resuscitation may be needed in case compressed gas is not available. The 3 devices are briefly described in the following text. Additional details are found in the Appendix to this lesson. You should read those sections of the Appendix that apply to the devices used in your hospital.

Self-inflating bags

A self-inflating bag remains fully inflated unless it is being squeezed (Figure 4.5). Once you release the bag, it recoils and draws fresh gas into the bag. If the bag is attached to an oxygen source, it fills with gas at the supplied FIO_2. If the bag is not attached to an oxygen source, it fills by drawing room air (21% oxygen) into the bag.

Because the bag self-inflates, it <loes not require compressed gas ora tight seal at the outlet to remain inflated.

- The ventilation rate is determined by how often you squeeze the bag and the inflation time is determined by how quickly you squeeze the bag.
- PIP is controlled by how hard the bag is squeezed.
- PEEP may be administered if an additional valve is attached to the bag.
- Because gas does not flow out of the mask unless the bag is being squeezed, a self-inflating bag and mask **cannot** be used to administer CPAP or free-flow oxygen.
- Free-flow oxygen may be administered through the open reservoir ("tail") on sorne self-inflating bags.

Most self-inflating bags have a pressure-release valve, also called a pop-off valve, which limits the peak pressure. These valves are usually set to release at 30 to 40 cm H_20 pressure, but they are not reliable and may not release until higher pressures are achieved. Sorne self-inflating bags have a device that allows the pressure-releas e valve to be temporarily occluded, allowing higher pressures to be administered. Occluding the pop-off valve should be an unusual occurrence and care must be taken not to use excessive pressure.

Fig ure 4.5. Self-inflating bags with a closed reservoir (A) and an open "tail" reservoir (B). Both bags reinflate automatically without compressed gas.

To ensure the appropriate pressure is used, a manometer should always be used. The manometer may be built into the bag or there may be an attachment site for an externa! manometer. If the attachment site is left open without a manometer attached, it will cause a large gas leak and prevent the baby from receiving the desired inflation pressure.

Testing a self-inflating bag during the equipment check and before use

Block the mask or gas outlet with the palm of your hand and squeeze the bag (Figure 4.6).

Figure 4.6. Testing a self-inflating bag

Testing a self-inflating bag

Block the mask or gas outlet and squeeze the bag.

- Do you feel pressure against your hand?
- Does the manometer register pressure?
- Does the pressure-release valve open when the manometer registers 30 to 40 cm H_2O pressure?
- Does the bag reinflate quickly when you release your grip?

If no,

- Is there a crack or leak in the bag?
- Is the manometer missing, resulting in an open attachment site?
- Is the pressure-release valve missing or blocked?

Flow-inflating bags

A flow-inflating bag inflates only when a compressed gas source is flowing into the bag and the outlet is sealed, such as when the mask is applied to a baby's face (Figure 4.7A). If compressed gas is not flowing into the bag or the outlet is not sealed, the bag collapses and looks like a deflated balloon (Figure 4.7B).

- The ventilation rate is determined by how often you squeeze the bag and the inflation time is determined by how quickly you squeeze and release the bag.
- PIP is controlled by how hard the bag is squeezed and the balance between the amount of gas flowing into the bag and the gas escaping through an adjustable flow-control valve.

- PEEP, CPAP, and free-flow oxygen can be administered with a flow-inflating bag and are adjusted by the balance between the gas flow into the bag and the gas escaping through the flow-control valve.

Similar to a self-inflating bag, a manometer should always be used to accurately measure the gas pressure. If the manometer attachment site is left open, it will cause a large leak and prevent the flow-inflating bag from filling.

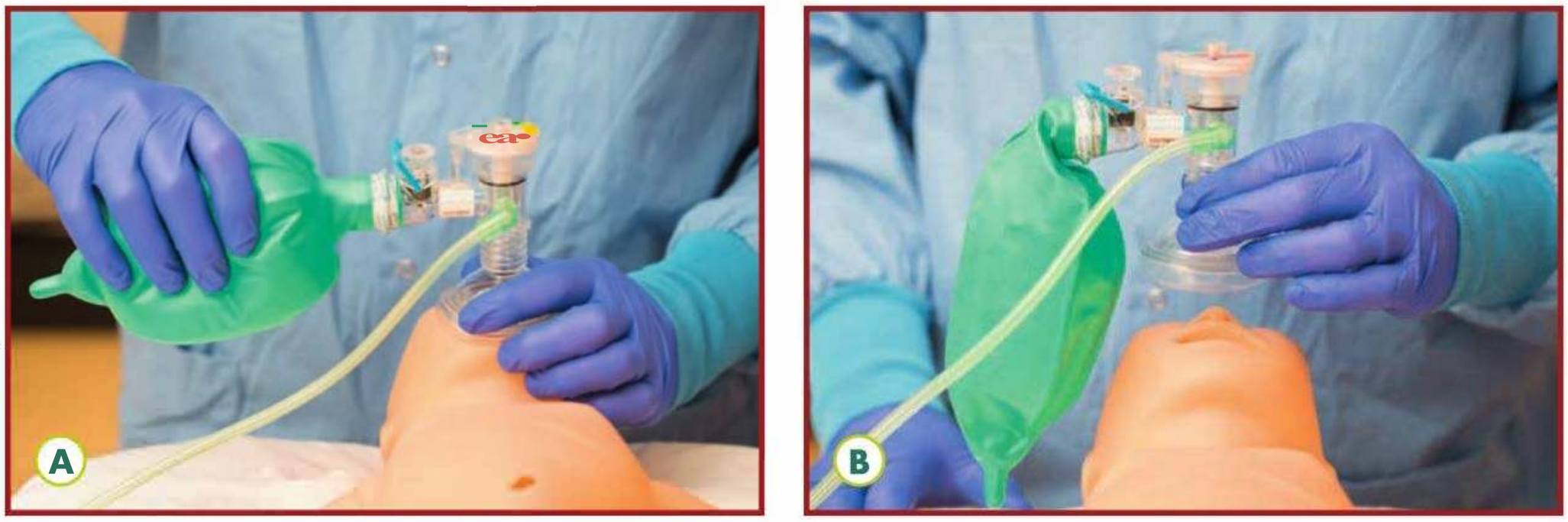


Figure 4.7. Flow-inflating bag inflated with compressed gas and a seal against the baby's face (A). If compressed gas is not flowing into the bag or the outlet is not sealed, the bag collapses (B).

Testing a flow-inflating bag during the equipment check and before use

Block the mask or gas outlet with the palm of your hand and squeeze the bag (Figure 4.8).

Figure 4.8. Testing a flow-inflating bag

Testing a flow-inflating bag

Block the mask or gas outlet.

- Does the bag fill properly?
- Adjust the flow-control valve to read 5 cm H20 PEEP.

Squeeze the bag 40 to 60 times per minute.

- Does the bag reinflate quickly when you release your grip?
- Adjust the flow-control valve to read 30 to 40 cm H_20 when squeezed firmly.
- Check to be sure that the pressure still reads 5 cm H_2O when not being squeezed (PEEP).

If the bag does not fill correctly,

- Is there a crack or hole in the bag?
- Is the flow-control valve open too far?
- Is the manometer attached?
- Is the gas tubing connected securely?
- Is the gas outlet sufficiently blocked?

T-piece resuscitators

A T-piece resuscitator is a mechanical device that uses valves to regulate the flow of compressed gas directed toward the patient (Figure 4.9). Similar to the flow-inflating bag, the device requires a compressed gas source. A breath is delivered by using a finger to alternately occlude and release a gas escape opening on the top of the T-piece cap. When the opening is occluded, gas is directed through the device and toward the baby. When the opening is released, sorne gas escapes through the cap. The position and function of control dials on the T-piece resuscitator may vary by manufacturer. The operation of one example is described below.

- The ventilation rate is determined by how often you occlude the opening on the cap and the inflation time is controlled by how long the opening is occluded.
- There are 2 control dials that are used to limit the inflation pressure. The *peak inflation pressure* control limits the peak pressure during each assisted breath. The *maximum pressure relief control* is a safety feature, similar to the pop-off valve on a self-inflating bag, which prevents the user from increasing the peak pressure beyond a preset value. This control dial may be covered by a removable shield.
- An adjustable dial on the T-piece cap controls how much gas is allowed to escape between breaths and, therefore, adjusts the PEEP and CPAP.
- A built-in manometer measures the inflation and expiratory pressure.

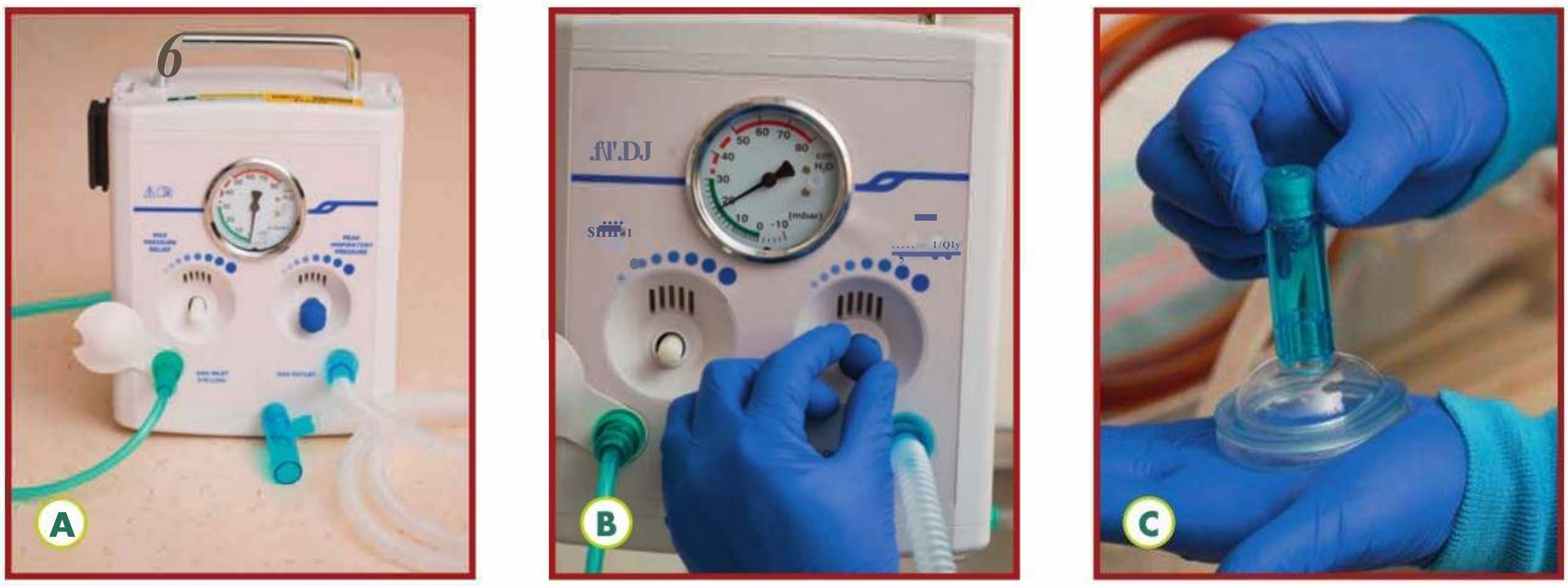


Figure 4.9. An example of a T-piece resuscitator (A). The T-piece resuscitator's pressure is controlled by adjustable valves. PIP is adjusted by a dial on the machine (B) and PEEP is controlled by a dial on the T-piece cap (C).

Testing a T-piece resuscitator during the equipment check and before use

Block the mask or gas outlet with the palm of your hand or occluding cap. First leave the opening on the T-piece cap open, then occlude the opening with your finger (Figure 4.10).

Testing a T-piece resuscitator

Block the mask or T-piece gas outlet without occluding the opening on the T-piece cap.

- Does the PEEP read 5 cm H_20 ?

Occlude the opening on the T-piece cap.

- Does the peak pressure read 20 to 25 cm H_20 ?

If the pressure is not correct,

- Is the T-piece gas outlet sealed?
- Is the gas tubing connected to the gas inlet?
- Is the gas flow set at 10 L/min?
- Is the gas outlet (proximal) disconnected?
- Is the maximum circuit pressure, PIP, or PEEP incorrectly set?

Figure 4.10. Testing a T-piece resuscitator

What are the indications for positive-pressure ventilation?

After completing the initial steps, PPV is indicated *if the baby is not breathing (apneic), OR if the baby is gasping, OR if the baby's heart rate is less than 100 bpm* (Figure 4.11). When indicated, PPV should be started within 1 minute of birth.

In addition, a trial of PPV may be considered if the baby is breathing and the heart rate is greater than or equal to 100 bpm, but the baby's oxygen saturation cannot be maintained within the target range despite free-flow oxygen or CPAP.

Immediately call for help if you are alone. Your assistant(s) will monitor the heart rate response to PPV, watch for chest movement, monitor the baby's oxygen saturation with pulse oximetry, and document events as they occur.

How do you prepare to begin positive-pressure ventilation?

Position yourself at the radiant warmer.

The person responsible for positioning the airway and holding the mask on the baby's face is positioned at the baby's head (Figure 4.12). It is difficult to maintain the head, neck, and mask in the correct position when standing at the side or foot of the bed. Team members at the side of the bed are better positioned to assess chest movement, listen to heart rate and breath sounds, and assist with pulse oximeter and cardiac monitor placement.

Complete the initial steps of newborn care.

If not done already, suction the mouth and nose to be certain that secretions will not obstruct PPV.

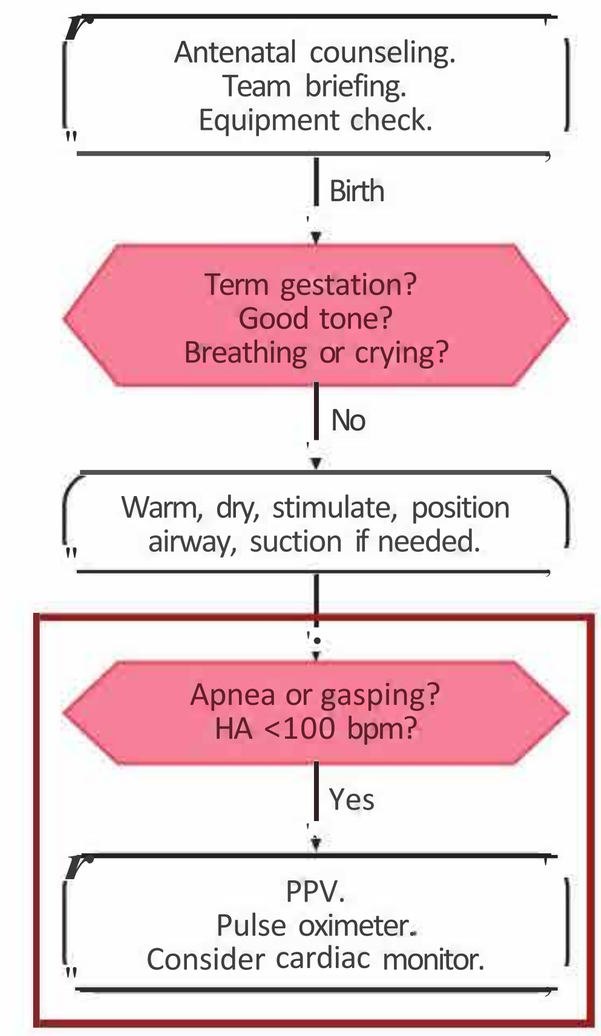


Figure 4.11. Indications for PPV

Figure 4.12. Position yourself at the baby's head to provide assisted ventilation.

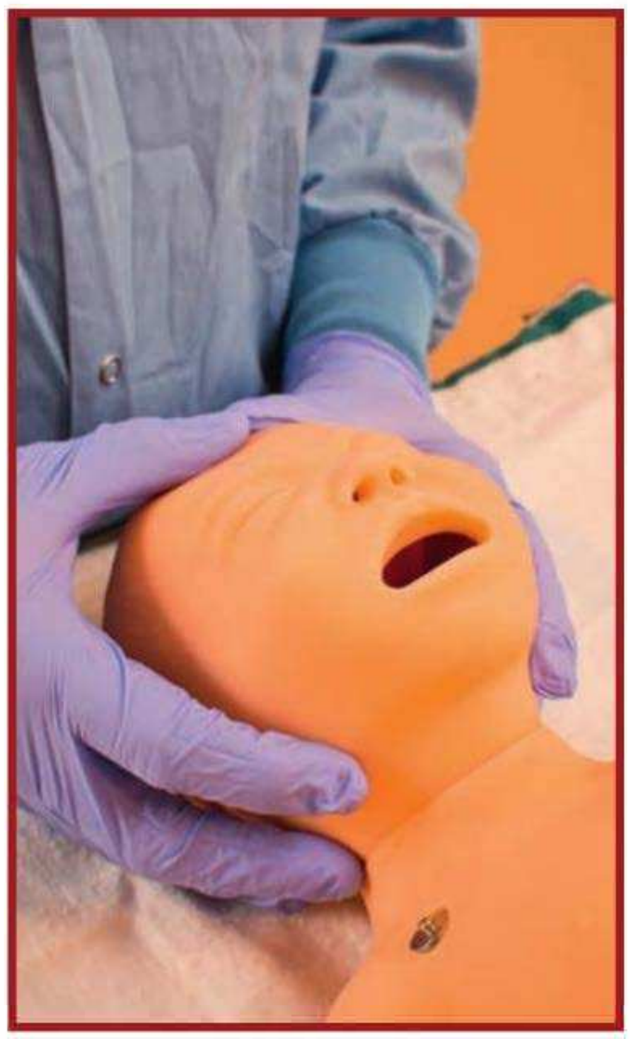


Figure 4.13. The sniffing position

Position the baby's head and neck for positive-pressure ventilation.

The baby's head and neck should be positioned midline and neutral, or slightly extended, in the sniffing position so that the baby's eyes are directed straight upward toward the ceiling (Figure 4.13). Improper positioning is one of the most common reasons for ineffective mask ventilation. The airway will be obstructed if the neck is excessively flexed or extended. Because the back of a newborn's head (occiput) is prominent, it may be helpful to lift the shoulders slightly by placing a rolled towel or small blanket under the baby's shoulders (Figure 4.14).

Figure 4.14. Shoulder roll used to position the head and neck

How do you position the mask on the baby's face?

Select the correct mask.

A variety of mask sizes should be available at every birth. Neonatal masks have a cushioned or soft pliable rim and con1e in 2 shapes-anaton1ically shaped and round (Figure 4.15). Anatomically shaped masks are placed with the pointed part of the mask over the nose. The mask should rest on the chin and cover the mouth and nose, but not the eyes. The correct mask will create a tight seal on the face. If the rim of a cushioned mask is improperly inflated, it may be difficult to achieve a good seal.

Place the mask on the baby's face.

An airtight seal between the rim of the mask and the face is necessary to achieve the pressure that will ínflate the lungs. Ventilation will not be successful if there is a large air leak from an improperly placed mask.

Figure 4.15. Correctly sized anatomic (A) and round (B) masks

One-Hand Hold

- Begin by cupping the chin in the bottom of an anatomic mask and then bring the mask over the mouth and nose (Figure 4.16).
- The bottom of the mask should rest on the chin, not below it. The tip of the mask should rest at or just below the nasal bridge to avoid putting pressure on the baby's eyes or causing a large leak around the eyes.
- Hold the mask on the face with the thumb and index finger encircling the rim.
- Place the other 3 fingers under the bony angle of the jaw and gently lift the jaw upward toward the mask.
- Once the mask is positioned, an airtight seal can be formed by using even, downward pressure on the rim of the mask while holding the head in the sniffing position (Figure 4.17).

Some round masl(s are designed to be placed directly over the nose and mouth and held in place by the stem rather than the rim (Figure 4.18). If you apply pressure to the rim of this type of mask, the mask shape will be deformed and will leak.

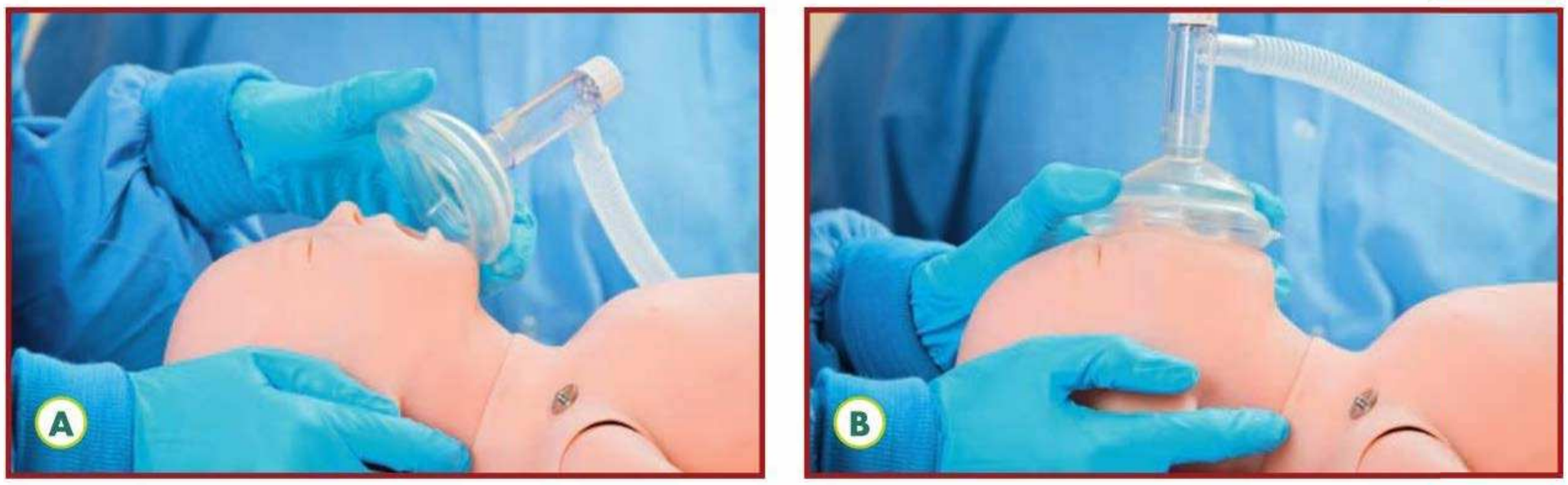


Figure 4.16. (A) Cup the chin in the anatomic mask. (B) Bring the mask over the mouth and nose.

Figure 4.17. Maintaining a seal with the 1-hand hold using an anatomic mask

Figure 4.18. Maintaining a seal with the 1-hand hold by holding only the stem of a round mask

Two-Hand Hold With Jaw Thrust

It can be difficult to maintain a good seal and the correct head position with 1 hand. If you cannot achieve a good seal, use both hands to hold the mask and lift the jaw.

- Use the thumb and first finger of both hands to hold the mask against the face.
- Place the other 3 fingers of each hand under the bony angle of the jaw and gently lift the jaw upward toward the mask (Figure 4.19).
- While you concentrate on making a good seal and maintaining the correct midline head position, another team member stands at the baby's side and squeezes the bag or occludes the T-piece cap.
- A third person monitors the baby's response.

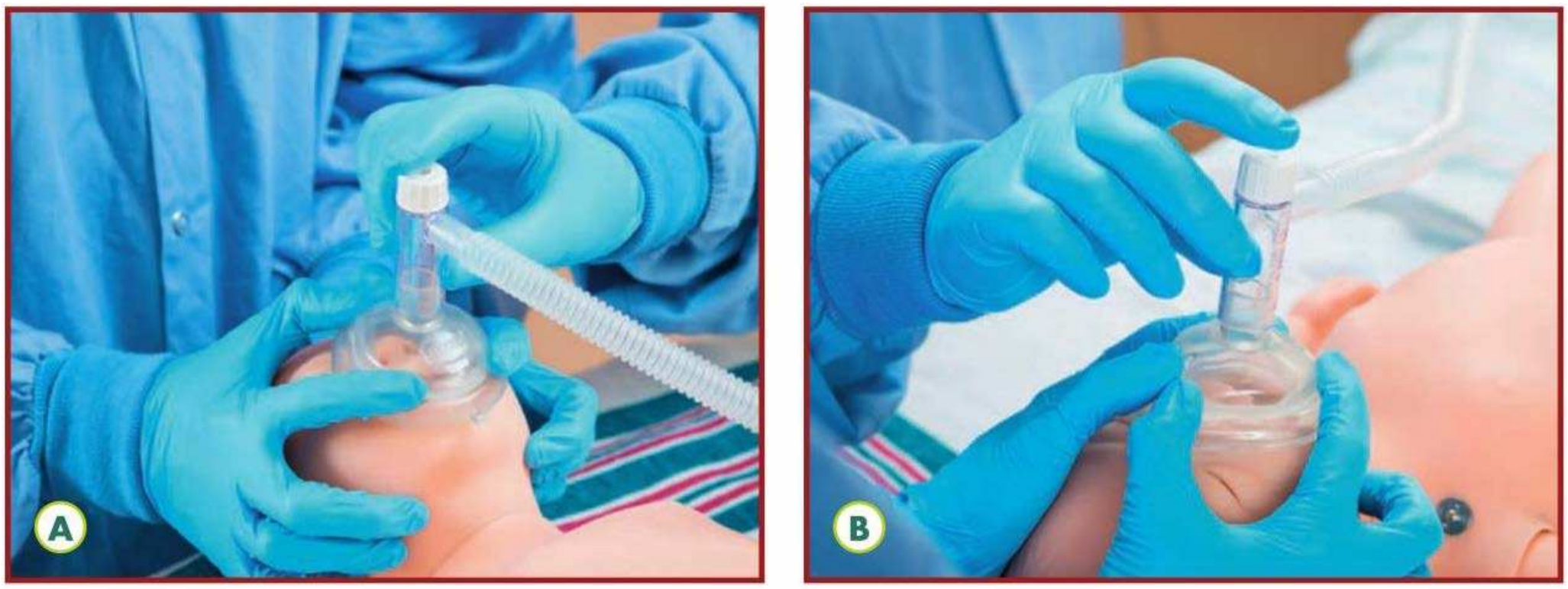


Figure 4.19. Two-hand hold with jaw thrust. An assistant delivers the breath.

Precautions

Care must be taken when holding the mask.

- Do not "jam„ the mask down on the face or occlude the nasal passages. Too much pressure can obstruct the mask, cause air to leak around the side of the mask, inadvertently flex the baby's neck, or bruise the face.
- Be careful not to rest your hand on the baby's eyes.
- Be careful not to compress the soft tissue of the baby's neck.
- Recheck the position of the mask and the baby's head at intervals to make sure they are still correctly positioned.

Figure 4.20. Flowmeter (left) set to 10 L/min. Adjust blender to desired $F10_2$.

Table 4-1 Target Pre-Ductal Oxygen Saturation

Target Oxygen Saturation Table	
1 min	60%-65%
2 min	65%-70%
3 min	70%-75%
4 min	75%-80%
5 min	80%-85%
10 min	85%-95%
Initial Oxygen Concentration for PPV	
≥35 weeks' GA	21% oxygen
< 35 weeks' GA	21%-30% oxygen

What concentration of oxygen should be used to start positive-pressure ventilation?

Studies have shown that resuscitation started with 21% oxygen in term and late preterm newborns, and 21% to 30% oxygen in preterm newborns, is justas effective as resuscitation started with 100% oxygen. To balance the hazards possibly associated with extremes of oxygenation, this program recommends attempting to maintain an oxygen saturation, measured with pulse oximetry, close to the saturation measured in healthy babies born at term. Before birth, the fetus has a blood oxygen saturation of approximately 60%. After birth, the oxygen saturation gradually increases above 90%. However, even healthy term newborns may take 10 minutes or longer to reach this saturation.

- For the initial resuscitation of newborns **greater than or equal to 35 weeks' gestation,** set the blender to **21% oxygen** (Figure 4.20).
- For the initial resuscitation of newborns **less than 35 weeks' gestation,** set the blender to **21% to 30% oxygen.**
- Set the flowmeter to **10 L/minute** (Figure 4.20).
- An assistant should place a pulse oximeter sensor on the right hand or wrist as soon as possible after PPV is started. Once the pulse oximeter is reading reliably, compare the baby's pre-ductal oxygen saturation with the range of target values summarized in Table 4-1 and adjust the $F10_2$ as needed.

What ventilation rate should be used during positive·pressure ventilation?

Breaths should be given at a rate of ***40 to 60 breaths per minute.***

- Count out loud to help maintain the correct rate.
- Use the rhythm, **"Breathe,** *two, three;* **breathe,** *two, three;* **breathe,** *two, three:'*
- Say "Breathe" as you squeeze the bag or occlude the T-piece cap and release while you say "two, three:'

How much pressure should be used to start positive·pressure ventilation?

After birth, fetal lung fluid within the alveoli must be replaced with air for gas exchange to occur. If the baby has not taken a spontaneous breath, the first few assisted breaths may require higher than usual pressure to move fluid out of the air spaces and inflate the alveoli.

However, excessively high lung volumes and airway pressures can cause lung injury. The goal is to use just enough pressure to ínflate and aerate the lungs so that the heart rate and oxygen saturation increase (Table 4-2).

- Start with a **PIP of 20 to** 25 **cm H_20** .
- Full-term babies may require a higher inflation pressure for the first few breaths to ínflate their lungs. After the initial inflating breaths, you may be able to decrease the inflation pressure.
- Administering PEEP with the initial inflating breaths helps to achieve stable lung inflation more quickly, remove fluid, and prevent the air spaces from collapsing during exhalation. **When PEEP is used, the suggested initial setting is 5 cm H_20** .

Once you ínflate the lungs, you should see a gentle rise and fall of the chest with each breath. If the baby appears to be taking very deep breaths during PPV, you are probably using too much pressure and the lungs may become overinflated. This increases the risk of producing an air leak within the lung (pneumothorax). Remember that the volume of a normal breath is much smaller than the amount of gas in a typical resuscitation bag.

If the baby is preterm, visual assessment of chest movement may be less reliable and there may be a greater risk of injury from overinflation. It is possible to achieve successful ventilation without apparent chest movement. Additional details about providing assisted ventilation to preterm newborns are included in Lesson 8.

Table 4-2. Initial Settings for Positive-Pressure Ventilation

	Component	Initial Setting
Oxygen concentration	≥ 35 weeks' gestation < 35 weeks' gestation	21% 21%-30%
Gas flow		10 L/minute
Rote		40-60 breaths/minute
PIP		20-25 cm H_20
PEEP		5 cm H_20

How do you evaluate the baby's response to positive-pressure ventilation?

The most important indicator of successful PPV is a rising heart rate. When you start PPV, an assistant will monitor the baby's heart rate response. The initial heart rate assessment may be made with a stethoscope. Once PPV begins, an assistant should apply a pulse oximeter sensor to continuously assess the baby's oxygen saturation

and heart rate. Continuous monitoring with a cardiac monitor may be considered. If PPV was started because the baby had a low heart rate, it should improve rapidly.

- Within 15 seconds of starting PPV, the baby's heart rate should be increasing.
- Within 30 seconds of starting PPV, the baby's heart rate should be greater than 100 bpm.

If the baby's **heart rate is increasing** after the first 15 seconds, continue PPV. You will check the response again after 30 seconds of PPV.

If the baby's **heart rate is not increasing** after the first 15 seconds, ask your assistant if the chest is moving.

- **If the chest is moving,** continue PPV while you monitor your ventilation technique. You will check the baby's response again after 30 seconds of PPV.
- **If the chest is NOT moving,** you may not be ventilating the baby's lungs. Perform the ventilation corrective steps described below until you achieve chest movement with PPV.

What are the MR. SOPA ventilation corrective steps?

The ventilation corrective steps are a series of adjustments that you will make if the baby's heart rate is not improving and the chest is not moving. The most likely reasons for ineffective mask ventilation are leak around the mask, airway obstruction, and insufficient ventilating

Table 4-3. The MR. SOPA Ventilation Corrective Steps

	Corrective Step	Actions
M	Mask adjustment.	Reapply the mask and lift the jaw forward. Consider the 2-hand hold.
R	Reposition the head and neck.	Place head neutral or slightly extended.
Give 5 breaths and assess chest movement. If no chest movement, do the next steps.		
S	Suction the mouth and nose.	Use a bulb syringe or suction catheter.
O	Open the mouth.	Use a finger to gently open the mouth.
Give 5 breaths and assess chest movement. If no chest movement, do the next step.		
P	Pressure increase.	Increase in 5-10 cm H_2O increments to maximum recommended pressure. • Max 40 cm H_2O term • Max 30 cm H_2O preterm
Give 5 breaths and assess chest movement. If no chest movement, do the next step.		
A	Alternative airway.	Insert a laryngeal mask or endotracheal tube.
Try PPV and assess chest movement and breath sounds.		

pressure. The ventilation corrective steps address these common problems and are summarized in Table 4-3.

You may use the MR. SOPA mnemonic to remember the 6 steps in order.

- Mask adjustment.
- Reposition the head and neck.
- Suction the 1nouth and nose.
- Open the mouth.
- Pressure increase.
- Alternative airway.

You will perform the corrective steps sequentially until you achieve chest movement with assisted breaths.

Figure 4.21 • Inadequate mask seal on the face may result in ineffective ventilation. Air leak between the cheek and bridge of the nose is common.

Mask adjustment.

Reapply the mask to the face to form a better seal. Indicators of a good seal while using a T-piece resuscitator and flow-inflating bag include achieving the desired PIP, maintaining the desired PEEP on the manometer, and rapid reinflation of a flow-inflating bag between breaths.

- If a leak is present, lift the jaw upward but do not press down hard on the baby's face. You may need to use a little more pressure on the rim of an anatomic mask.
- The most common place for a leak to occur is between the cheek and bridge of the nose (Figure 4.21).
- If you continue to have difficulty achieving a tight seal, use the **2-hand hold** described previously.

Reposition the head and neck.

The airway may be obstructed because the neck is flexed too far forward or is overextended. Reposition the baby's head and neck to ensure that it is midline and neutral or slightly extended (the sniffing position).

Once you have adjusted the mask and repositioned the head and neck, try PPV again and assess chest movement. If the chest is not moving, proceed to the next 2 corrective steps.

Suction the mouth and nose.

Suction the mouth and nose with a bulb syringe. The airway may be blocked by thick secretions. In unusual situations, thick secretions may be blocking the trachea, and tracheal intubation for suction may be required.

Open the mouth.

Opening the baby's mouth may decrease the resistance to airflow during PPV. Use your finger to open the baby's mouth and reapply the mask.

After suctioning the mouth and nose and opening the mouth, try PPV again and assess chest movement. If the chest is still not moving, proceed to the next step.

Pressure increase.

Although you have an adequate seal and an open airway, inflating the baby's lungs may require a higher inflation pressure.

- Use the manometer to guide adjustments of the inflation pressure. Increase the pressure by 5 to 10 cm H_20 increments until you achieve chest movement.
- The maximum recommended pressure with face-mask ventilation is 40 cm H_20 for a term newborn and 30 cm H_20 for a preterm newborn.

After each pressure increase, try PPV again and assess the chest movement. If the chest is not moving with the maximum recommended pressure, proceed to the next step.

Alternative airway.

Mask ventilation is not always sufficient to inflate the lungs. If you have completed the first 5 corrective steps and you still cannot achieve chest movement, you should insert an alternative airway such as a laryngeal mask or endotracheal tube. Once an alternative airway is inserted, begin PPV and evaluate the baby's chest movement and breath sounds. Instructions for inserting a laryngeal mask are included in this lesson. Endotracheal intubation is addressed in Lesson 5.

The baby's chest started moving after one of the ventilation corrective steps. Now what do you do?

Once you achieve chest movement with each assisted breath, announce, ***"The chest is moving NOW"*** This ensures that your team is aware of your assessment and knows that additional MR. SOPA steps are not necessary.

Continue PPV that moves the chest for 30 seconds while you monitor your ventilation rate, pressure, and the baby's heart rate response.

If you have difficulty maintaining chest movement during this time, repeat the ventilation corrective steps as needed. Insert an alternative airway if you have persistent difficulty maintaining effective ventilation with a face mask.

What do you do after 30 seconds of positive-pressure ventilation that ventilates the lungs?

After 30 seconds of PPV that ventilates the lungs, as indicated by an increasing heart rate or chest movement, you will check the baby's heart rate response again.

- **The heart rate is greater than or equal to 100 bpm.**

  Assisted ventilation has been successful.

  - Continue ventilating at a rate of 40 to 60 breaths per minute.
  - Monitor the baby's chest movement, heart rate, and respiratory effort.
  - Adjust the FiO_2 as needed based on pulse oximetry.
  - When the heart rate is consistently greater than 100 bpm, gradually reduce the rate of PPV, observe for effective spontaneous respirations, and gently stimulate the baby to breathe.
  - Positive-pressure ventilation may be discontinued when the baby has a heart rate continuously greater than 100 bpm and sustained spontaneous breathing.

- **The heart rate is at least 60 bpm but less than 100 bpm.**

  If the heart rate is improving, continue to administer PPV as long as the baby is showing steady improvement. Monitor the oxygen saturation and adjust the FiO_2 to meet the target saturation range indicated in the table.

  If the heart rate **is not** improving, consider each of the following:

  - Quickly reassess your ventilation technique. Is the chest moving? Are you ventilating at a rate of 40 to 60 breaths/minute? Do you hear breath sounds? If necessary, perform the ventilation corrective steps.
  - Adjust the FiO_2 to meet the target saturation.
  - If not already done, consider placing cardiac monitor leads for continuous monitoring.
  - If not already done, consider inserting a laryngeal mask or endotracheal tube.
  - If available, call for additional expertise to help problem solve this situation.

- **The heart rate is less than 60 bpm.**

  This uncommon situation occurs when the heart cannot respond to ventilation alone and requires additional support to bring oxygenated blood to the coronary arteries.

Consider each of the following:

- Quickly reassess your ventilation technique. Is the chest moving? Are you ventilating at a rate of 40 to 60 breaths/minute? Do you hear breath sounds? If necessary, perform ventilation corrective steps.
- If the pulse oximeter has a reliable signal, adjust the FIO_2 to meet the target saturation.
- If not already done, place cardiac monitor leads and begin continuous monitoring.
- If not already done, insert a laryngeal mask or endotracheal tube.
- If available, call for additional expertise to help problem solve this situation.
- If the baby's heart rate remains less than 60 bpm after at least 30 seconds of PPV that moves the chest, preferably through an alternative airway, increase the FIO_2 to 100% and begin chest compressions as described in Lesson 6.

While performing the ventilation corrective steps, can a carbon dioxide detector help assess the effectiveness of ventilation?

Using a carbon dioxide (CO_2) detector during the ventilation corrective steps can provide a visual cue that helps you and your team identify when you have achieved ventilation that inflates and aerates the lungs. Place a CO_2 detector between the PPV device and mask. If the lungs are being effectively ventilated and gas exchange is occurring, CO_2 should be exhaled through the mask.

- If you are effectively ventilating the lungs, you should see the detector turn yellow during each exhalation (Figure 4.22).
- If the CO_2 detector is purple and turns yellow after a corrective step, the step was effective and the baby's heart rate will likely improve quickly.
  - If the CO_2 detector <loes not turn yellow, your face-mask ventilation attempts may not be ventilating the lungs.
  - If the detector remains purple after the first 5 corrective steps and the heart rate has not improved, it may be another indication that you have not achieved effective ventilation and an alternative airway is needed.
- **Caution:** If the baby's heart rate is very low or not pumping blood, the detector may not change color because CO_2 is not being carried to the lungs even though you are ventilating the lungs.

Figure 4.22. Carbon dioxide detector used with face mask during ventilation corrective steps. Yellow color on the device as shown suggests ventilation of the lungs.

What is a laryngeal mask?

A laryngeal mask is a small mask attached to an airway tube (Figure 4.23). The mask is inserted into the baby's mouth and advanced into the throat until it makes a seal over the entrance to the baby's trachea (the glottis) (Figure 4.24). The laryngeal mask makes a better seal than a face mask and may improve the effectiveness of ventilation. Unlike endotracheal intubation, no instruments are required to insert a laryngeal mask and you do not need to visualize the baby's vocal cords during insertion. If the baby cannot be successfully ventilated with a face mask and intubation is unfeasible or unsuccessful, a laryngeal mask may provide a successful rescue airway.

Figure 4.23. Examples of neonatal laryngeal masks

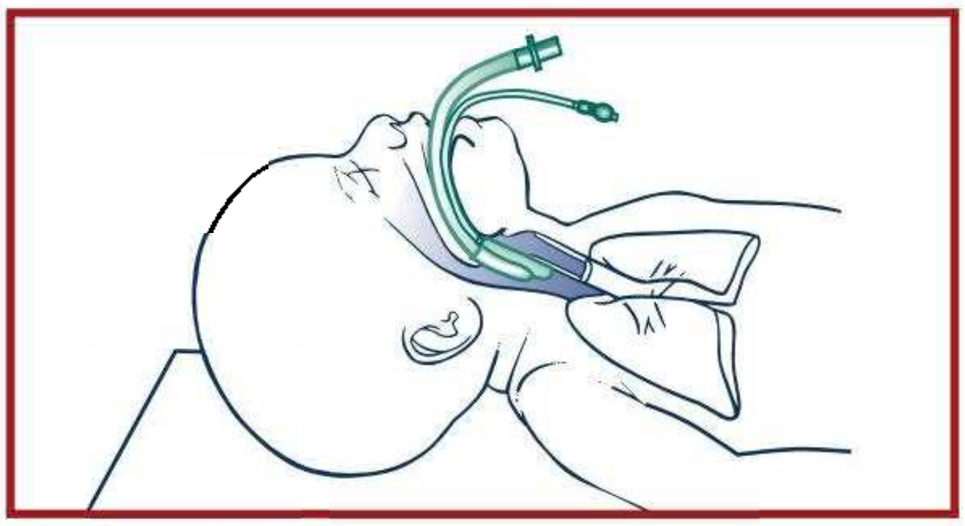


Figure 4.24. Laryngeal mask forming a seal over the glottis

Severa! variations are available, including devices with an inflatable mask, a soft-gel mask that <loes not require inflation, a pre-curved airway tube, and a port for a gastric drainage tube. The laryngeal mask is an effective alternative airway when attempts at face-mask ventilation or intubation are unsuccessful; however, its use in preterm newborns is limited because even the smallest laryngeal mask may be too large for very preterm newborns.

To learn more about limitations of the laryngeal mask, see the Frequently Asked Questions section in this lesson on page 96.

How do you insert a laryngeal mask?

The following instructions and images apply to one example of a disposable laryngeal mask with a pre-curved airway tube and a soft-gel mask that <loes not require inflation. It is intended for use in babies weighing 2 to 5 kg. Devices vary by manufacturer and you should refer to the manufacturer's instructions for the specific device used at your institution.

O If not already done, attach cardiac monitor leads for accurate assessment of the baby's heart rate.

f) Using clean technique, remove the device from the sterile package and protective container. You may place a thin layer of water-based lubricant onto the back and sides of the mask, but this may not be necessary because newborns often have sufficient oral secretions to lubricate the device (Figure 4.25).

Figure 4.25. Remove the device and lubricate the back and sides (optional).

E) Stand at the baby's head and position the baby in the sniffing position.

- Hold the device along the airway tube with the closed bottom of the mask facing the baby's palate and the open bowl of the mask facing toward the baby's chin (Figure 4.26).
- Open the baby's mouth by pressing gently downward on the baby's chin.
- Insert the leading tip of the mask into the baby's mouth, on top of the tongue, with the bottom of the mask pressed against the baby's palate (Figure 4.27).
- Glide the device downward and backward, following the contour of the palate, with a continuous but gentle push until you feel definitive resistance (Figure 4.28).

6) Holding the tube in place, attach a CO_2 detector and PPV device. Begin PPV and secure the device in place (Figure 4.29).

- If the laryngeal mask is correctly inserted and you are providing ventilation that inflates the lungs, you should detect exhaled CO_2 within 8 to 10 positive-pressure breaths. You should see chest wall movement and hear equal breath sounds when you listen with a stethoscope. You should not hear a large leak of air coming from the baby's mouth or see a growing bulge in the baby's neck.

Figure 4.26. Preparing for insertion

Figure 4.27. Insert the mask into the baby's mouth.

Figure 4.28. Advance the device following the contour of the mouth and palote.

Figure 4.29. Start PPV and confirm placement.

When should you remove the laryngeal mask?

The airway can be removed when the baby establishes effective spontaneous respirations and the device is no longer needed or when an endotracheal tube can be inserted successfully. Babies can breathe spontaneously through the device, and crying and grunting sounds may be audible.

- When you decide to remove the laryngeal mask, suction secretions from the mouth and throat before you remove the device.
- If the device has an inflatable rim, deflate the rim before removal.

What do you do if the baby is breathing spontaneously and has a heart rate of at least 100 bpm, but has labored breathing or low oxygen saturation despite free-flow oxygen?

If the baby is breathing spontaneously and has a heart rate of at least 100 bpm, but has labored or grunting respirations or low oxygen saturation, CPAP may be considered. CPAP is **NOT** appropriate if the baby is apneic or gasping or if the baby's heart rate is less than 100 bpm.

CPAP is a technique for maintaining pressure within the lungs of a *spontaneously breathing* baby. CPAP keeps the lungs slightly inflated at ali times and may be helpful for preterm babies whose lungs are surfactant deficient, causing the alveoli to collapse at the end of each exhalation. When CPAP is provided, the baby <loes not have to work as hard to ínflate the lungs with each breath. Using early CPAP for preterm newborns may avoid the need for intubation and mechanical ventilation. Administering CPAP may increase the chance of developing a pneumothorax (air leak). Providers should be aware of this potential complication and be prepared to address it.

How do you administer CPAP during the initial stabilization period?

CPAP is administered by making a seal between the baby's face anda mask attached to either a T-piece resuscitator ora flow-inflating bag. CPAP **cannot** be administered with a self-inflating bag even if a PEEP valve has been placed. The desired CPAP is achieved by adjusting the PEEP dial on the cap of the T-piece resuscitator or the flow-control valve on the flow-inflating bag (Figure 4.30).

- Test the amount of CPAP before applying the mask to the baby's face by holding the mask tightly against your hand and reading the pressure on the manometer (pressure gauge).
- Adjust the PEEP cap or the flow-control valve so that the manometer reads 5 to 6 cm H_20 pressure.

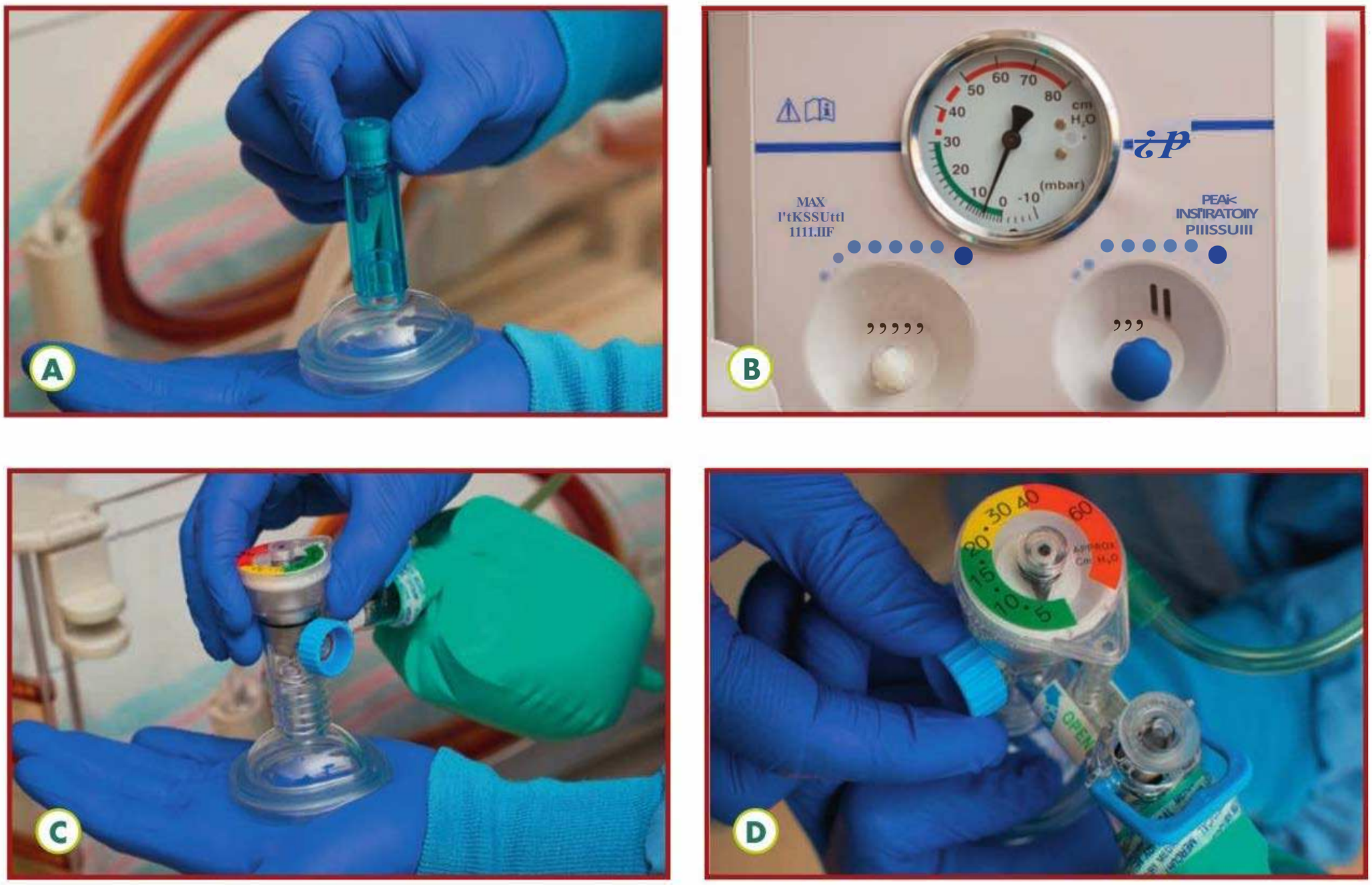


Figure 4.30. Adjust the CPAP pressure by turning the cap on a T-piece resuscitator (A). The resulting CPAP pressure is shown on the manometer (B). Adjust the CPAP pressure using the flow-control valve on a flow-inflating bag (C). The resulting CPAP pressure is shown on the manometer (D). For both, adjust the CPAP before placing the mask on the baby's face.

After you have adjusted the CPAP to the desired pressure, place it firmly against the baby's face (Figure 4.31) using the 2-hand hold with jaw thrust.

- Lift the baby's jaw into the mask instead of pushing the baby's head down into the mattress.
- Check that the pressure is still at the selected level. If it is lower, you may not have an airtight seal of the mask on the baby's face.
- You may adjust the CPAP depending on how hard the baby is working to breathe. Do not use more than 8 cm H_20 .

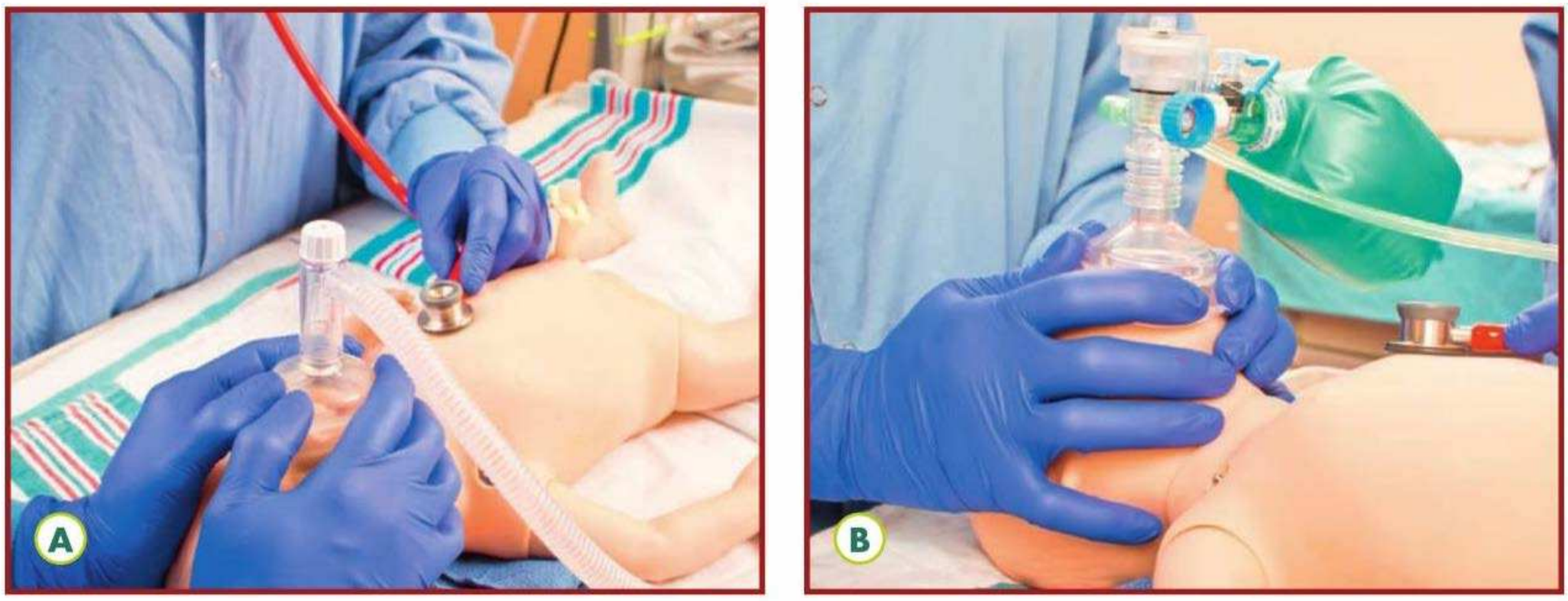


Figure 4.31. Administering face-mask CPAP with a T-piece (A) and flow-inflating bag (B). The manometer shows the amount of CPAP administered. An airtight seal must be maintained with the mask.

- During CPAP, you do NOT occlude the T-piece cap or squeeze the flow-inflating bag.
- If the baby cannot maintain a heart rate of at least 100 bpm with spontaneous respirations, you need to give PPV breaths instead of CPAP.

If CPAP will be administered for a prolonged period, you will use nasal prongs or a nasal mask (Figure 4.32). After the initial stabilization, CPAP can be administered with a bubbling water system, a dedicated CPAP device, or a mechanical ventilator.

Figure 4.32. CPAP administered to a preterm newborn with nasal prongs. (Used with permission of Mayo Foundation for Medical Education and Research.)

When should you insert an orogastric tube?

During CPAP or PPV using a face mask or laryngeal mask, gas enters the esophagus and stomach. Gas in the stomach may interfere with ventilation. If a newborn requires CPAP or PPV for longer than several minutes, consider placing an orogastric tube and leaving it uncapped to act as a vent for the stomach.

Equipment needed

- 8F orogastric tube
- 20-mL syringe
- Tape

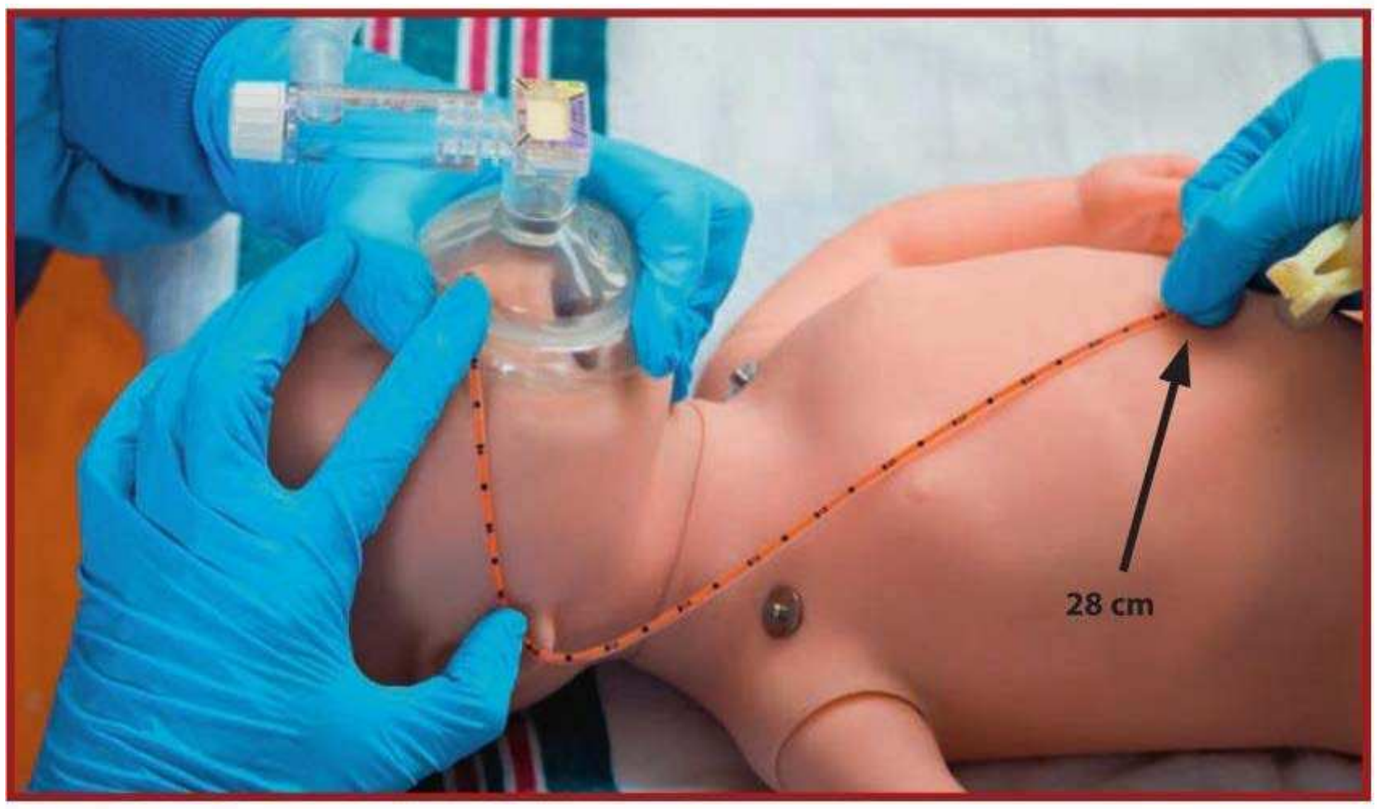


Figure 4.33. Measuring the correct insertion depth for an orogastric tube. In this example, the tube should be inserted 28 cm.

Insertion steps

- Measure the distance from the bridge of the nose to the earlobe and from the earlobe to a point halfway between the xiphoid process (the lower tip of the sternum) and the umbilicus. Note the centimeter mark at this place on the tube (Figure 4.33). To minimize interruption of ventilation, measurement of the orogastric tube can be approximated with the mask in place.

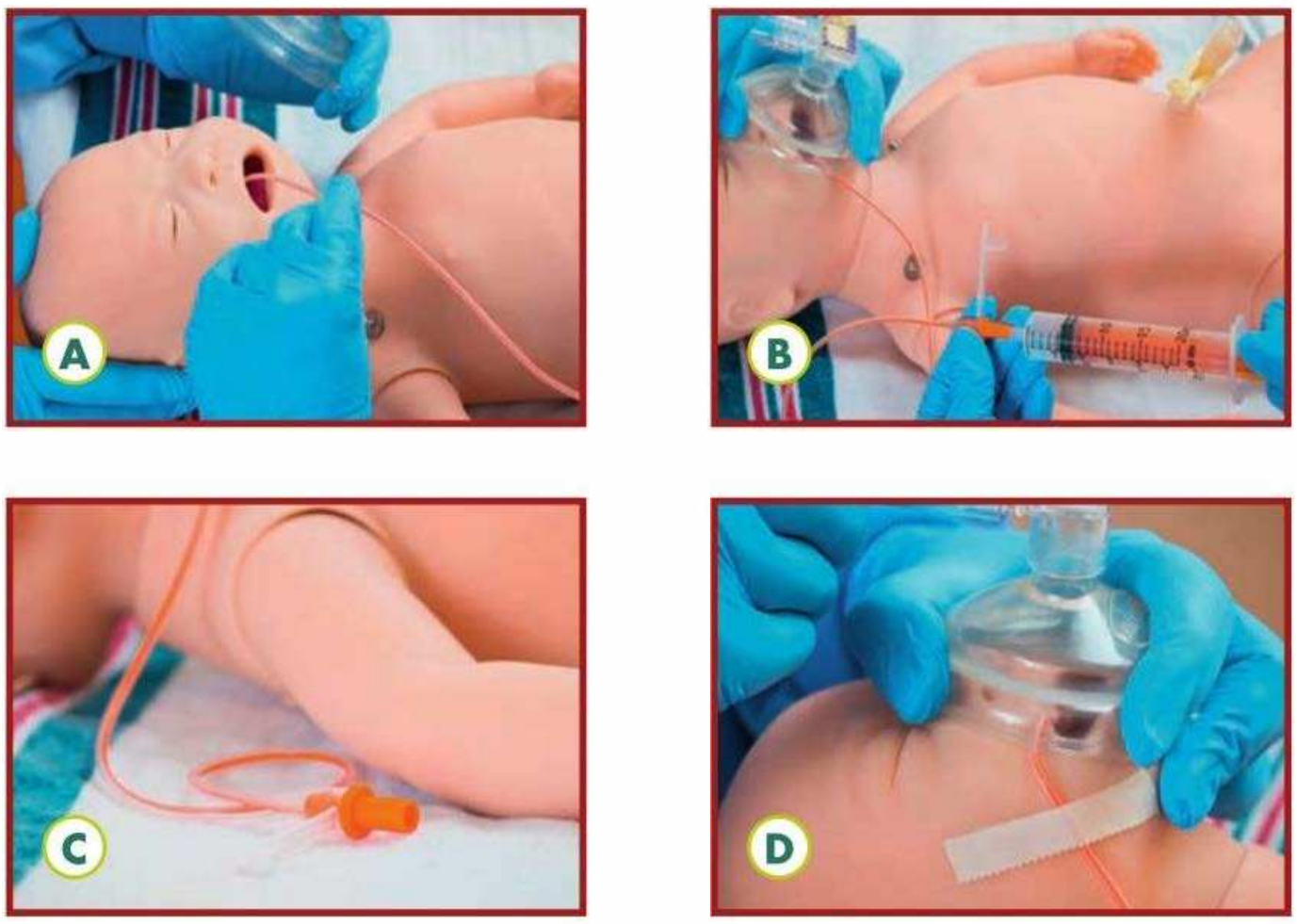


Figure 4.34. Insertion of an orogastric tube (A), aspirating the orogastric tube (B), opening the orogastric tube to vent (C), and securing the orogastric tube with tape (D)

f) Insert the tube through the mouth (Figure 4.34A). Ventilation can be resumed as soon as the tube has been inserted. Reassess the face-mask seal.

8 Once the tube is inserted the desired distance, attach a syringe and remove the gastric contents (Figure 4.34B).

8 Remove the syringe from the tube and leave the end of the tube open to provide a vent for air entering the stomach (Figure 4.34C).

0 Tape the tube to the baby,s cheek (Figure 4.34D).

Focus on Teamwork

Providing PPV highlights several opportunities for effective teams to use the Neonatal Resuscitation Program (NRP®) Key Behavioral Skills.

Behavior	Example
Anticípate and plan.	Ensure that you hove enough personnel present at the time of birth based on the risk factors you identified. During your pre-resuscitation team briefing, determine who performs PPV, auscultates the heart rote, assesses chest movement, places the pulse oximeter and cardiac monitor, and documents events as they occur.
Delegate workload optimally. Call for additional help when needed.	lf PPV is required, at least 2 or 3 qualified providers are needed to perform all of the tasks quickly. lf you hove difficulty maintaining a good seal, the 2-hand hold may be required, which requires a second person to administer the assisted breath and a third person to evaluate the response. You may need to call for additional help if intubation is required.
Communicate effectively.	The individuals providing PPV and assessing the effectiveness of ventilation must share information and communicate with each other. lf the ventilation corrective steps are required, frequent information sharing after each step is crucial. lt is important to announce when chest movement has been achieved ***("Chest is moving NOW")*** so that the team knows that the heart rote should be assessed in 30 seconds.
Know your environment. Use available resources.	Know how to operate and troubleshoot your PPV device. Know how to obtain a laryngeal mask and cardiac monitor.

Quality Improvement Opportunities

Ask yourself the following questions and begin a discussion with your team if you find a difference between the NRP recommendations and what is currently done in your own hospital setting. Consider using the suggested process and outcome measures to guide your data collection, identify areas for improvement, and monitor if your improvement efforts are working.

Quality improvement questions

- Who provides PPV in your delivery room setting?
- Who monitors the baby's heart rate response during PPV?
- Is a cardiac monitor for the newborn readily available in your delivery room setting?
- How often do providers in your delivery room setting practice PPV?
- Do providers know where to find a laryngeal mask and how to insert it?

Process and oukome measures

- How often is PPV given in your delivery room setting?
- How often do newborns without any risk factors require PPV?
- When PPV is required, how often is a second trained provider present at the time of birth?
- How often are the MR. SOPA steps performed in your delivery room setting?
- How often are chest compressions performed in your delivery room setting?
- How often is a complete resuscitation record completed for newborns that have received PPV?

Frequently Asked Questions

What are the advantages and disadvantages of each resuscitation device?

The *self-inflating bag* is often considered easier to use than the other devices and requires little time to set up. It <loes not require a compressed gas source and can be used in an emergency setting when compressed gas may not be readily available. Because it fully reinflates even without a seal, you will be less likely to know if you have a large leak between the mask and the baby's face. It is difficult to control the inflation time with a self-inflating bag. In addition, the mask cannot be used to administer free-flow oxygen or CPAP to a baby.

The *flow-inflating bag* is more complicated to set up than the other devices and takes more practice to use effectively. It requires a compressed gas source and adjustments to find the correct balance between gas inflow and outflow. The advantage is that you will know immediately if you lose gas pressure or have a leak between the bag and mask because the bag will deflate. Absent or partial inflation of the bag indicates that a tight seal has not been established or the bag has a leak. An effective face-mask seal is indicated by observing stable PEEP/CPAP on the manometer. The inflation time can be increased, if needed, by squeezing the bag for a longer period of time. The flow-inflating bag can deliver CPAP, PEEP, and free-flow oxygen.

The *T-piece resuscitator* also requires sorne preparation time for setup prior to use. Similar to the flow-inflating bag, it requires a compressed gas source and adjustment to the dials controlling the PIP and PEEP. The primary advantage of the T-piece resuscitator is that it provides more consistent pressure with each breath than either the self-inflating or flow-inflating bag. An effective face-mask seal is indicated by observing stable PEEP/CPAP on the T-piece manometer. In addition, the users may not become fatigued because they are not repeatedly squeezing a bag. The inflation time can be increased, if needed, by occluding the hole on the T-piece cap for a longer period of time. The T-piece can deliver CPAP, PEEP, and free-flow oxygen.

Why not routinely use 100% oxygen during all neonatal resuscitations?

Multiple studies in both animals and humans have raised concerns about the safety of routinely using 100% oxygen during neonatal resuscitation. A series of human randomized and quasi-randomized studies over the last 2 decades have demonstrated that resuscitation with 21% oxygen, is at least as effective as resuscitation with 100% oxygen. In meta-analyses of these studies, mortality was decreased among term and late-preterm babies resuscitated with 21% oxygen compared with 100% oxygen. Intermediate initial oxygen concentrations, between 21% and 100%, have not been studied. Because oxygen relaxes pulmonary blood vessels, sorne have expressed concern that babies resuscitated with lower oxygen concentrations will be more likely to develop pulmonary hypertension. Animal studies have shown that pulmonary vascular resistance decreases appropriately with 21% oxygen, and that resuscitation with 21% oxygen may actually prevent rebound pulmonary hypertension and preserve the response to inhaled nitric oxide if pulmonary hypertension develops.

In preterm newborns, there was no difference in outcomes between those resuscitated with low oxygen (21%-30%) and high oxygen (60%-100%). Although no difference was found, the recommendation

to start with low oxygen and titrate upward as needed using pulse oximetry reflects a preference to avoid exposing preterm newborns to additional oxygen without evidence demonstrating a benefit for important outcomes. The ideal initial $F10_2$ for resuscitating preterm newborns is still unknown, but the majority of preterm newborns enrolled in studies required sorne oxygen supplementation during the first minutes of life.

Can a nurse or respiratory therapist insert a laryngeal mask?

Each health care provider's scope of practice is defined by their state licensing board, and each hospital determines the level of competence and qualifications required for licensed providers to perform clinical skills. Although laryngeal mask insertion is consistent with the general guidelines for nurse and respiratory therapist practice, you must check with your state licensing board and institution.

What are the limitations of a laryngeal mask?

Laryngeal masks have several limitations to consider during neonatal resuscitation.

- The device has not been studied for suctioning secretions from the a1rway.
- If you need to use high ventilation pressures, air may leak through the seal between the pharynx and the mask, resulting in insufficient pressure to inflate the lungs.
- Few reports describe the use of a laryngeal mask during chest compressions. However, if tracheal intubation is unsuccessful, it is reasonable to attempt compressions with the device in place.
- There is insufficient evidence to recommend using a laryngeal mask to administer intratracheal medications. Intratracheal medications may leak from the mask into the esophagus and not enter the lungs.
- Laryngeal masks cannot be used in very small newborns. Currently, the smallest laryngeal mask is intended for use in babies who weigh more than approximately 2 kg. Many reports describe its use in babies who weigh 1.5 to 2.5 kg. Sorne reports have described using a laryngeal mask successfully in babies who weigh less than 1.5 kg.

LESSON 4 REVIEW

1. The single most i1nportant a11dmost effective step in neonatal resuscitation is (aggressive stimulation)/(ventilation of the lungs).

2. After the initial steps, positive-pressure ventilation is indicated ifthe baby is ___ , OR ifthe baby is ____ , OR ifthe baby's heart rate is less than ___ beats per minute. *(Fill in the blanks.)*

3. A baby is born limp and apneic. You place the baby under a radiant warmer, dry and stimulate, position the head and neck to open the airway, and suction the mouth and nose. It has been 1 minute since birth and the baby remains apneic. The next step is to (stimulate more)/(begin positive-pressure ventilation).

4. For positive-pressure ventilation, adjust the flowmeter to (5 L/min)/(10 L/min).

5. Administer positive-pressure ventilation ata rate of (20 to 25 breaths per minute)/(40 to 60 breaths per minute).

6. Begin positive-pressure ventilation with an inflation pressure of (20 to 25 cm H_20)/(40 to 60 cm H_20).

7. Ventilation of the term newborn begins with (21% oxygen)/(100% oxygen).

8. If you are using a device that administers positive end-expiratory pressure (PEEP), the recommended initial pressure is (5 cm H_20)/(10 cm H_20).

9. You have started positive-pressure ventilation for an apneic newborn. The heart rate is 40 beats per minute and is not improving. Your assistant <loes not see chest movement. You should (start the ventilation corrective steps)/(proceed to chest compressions).

10. Inflation and aeration of the lungs is suggested by a $C0_2$ detector that turns (yellow)/(purple).

11. You have started positive-pressure ventilation for an apneic newborn. The heart rate has remained 40 beats per minute despite performing all of the ventilation corrective steps and ventilating through an endotracheal tube for 30 seconds. Your assistant sees chest movement with positive-pressure ventilation. You should (increase the ventilation rate to 100 breaths/minute)/(proceed to chest compressions).

12. A laryngeal mask is inserted into the baby's mouth and advanced into the throat until it (passes between the baby's vocal cords)/(makes a seal over the entrance to the baby's trachea).

13. To insertan orogastric tube, measure the distance from the bridge of the nose to the earlobe and from the earlobe (to the nipples)/(to a point halfway between the xiphoid process and the umbilicus).

Answers

1. The single most important and most effective step in neonatal resuscitation is ventilation of the lungs.

2. After the initial steps, positive-pressure ventilation is indicated if the baby is apneic, OR if the baby is gasping, OR if the baby's heart rate is less than 100 beats per minute.

3. The next step is to begin positive-pressure ventilation.

4. For positive-pressure ventilation, adjust the flowmeter to 10 L/mln.

5. Administer positive-pressure ventilation ata rate of 40 to 60 breaths per minute.

6. Begin positive-pressure ventilation with an inflation pressure of 20 to 25 cm H_20 .

7. Ventilation of the term newborn begins with 21 % oxygen.

8. If you are using a device that administers positive end-expiratory pressure (PEEP), the recommended initial pressure is 5 cm H_20 .

9. You should start the ventilation corrective steps.

10. Inflation and aeration of the lungs is suggested by a $C0_2$ detector that turns yellow.

11. You should proceed to chest compressions.

12. A laryngeal mask is inserted into the baby's mouth and advanced into the throat until it makes a seal over the entrance to the baby's trachea.

13. Measure the distance from the bridge of the nose to the earlobe and from the earlobe to a point halfway between the xiphoid process and the umbilicus.

Appendix

Read the section(s) that refers to the type of device used in your hospital.

A. Self-inflating resuscitation bag

What are the parts of a self-inflating bag?

There are 8 basic parts to a self-inflating bag (Figure 4A.l).

O Gas outlet

f) Positive end-expiratory pressure (PEEP) valve (optional)

E) Manometer

9 Pressure-releas e valve

0 Gas inlet

O Gas tubing

O (A) Oxygen reservoir (closed type), (B) Oxygen reservo ir (open type)

0 Valve assembly

The self-inflating bag reexpands after being squeezed and fills with gas from 3 locations. As the bag reinflates, air from the room is drawn in from openings in the back of the bag. Gas from the blender and flowmeter travels through *gas tubing* and enters the bag at the *gas inlet.* Gas from the blender collects in the *oxygen reservoir* and provides a third source for gas to fill the bag. Oxygen tubing <loes not need to be attached for the bag to provide positive-pressure ventilation (PPV) with 21% oxygen. O_{xy} gen tubing must be attached to a compressed gas source to deliver more than 21% oxygen. The *gas outlet* is where gas exits from the bag to the baby and where a face mask, laryngeal mask, or endotracheal tube is attached.

A *manometer* (pressure gauge) measures the inflating pressure used during PPV Sorne bags will have a built-in manometer and others will need one attached. The attachment site is usually close to the

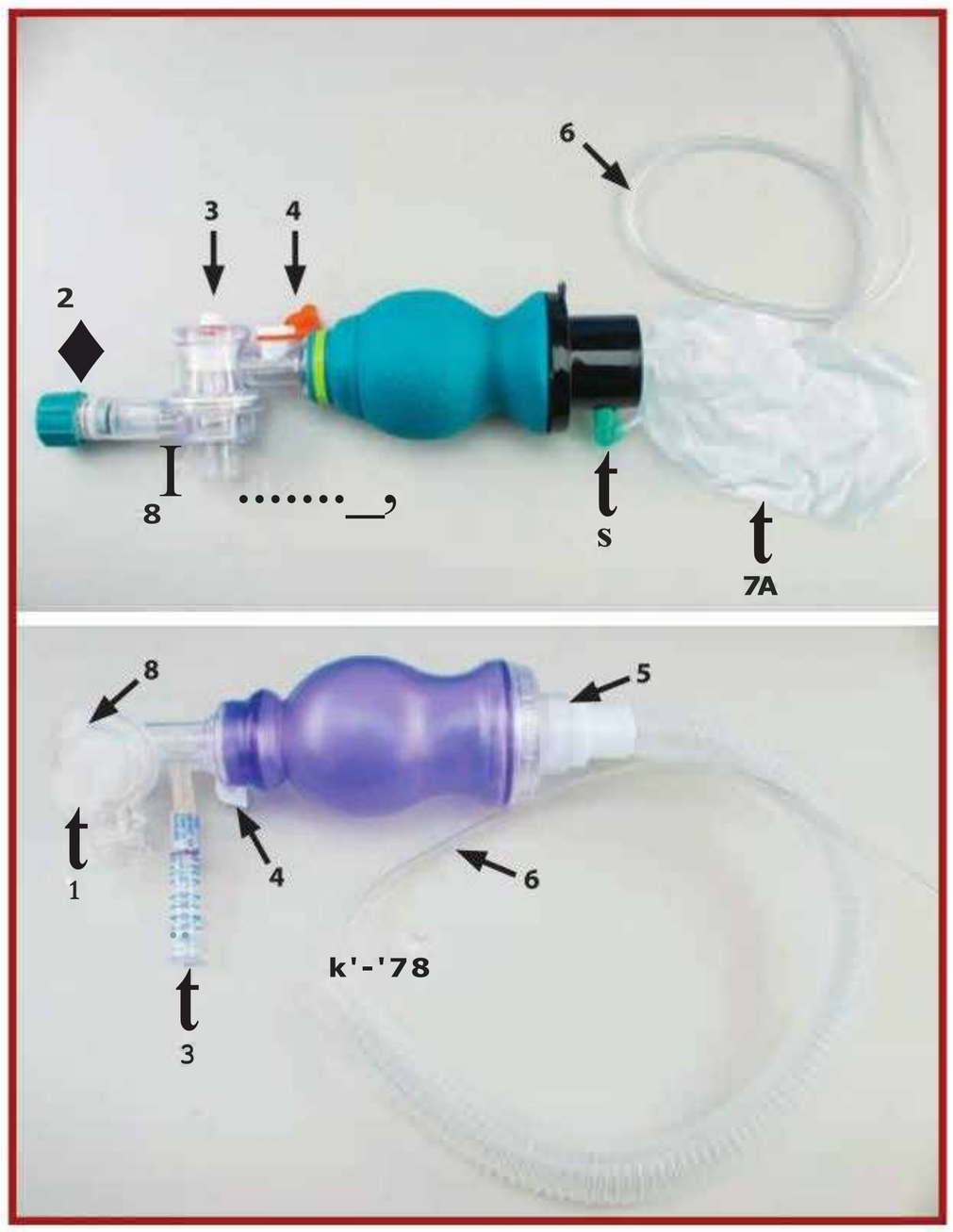


Figure 4A.1. Self-inflating bags with a closed (7A) and open (7B) reservoir

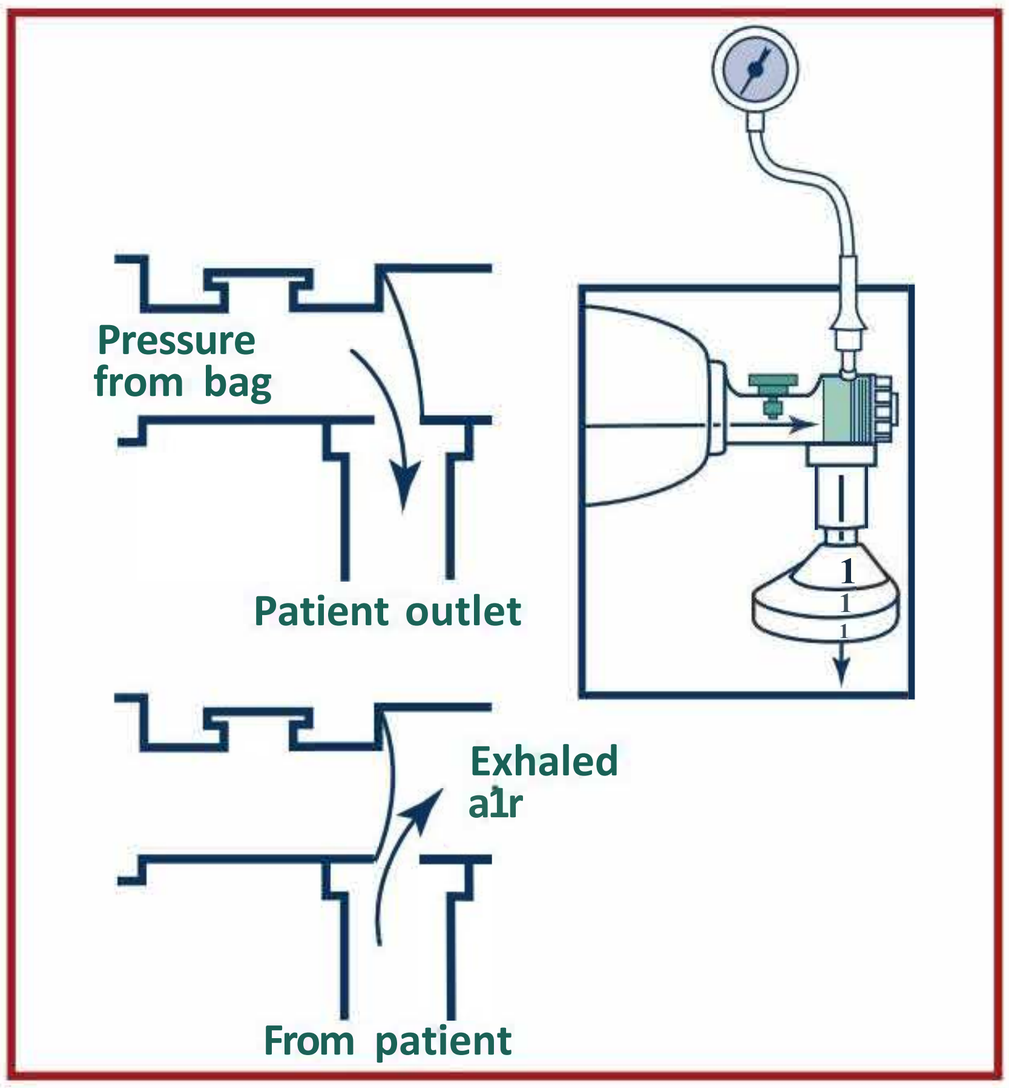


Figure 4A.2. Valve assembly within a self-inflating bag

patient outlet. If the .manometer attachment site is left open, without a manometer attached, air will leak out and prevent you from achieving inflation pressure. Do not attach the oxygen inflow tubing to the manometer attachment site. This could generate undesired high pressure. Most self-inflating bags also have a *pressure-release (pop-off) valve.* These valves are usually set to release at 30 cm to 40 cm H_20 pressure, but they are not reliable and may not release until higher pressures are achieved.

Self-inflating bags have a *valve assembly* positioned between the bag and the patient outlet (Figure 4A.2). When the bag is squeezed during ventilation, the valve opens and directs gas to the patient. When the bag reinflates, the valve is closed. This prevents the patient's exhaled air from entering the bag and being rebreathed. Sorne self-inflating bags also have an adjustable *PEEP valve.*

Why is an oxygen reservoir used on a self-inflating bag?

An oxygen reservoir is an appliance that can be placed over the bag's air inlet. Gas from the blender collects in the reservoir. At very low flow rates, the reservoir prevents blended gas from being diluted with room air. Several different types of oxygen reservoirs are available, but they all perform the same function. Sorne have open ends ("tails") and others look like a bag covering the air inlet.

B. Flow-inflating resuscitation bag

What are the parts of a flow-inflating bag?

There are 6 parts to a flow-inflating bag (Figure 4A.3).

O Gas outlet

f) Manometer

E) Gas inlet

8 Pressure-release valve (optional)

0 Gas tubing

O Flow-control valve

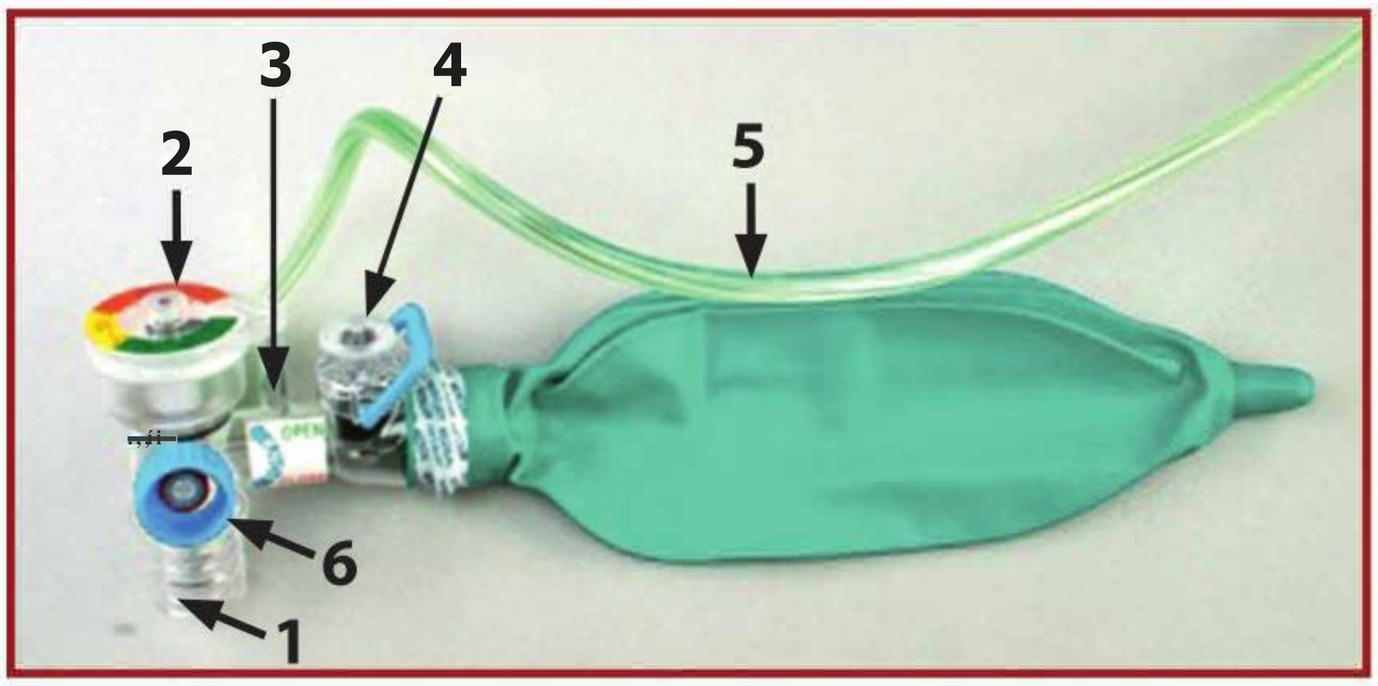


Figure 4A.3. Parts of a flow-inflating bag

Compressed gas from the blender and flowmeter enters the bag through oxygen tubing attached to the *gas inlet*. The *gas outlet* is where gas exits from the bag to the baby and where a face mask, laryngeal mask, or endotracheal tube is attached. Even if you plan to use 21% oxygen for PPV, you must have a compressed gas source to fill the flow-inflating bag.

The *flow-control valve* provides an adjustable leak that allows you to regulate the pressure in the bag. The adjustable leak allows excess gas to escape rather than overinflate the bag or be forced into the patient. The flow-control valve adjusts both the peak inflation pressure (PIP) and the PEEP.

Flow-inflating bags have a site for attaching a *manometer*. The attachment site usually is close to the patient outlet. A manometer must be attached or the site will be a source of leak and the bag will not inflate properly. A *pressure release (pop-off) valve* may also be present.

How does a flow-inflating bag work?

For a flow-inflating bag to work properly, there must be adequate gas flow from the source and a sealed system. The bag inflation is controlled by the balance between gas entering the bag, gas exiting the adjustable flow-control valve, and gas exiting the gas outlet. A flow-inflating bag will not ínflate adequately if the mask is not properly sealed; if flow from the gas source is insufficient, disconnected, or occluded; if there is a hole in the bag; if the flow-control valve is open too far; or if the manometer attachment site has been left open (Figure 4A.4).

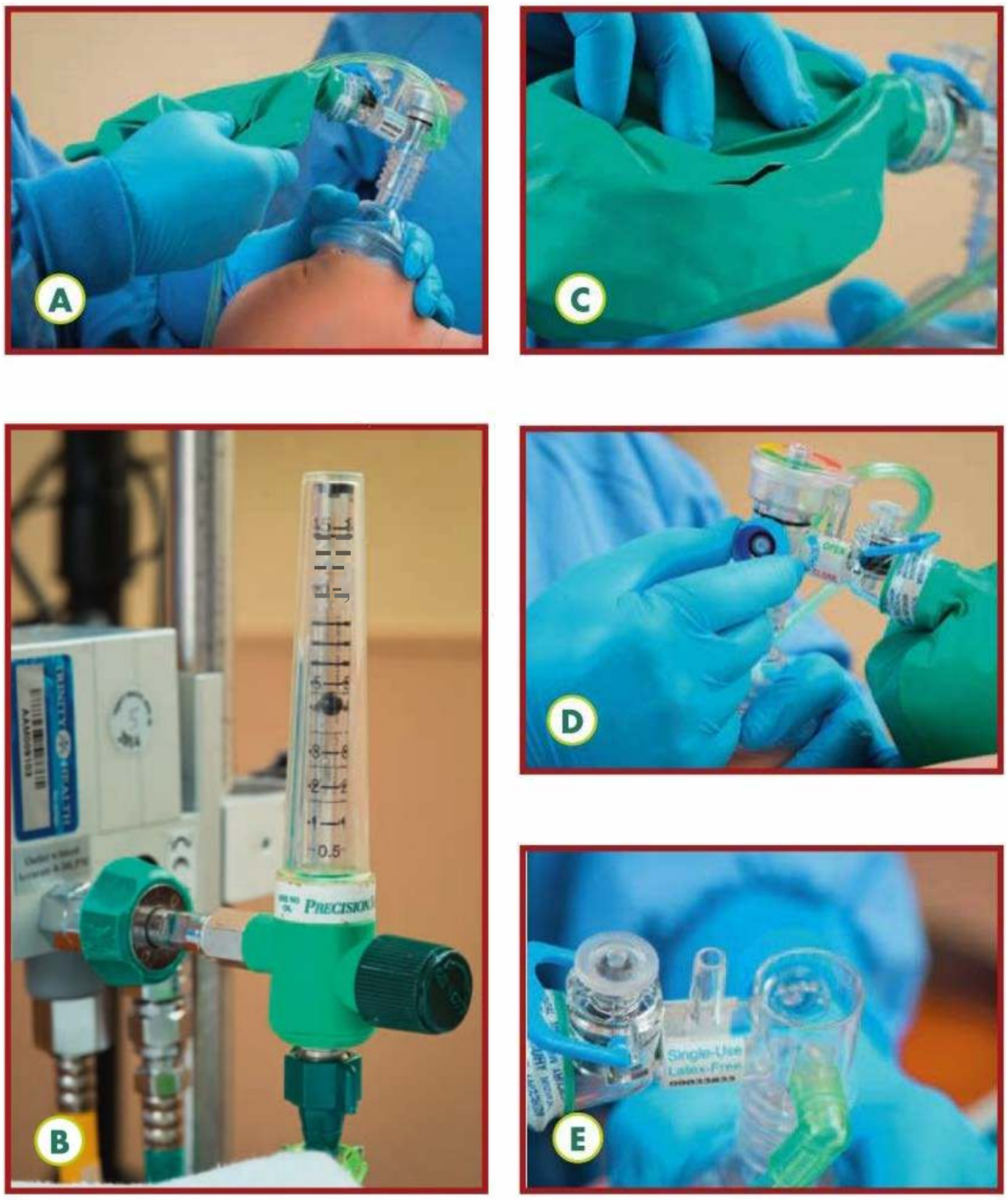


Figure 4A.4. Reasons for insufficient inflation of a flow-inflating bag: (A) inadequate mask seal with leak, (B) insufficient gas inflow, (C) hole in bag, (D) flow-control valve open too far, (E) manometer attachment site open

How do you adjust the inflation of a flow-inflating bag?

There are 2 ways that you can adjust the pressure in the bag a11dthus the amount of inflation of the bag.

- By adjusting the incoming gas from the flowmeter, you regulate how much gas enters the bag.
- By adjusting the flow-control valve on the bag, you regulate how much gas escapes from the bag.

The flowmeter and flow-control valve should be set so that the bag is inflated to the point where it is comfortable to handle and <loes not completely deflate with each assisted breath (Figure 4A.5A). An overinflated bag (Figure 4A.5B) is difficult to n1anage and may deliver high pressure to the baby; a pneumothorax or other air leak may

Figure 4A.5. Correct flow-inflating bag inflation (A), overinflation (B), and underinflation (C)

develop. An underinflated bag (Figure 4A.SC) makes it difficult to achieve the desired inflation pressure. With practice, you will be able to make the necessary adjustments to achieve a balance. If there is a good seal between the baby's face and the mask, you should be able to maintain the appropriate amount of inflation with the flowmeter set at 8 to 10 L/min.

C. T-piece Resuscitator

What are the parts of a T-piece resuscitator?

There are 9 parts to a T-piece resuscitator (Figure 4A.6). The position and function of control dials on the T-piece resuscitator may vary by manufacturer. The parts and operation of one example is described below.

O Gas tubing

8 Gas inlet

E) Maximum pressure-relief control

8 Manometer

0 Inflation pressure control

O Gas outlet (proximal)

O T-piece gas outlet (patient)

O T-piece PEEP adjustment dial

f) Opening on T-piece cap

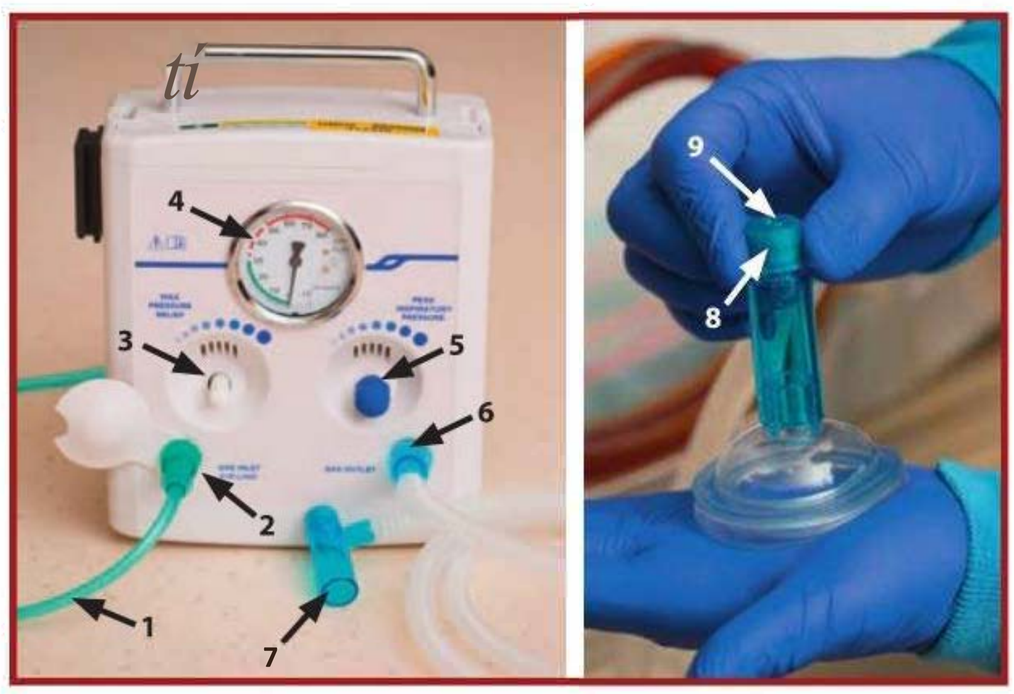


Figure 4A.6. Parts of a T-piece resuscitator

How does a T-piece resuscitator work?

Gas from a compressed source enters the T-piece resuscitator through *gas tubing* at the *gas inlet.* Gas exits the control box from the *gas outlet (proximal)* and travels through corrugated tubing to the *T-piece gas outlet (patient),* where a face mask, laryngeal mask, or endotracheal tube

attaches. When the *opening on the T-piece cap* is occluded by the operator, the preset inflation pressure is delivered to the patient for as long as the T-piece opening is occluded. On the device in Figure 4A.6, the maximum pressure that can be used is regulated by the *maximum pressure relief control* valve. *PEEP* is adjusted using a dial on the T-piece cap.

How do you prepare the T-piece resuscitator for use?

Assemble the parts of the T-piece resuscitator as instructed by the manufacturer. Occlude the patient outlet (using a test lung, outlet-occluding cap, or palm). Connect the device to the compressed gas source using gas tubing.

Adjust the pressure settings as follows:

- Adjust the blended gas flowmeter on the wall to regulate how much gas flows into the T-piece resuscitator. In most cases, **10 L/min is appropriate.**
- Set the *maximum pressure-relief control* by occluding the T-piece cap with your finger and adjusting the maximum pressure relief dial to a selected value (40 cm H_20 is the recommended maximum for term newborns, 30 cm H_20 is the recommended maximum for preterm newborns). Sorne manufacturers recommend that the maximum relief control be adjusted toan institution-defined limit when the device is put into original service and not be readjusted during regular use.
- Set the desired peak inflation pressure (PIP) by occluding the T-piece cap with your finger and adjusting the *inflation pressure control* to the selected pressure (Figure 4A.7).
- Set the PEEP by removi11gyour finger from the T-piece cap and adjusting the dial on the cap to the desired setting (5 cm H_20 is recommended) (Figure 4A.8).

Figure 4A.7. Adjusting the peak inflation pressure (PIP)

Figure 4A.8. Adjusting the PEEP

When the device is used to ventilate the baby, either by applying the mask to the baby's face or by connecting the device to a laryngeal mask or endotracheal tube, you administer a breath by alternately covering and releasing the opening on the T-piece cap. The inflation time is controlled by how long your finger covers the opening. Be careful not to become distracted and inadvertently cover the opening on the T-piece cap with your finger for a prolonged time.

How do you adjust the concentration of oxygen in a T-piece resuscitator?

The concentration of oxygen delivered by the T-piece resuscitator is controlled by the oxygen blender.

LESSON 4: PRACTICE SCENARIOS

Positive-Pressure Ventilation, Laryngeal Mask, Orogastric Tube, and (optional} Continuous Positive Airway Pressure

Comprehensive Skills Test Scenarios for Neonatal Resuscitation Program (NRP) Essentials Providers

Learning Objectives

- Identify the newborn that requires positive-pressure ventilation (PPV).
- f) Demonstrate correct technique for delivering PPV.
- E) Demonstrate the steps for assessing response to PPV.
- 9 Demonstrate ventilation corrective steps (MR SOPA).
- Identify indications and method for discontinuing PPV.
- Identify indications for continuous positive airway pressure (CPAP) in the delivery room and demonstrate correct technique for administering CPAP.
- *O* Identify uses and limitations of the laryngeal mask.
- C) Demonstrate the correct technique for inserting and removing a laryngeal mask.
- List pertinent NRP Key Behavioral Skills related to successful PPV.

These Practice Scenarios are for review/practice and evaluation. The scenarios may also be used as the Comprehensive Skills Test ("test out") option during a Provider Course.

This is the suggested Practice Scenario sequence.

- **Review the Knowledge Check Questions** with your NRP instructor.
  a. What are the indications for PPV? When can you stop PPV?
  b. What is PIP? PEEP? How is CPAP different than PPV?
  c. What is the recommended oxygen concentration for beginning PPV for a newborn greater than or equal to 35 weeks' gestation? For a newborn less than 35 weeks' gestation?
  d. What is the recommended initial ventilation pressure and rate for a term newborn?

e. What is the most important indicator of successful ventilation?

f. What are the MR. SOPA ventilation corrective steps?

g. What are the indications for CPAP? (optional)

h. What is the purpose of an orogastric tube?

i. What are the indications for a laryngeal mask? What are the limitations of a laryngeal mask?

j. At what point should you proceed to chest compressions?

8 **Practice/review these skills** with your NRP instructor.

a. Safety check a self-inflating bag prior to use. (Ensure that the pressure-release valve is not occluded.)

b. Safety check a T-piece resuscitator prior to use. (Ensure that pressures are correctly set prior to initiating PPV on the newborn.)

c. Position the newborn's head and neck in sniffing position.

d. Position the correct-sized mask on the newborn's face.

e. Perform the ventilation corrective steps (MR. SOPA).

f. Deliver PPV at the correct rate, pressure, and oxygen concentration per pulse oximetry.

g. Use the 2-hand hold with jaw thrust.

h. Discontinue PPV by decreasing rate and pressure as the baby begins to breathe.

i. Insert and remove a laryngeal mask (if this skill is within your scope of responsibility).

j. Measure and insertan orogastric tube to decompress the stomach.

k. Administer CPAP with a T-piece resuscitator and/or a flow-inflating bag using correct technique (if this skill is within your scope of responsibility).

8 **Practice the scenarios** applicable to your role with your NRP instructor until you need little or no assistance or coaching.

0 **Pass the Lesson 4 Practice Scenario evaluation** by leading practice scenario(s) and performing the skills relevant to your role and responsibilities. If a technical skill included in a scenario is not within your scope of responsibility, delegate the skill to a qualified team member and perform the role of assistant if appropriate.

- When you can lead the scenario(s) and perform the skills with little or no instructor coaching, NRP Advanced learners may proceed to the next lesson's practice scenario. The NRP Essentials learners may proceed to the Simulation and Debriefing component of the Provider Course.

Note: If the institution's policy is that a T-piece resuscitator normally is used in the delivery room, the learner should demonstrate proficiency with that device. However, the learner also should demonstrate ability to use a self-inflating bag and mask.

Practice Scenarios

Three scenario options are offered. The number of people attending the birth scenarios and their qualifications are determined by the instructor and based on hospital policy.

- Term newborn with risk factors requires PPV. (CPAP and orogastric tube insertion are optional in this scenario.)

f.) Term newborn without known risk factors unexpectedly requires PPV.

- Term newborn is difficult to ventilate with a face mask and requires a laryngeal mask.

"You are called to attend a vaginal birth. Labor is progressing rapidly. Demonstrate how you would prepare for the birth of this baby. As you work, say your thoughts and actions aloud so I will know what you are thinking and doing."

Option 1: Term newborn with risk factors requires PPV. (CPAP and orogastric tube insertion are optional.)

	Critical Performance Steps
Assess perinatal risk.	
	Assesses perinatal risk (learner asks 4 pre-birth questions and instructor ["OB provider"] responds) Gestational age? **"38 weeks' gestation."** Clear fluid? **"Amniotic fluid is clear."** Additional risk factors? **"Mom has pregnancy-induced hypertension, and her labor has been induced at 38 weeks' gestation. Several late decelerations of fetal heart rote hove been noted."** Umbilical cord management plan? **"1will delay cord clamping. If the baby is not crying, 1'11take a moment to stimulate the baby. If there's no response, 1'11clamp and cut the cord."**
Assemble team.	
	Assembles team based on perinatal risk factors. If risk factors are present, at least 2 qualified people should be present solely to manage the baby. The number of team members and qualifications vary depending on risk.

	Critical Performance Steps (cont)
Perform a pre-resuscitation briefing.	
	Identifies team leader. Assesses risk factors, delegates tasks, identifies who will document events as they occur, determines supplies and equipment needed, identifies how to call for additional help.
Perform equipment check.	
	"The baby has been born."
Rapid evaluation.	
	Asks 3 rapid evaluation questions: • Term? **'rves."** • Muscle tone? **"No."** • Breathing or crying? **"No, not breathing or crying."**
Initial steps at radiant warmer.	
	Receives baby at radiant warmer, dries and removes linen, stimulates briefly by rubbing the baby's back, positions airway, suctions mouth and nose
Assess breathing. If breathing, check heart rote.	
	Is the baby breathing? **"No."** **(Heart rote= 60 bpm, if assessed)**
	Indicates need for PPV
Begin PPV within 60 seconds of birth.	
	Applies mask correctly
	Starts PPV in 21 % oxygen (room air) at 20 to 25 cm H_2O (PEEP of 5 cm H_2O if using T-piece resuscitator, flow-inflating bag, or self-inflating bag with PEEP valve); rote 40 to 60 breaths/min
	Requests assistant to place pulse oximeter sensor on baby's right hand or wrist **"Pulse oximeter has no signal."**
	Requests cardiac monitor (optional)
	Within 15 seconds of beginning PPV, requests heart rote check to assess if heart rote is increasing **Heart rate=40 bpm, not increasing**
	Assesses chest movement **"No chest movement."**
Ventilation corrective steps (MR. SOPA). Instructor determines how many MR. SOPA steps are needed before PPV can result in chest movement.	
	• Mask adjustment • Repositions the head and neck Gives 5 breaths and asks assistant to assess chest movement **"No chest movement."**
	• Suctions the mouth and nose • Opens the mouth Gives 5 breaths and asks assistant to assess chest movement **"No chest movement." Heart rote= 40 bpm "Pulse oximeter has no signal."**
	• Increases Pressure by 5 to lO cm H_2O increments to maximum 40 cm H_2O for term baby Gives 5 breaths and asks assistant to assess chest movement **"Chest moves with PPV." (Note:** If instructor states that the chest is <u>not</u> moving with PPV after this MR. SOPA step, the learners should inserta laryngeal mask. See Option 3.)
	The learner's assistant announces, "The chest is moving NOW. Continue PPV for 30 seconds."

	Critical Performance Steps (cont)
Deliver PPV that moves the chest.	
	Delivers PPV x 30 seconds. (Learner gradually discontinues PPV if baby has a heart rote greater than 100 bpm and críes before 30 seconds of PPV.)
	Assesses heart rote after 30 seconds of PPV that moves the chest **Heart rote= 120 bpm 5P0_2= 64% "Occasional respiratory effort."**
	Continues PPV, adjusts oxygen concentration per pulse oximetry, monitors heart rote and respiratory effort **Heart rote= 140 bpm SP0_2= 74%** **"The baby has increasing spontaneous respiratory effort and improving muscle tone."**
	Gradually discontinues PPV **Heart rote= 140 bpm SP0_2= 72% "The baby has strong and continuous respiratory effort."**
Free-flow oxygen.	
	Discontinues PPV. Assesses need for free-flow oxygen to maintain oxygen saturation within target range. **Heart rote= 140 bpm 5P0_2= 70% "The baby has good spontaneous respiratory effort."**
	Initiates free-flow oxygen correctly. Assesses heart rote, oxygen saturation, respiratory status. **Heart rote= 140 bpm 5P0_2= 90% "The baby has good respiratory effort."**
End scenario.	
	Weans and discontinues free-flow oxygen and maintains oxygen saturation within target. Monitors heart rote, breathing, oxygen saturation, temperature. Plans post-resuscitation care. Communicates with perinatal team and parents. Debriefs the resuscitation.
Optional: CPAP and orogastric tube.	
	"After discontinuing PPV and free-flow oxygen, the newborn has labored breathing and grunting respirations." **Heart rote= 140 bpm SP0_2= 80%**
Administer CPAP and insert orogastric tube.	
	Applies CPAP at 5 cm H_2O pressure. Adjusts oxygen concentration per pulse oximetry. **Heart rote= 140 bpm SP0_2= 85%**
	Continues CPAP, adjusts oxygen concentration per pulse oximetry **Heart rote= 140 bpm SP0_2= 90%** **"The baby is_ minutes old. Breathing effort has improved."**
	Measures insertion depth for orogastric tube while CPAP is in progress • Places the distal end of the orogastric tube at the bridge of the nose and measures to the earlobe and from the earlobe to a point halfway between the xiphoid process and the umbilicus. Notes the centimeter mark on the tube. Inserts the tube through the mouth. Resumes CPAP. • Attaches a syringe and removes the gastric contents. Removes the syringe from the tube and leaves the end open as an air vent. • Tapes the tube to the baby's cheek.
End scenario.	
	Monitors heart rote, breathing, oxygen saturation, temperature. Plans post-resuscitation care. Communicates with perinatal team and parents. Debriefs the resuscitation.

Option 2: Term newborn without known risk factors unexpectedly requires PPV. (This scenario is designed for attendance by 1 person assigned to manage newborn care at birth.)

Critical Performance Steps	
Assess perinatal risk.	
	Assesses perinatal risk (learner asks 4 pre-birth questions and instructor ["OB provider"] responds)
	Gestational age? **"39 weeks' gestation."**
	Clear fluid? **"Amniotic fluid is clear."**
	Additional risk factors? **"There are no additional risk factors."**
	Plan for umbilical cord management? "I will delay cord clamping. If the baby is not crying, I'll take a moment to stimulate the baby. If there's no response, I'll clamp and cut the cord."
This birth will be attended by 1 qualified individual.	
	Knows the answers to the 4 pre-birth questions, determines supplies and equipment needed, knows how to call for help.
Perform equipment check.	
	"The baby has been born."
Rapid evaluation.	
	Asks 3 rapid evaluation questions:
	• Term? **"Yes, as expected."**
	• Muscle tone? **"No."**
	• Breathing or crying? **"No, not breathing or crying."**
Initial steps at radiant warmer.	
	Receives baby at radiant warmer, dries and removes linen, stimulates briefly by rubbing the baby's back, positions airway, suctions mouth and nose
Assess breathing. If breathing, assess heart rate.	
	Is the baby breathing? **"No." (Heart rate = 70 bpm, if assessed)**
	Indicates need for PPV
	Uses standardized process to call for resuscitation team
Begin PPV by 60 seconds after birth.	
	Positions head in sniffing position
	Applies mask correctly
	Starts PPV in 21 % oxygen (room air) at 20 to 25 cm H_2O (PEEP of 5 cm H_2O if using T-piece resuscitator, flow-inflating bag, or self-inflating bag with PEEP valve); rote 40 to 60 breaths/min
	Requests additional help until resuscitation team arrives
	Requests pulse oximeter sensor placement on baby's right hand or wrist
	Requests cardiac monitor (optional)
	Within 15 seconds of beginning PPV, requests heart rote check to assess if heart rote is increasing **Heart rate = 70 bpm and not increasing SP02=66%**
	The learner asks assistant to assess chest movement **"No chest movement."**

	Critical Performance Steps (cont)
Ventilation corrective steps (MR. SOPA). Instructor determines how many MR. SOPA steps to use before PPV can result in chest movement	
	• Mask adjustment • Repositions the head and neck Gives 5 breaths and asks assistant to assess chest movement **"No chest movement."**
	• Suctions the mouth and nose • Opens the mouth Gives 5 breaths and asks assistant to assess chest movement **"No chest movement." Heart rote= 70 bpm SPO_2 = 66%**
	• Increases Pressure by 5 to 10 cm H_20 increments to maximum 40 cm H_20 for term newborn Gives 5 breaths and asks assistant to assess chest movement **"Chest moves with PPV." (Note:** If instructor states that the chest is not moving after this MR. SOPA step, the learners should insert a laryngeal mask. See Option 3.)
	The learner's assistant announces, "The chest is moving NOW. Continue PPV for 30 seconds."
Deliver PPV that moves the chest.	
	Delivers PPV x 30 seconds. (Learner may gradually discontinue PPV if baby has a heart rote greater than 100 bpm and críes before 30 seconds of PPV.)
	Assesses heart rote and assesses need for free-flow supplemental oxygen **Heart rote= 120 bpm SPO_2 = 72% "The baby has increasing respiratory effort."**
	Gradually discontinues PPV, monitors heart rote and respiratory effort **Heart rote= 140 bpm $5PO_2$ = *75%* and increasing "The baby is breathing regularly, muscle tone is improving."**
End scenario.	
	Discontinues PPV. Monitors heart rate, breathing, oxygen saturation, temperature. Communicates with resuscitation team members as they arrive. Updates parents and informs them of next steps. Debriefs the resuscitation.

Option 3: Term newborn is difficult to ventilate with a face mask and requires a laryngeal mask.

	Critical Performance Steps
Assess perinatal risk.	
	Assesses perinatal risk (learner asks 4 pre-birth questions and instructor ["OB provider"] responds) Gestational age? **"40 weeks' gestation."** Clear fluid? **"Amniotic fluid is clear."** Additional risk factors? **"A few fetal heart decelerations in the last 20 minutes."** Umbilical cord management plan? **"I will delay cord clamping. If the baby is not crying, I'll take a moment** to **stimulate the baby. If there's no response, I'll clamp and cut the cord."**
Assemble team.	
	Assembles team based on perinatal risk factors. When the likelihood of resuscitation is low, 1 qualified individual should attend the birth. If risk factors are present, at least 2 qualified people should be present solely to manage the baby. The number of team members and qualifications vary depending on risk.
	If the birth will be attended by 1 person, Knows the answers to the 4 pre-birth questions, determines supplies and equipment needed, knows how to call for help

	Critical Performance Steps (cont)
	If the birth will beattended by a team, perform a pre-resuscitation briefing. Identifies team leader. Assesses risk factors, delegates tasks, identifies who will document events, determines supplies and equipment needed, knows how to call for additional help.
Rapid evaluation.	
	Asks 3 rapid evaluation questions: • Term? **"Yes, appears termas expected."** • Muscle tone? **"No."** • Breathing or crying? **"No, not breathing or crying."**
Initial steps at radiant warmer.	
	Receives baby at radiant warmer, dries and removes linen, stimulates briefly by rubbing the baby's back, positions airway, suctions mouth and nose
Assess breathing. If breathing, ossess heort rate.	
	Is the baby breathing? **"No."** **(Heort rote=70 bpm, if ossessed)**
	Indicates need for PPV. Requests immediate help from 1 person and uses standardized method to call for additional help.
Begin PPV within 60 seconds of birth.	
	Positions head in sniffing position
	Applies mask correctly
	Starts PPV in 21 % oxygen (room air) at 20 to 25 cm H_2O (PEEP of 5 cm H_2O if using T-piece resuscitator, flow-inflating bag, or self-inflating bag with PEEP valve); rote 40 to 60 breaths/min
	Requests pulse oximeter sensor placement on baby's right hand or wrist
	Requests cardiac monitor (optional at this time)
	Within 15 seconds of beginning PPV, requests heart rote check to assess if heart rote is increasing **Heort rote=70 bpm ond not increasing** **$SP0_2$=67%**
	Asks assistant to assess chest movement **"No chest movement."**
Perform ventilation corrective steps (MR. SOPA). Instructor determines how many MR. SOPA steps to use before PPV can result in chest movement.	
	• Mask adjustment • Reposition the head and neck Gives 5 breaths and asks assistant to assess chest movement **"No chest movement." Heart rate=70 bpm and not increosing** **$SP0_2$=67%**
	• Suctions the mouth and nose • Opens the mouth Gives 5 breaths and asks assistant to assess chest movement **"No chest movement." Heart rate=70 bpm and not increosing** **$SP0_2$=65%**
	• Increases Pressure by 5 to 10 cm H_20 increments to maximum 40 cm H_20 for term baby Gives 5 breaths and asks assistant to assess chest movement **"Chest moves with PPV." (Note:** If instructor states that the chest is not moving after this MR. SOPA step, learners will proceed with laryngeal mask insertion now.)
	Learner's assistant announces, "The chest is moving NOW. Continue PPV for 30 seconds."

	Critical Performance Steps (cont)
Deliver PPV that moves the chest.	
	Delivers PPV that moves the chest x 30 seconds
	Requests heart rote assessment **Heart rote=60 bpm and not increasing "Pulse oximeter has no signal."**
Laryngeal mask preparation.	
	Calls for additional help if needed. Places chest leads and attaches a cardiac monitor, if not already done.
	Obtains a size 1 laryngeal mask (and a 5-ml syringe if mask requires inflation), and a 5F or 6F orogastric tube if the laryngeal mask has an insertion port
	Resuscitation team continues MR. SOPA steps with face mask while operator is preparing laryngeal mask
	If the laryngeal mask requires inflation, Quickly inflates the rim with no more than 4 ml of air to test for leaks. Withdraws air.
	Lubricates back and sides of the mask with water-soluble lubricant, keeping lubricant away from the inside of the mask (optional step for manikin use)
Laryngeal mask insertion.	
	Stands at the baby's head. Places baby's head in sniffing position.
	Holds the device along the airway tube with the closed bottom of the mask facing the baby's palote and the open bowl of the mask facing toward the baby's chin
	Opens the newborn's mouth by gently pressing downward on the baby's chin. Inserts the leading tip of the mask into the baby's mouth, on top of the tongue, with the bottom of the mask pressed against the baby's palote.
	Glides the device downward and backward, following the contour of the palote, with a continuous but gentle push until definitive resistance is met
	If the laryngeal mask requires inflation, Supports the device in place, allowing it to rise and seat while inflating the rim by injecting 2 to 4 ml of air via the inflation valve. The pilot balloon mirrors inflation of the rim. Removes syringe.
	Holds the laryngeal mask in place and attaches a CO_2 detector and the PPV device
Positive-pressure ventilation with laryngeal mask	
	The person holding the laryngeal mask holds the PPV device and begins PPV.
	Learner and/or the assistant confirms insertion by assessing and announces the presence of • Symmetrical chest movement • Bilateral breath sounds • Color change on CO_2 detector within 8 to 10 positive-pressure breaths
	Operator continues PPV at appropriate rote and pressure for 30 seconds, monitoring heart rote and SPO_2
	Secures laryngeal mask with waterproof tape
	If the laryngeal mask has a gastric port and will be in place for more than severa! minutes, measures for orogastric tube insertion (described above), inserts orogastric tube down port, and decompresses stomach contents with syringe. Leaves orogastric tube open to air as a vent. Tapes tube to baby's cheek.

	Critical Performance Steps (cont)
Assess heart rote after 30 seconds of PPV that moves the chest.	
	Heart rote= 120 bpm SP0$_2$=74% **"The baby has occasional spontaneous respirations."**
	Gradually decreases PPV rote and pressure. Stimulates newborn. Requests heart rote assessment, SP02 to assess need for supplemental oxygen, and respiratory status
	Heart rote= 140 bpm 5Po$_2$=78% and gradually increasing "The baby is crying."
Remove laryngeal mask.	
	Suctions secretions from the back of the mouth and throat. **If the mask has an inflatable rim,** deflates the rim before removing. Removes laryngeal mask.
	Monitors heart rote, breathing, oxygen saturation
	Heart rote= 140 bpm 5Po$_2$=86% and gradually increasing **"The baby has spontaneous, regular breathing."**
End scenario.	
	Monitors heart rote, breathing, oxygen saturation, temperature. Communicates with perinatal team. Updates parents and informs them of next steps, including post-resuscitation care. Debriefs the resuscitation.

Sample Debriefing Questions

O What is the most important issue to discuss during this debriefing?

f) What went well during this resuscitation?

E) What will you do differently when faced with this situation in a future scenario?

8 Do you have additional comments or suggestions for your team members? For the team leader?

0 Give me an example of how you used at least one of the NRP Key Behavioral Skills.

If significant errors were made, consider asking the learners

O What happened? What should have happened? What could you have done to make the right things happen?

f) What NRP Key Behavioral Skills might have been helpful in this situation?

NRP Key Behavioral Skills

- Know your environment.
- Use available information.
- Anticipate and plan.
- Clearly identify a team leader.
- Communicate effectively.
- Delegate the workload optimally.
- Allocate attention wisely.
- Use available resources.
- Call for additional help when needed.
- Maintain professional behavior.