Chapter 10 - Airway Management

National EMS Education Standard Competencies (1 of 6)
Airway Management, Respiration, and Artificial Ventilation
Applies knowledge of general anatomy and physiology to patient assessment and management in order to assure a patent airway, adequate mechanical ventilation, and respiration for patients of all ages.

National EMS Education Standard Competencies (2 of 6)
Airway Management
- Airway anatomy
- Airway assessment
- Techniques of assuring a patent airway

National EMS Education Standard Competencies (3 of 6)
Respiration
- Anatomy of the respiratory system
- Physiology and pathophysiology of respiration
  - Pulmonary ventilation
  - Oxygenation
  - Respiration (external, internal, cellular)

National EMS Education Standard Competencies (4 of 6)
Respiration (cont’d)
- Assessment and management of adequate and inadequate ventilation
- Supplemental oxygen therapy
- Assessment and management of adequate and inadequate ventilation
- Artificial ventilation

National EMS Education Standard Competencies (5 of 6)
Artificial Ventilation (cont’d)
- Minute ventilation
- Alveolar ventilation
- Effect of artificial ventilation on cardiac output

National EMS Education Standard Competencies (6 of 6)
Pathophysiology
Applies fundamental knowledge of the pathophysiology of respiration and perfusion to patient assessment and management.

Introduction (1 of 2)
- The primary component of caring for patients is ensuring that they can breathe adequately.
- When the ability to breathe is disrupted:
  - Oxygen delivery to tissues and cells is compromised.
  - Vital organs may not function normally.
  - Brain tissue will begin to die within 4 to 6 minutes.

Introduction (2 of 2)
• Oxygen reaches body tissues and cells through breathing and circulation.
  – During inhalation, oxygen moves from the atmosphere into the lungs.
  – Oxygen-enriched blood is pumped through the body by the heart.
• You must be able to locate the parts of the respiratory system and understand how the system works.

10 **Anatomy of the Respiratory System (1 of 3)**

11 **Anatomy of the Respiratory System (2 of 3)**
• The respiratory system consists of all the structures that make up the airway and help us breathe, or ventilate.
• The airway is divided into the upper and lower airways.

12 **Anatomy of the Respiratory System (3 of 3)**
• Structures that help us breathe
  – Diaphragm
  – Chest wall muscles
  – Accessory muscles of breathing
  – Nerves from the brain and spinal cord to those muscles

13 **Anatomy of the Upper Airway (1 of 7)**
• Upper airway consists of:
  – Nose
  – Mouth
  – Jaw
  – Oral cavity
  – Pharynx
  – Larynx

14 **Anatomy of the Upper Airway (2 of 7)**
• The upper airway’s main function is to warm, filter, and humidify air as it enters the body.
• Pharynx
  – Muscular tube extending from nose and mouth to level of esophagus and trachea
  – Composed, from top to bottom, of the nasopharynx, oropharynx, and laryngopharynx

15 **Anatomy of the Upper Airway (3 of 7)**
• Nasopharynx
  – Filters out dust and small particles
  – Warms and humidifies air as it enters the body

16 **Anatomy of the Upper Airway (4 of 7)**
• Oropharynx
  – Posterior portion of the oral cavity
  – Entrance for respiratory and digestive system
  – The epiglottis is superior to the larynx.

17 **Anatomy of the Upper Airway (5 of 7)**
Chapter 10 - Airway Management

Anatomy of the Upper Airway

(6 of 7)

- Larynx
  - Complex structure formed by many independent cartilaginous structures
  - Marks where the upper airway ends and the lower airway begins

Anatomy of the Upper Airway

(7 of 7)

- Larynx (cont’d)
  - Thyroid cartilage forms a “V” shape anteriorly
  - Cricoid cartilage forms the lowest portion of the larynx
  - Glottis is the area between the vocal cords

Anatomy of the Lower Airway (1 of 6)

- The lower airway’s function is to deliver oxygen to the alveoli.
- Lower airway includes:
  - Trachea
  - Bronchi
  - Lungs

Anatomy of the Lower Airway (2 of 6)

- Trachea
  - Conduit for air entry into the lungs
  - Divides at the carina into two main stem bronchi, right and left
  - Bronchi are supported by cartilage.
  - Bronchi distribute oxygen to the lungs.

Anatomy of the Lower Airway (3 of 6)

Anatomy of the Lower Airway (4 of 6)

- Trachea (cont’d)
  - Bronchioles are made of smooth muscle; they dilate and constrict as oxygen passes through them.
  - Smaller bronchioles connect to alveoli.
  - Oxygen is transported back to the heart and distributed to the rest of the body.

Anatomy of the Lower Airway (5 of 6)

- The heart and great vessels (vena cava and aorta) are found in the thoracic cavity.

Anatomy of the Lower Airway (6 of 6)

- The mediastinum—the space between the lungs—contains:
  - Heart
  - Great vessels
  - Esophagus
  - Trachea
  - Major bronchi
  - Many nerves

Physiology of Breathing (1 of 2)

- The respiratory and cardiovascular systems work together.
  - Ensure a constant supply of oxygen and nutrients is delivered to cells
  - Remove carbon dioxide and waste products
Physiology of Breathing (2 of 2)

Ventilation (1 of 7)
- Physical act of moving air into and out of the lungs
- Inhalation
  - Active, muscular part of breathing
  - The diaphragm and intercostal muscles contract.

Ventilation (2 of 7)
- Inhalation (cont’d)
  - The lungs require the movement of the chest and supporting structures to expand.
  - Partial pressure: the amount of gas in the air or dissolved in fluid (blood)
  - Oxygen and carbon dioxide both diffuse until the partial pressures in the air and the blood are equal.

Ventilation (3 of 7)

Ventilation (4 of 7)
- Inhalation (cont’d)
  - Inspiration focuses on delivering oxygen to the alveoli.
  - Tidal volume
  - Dead space

Ventilation (5 of 7)
- Exhalation
  - Does not normally require muscular effort
  - Passive process
  - Diaphragm and intercostal muscles relax
  - Smaller thorax compresses air into the lungs

Ventilation (6 of 7)
- Exhalation (cont’d)
  - Air can enter and leave the lungs only if it travels through the trachea.

Ventilation (7 of 7)
- Regulation of ventilation involves a complex series of receptors and feedback loops.
  - Failure to meet the body’s need for oxygen may result in hypoxia.
  - Based on pH changes in the blood and cerebrospinal fluid
  - Patients with COPD have difficulty eliminating carbon dioxide through exhalation.

Oxygenation
- Process of loading oxygen molecules onto hemoglobin molecules in bloodstream
- Required for internal respiration to take place
  - Does not guarantee that internal respiration is taking place
  - Ventilation without oxygenation can occur where oxygen levels have been depleted (e.g., mines, confined spaces).

Respiration (1 of 4)
- Actual exchange of oxygen and carbon dioxide in the alveoli and tissues of the body
  - Cells take energy from nutrients through metabolism.

Respiration (2 of 4)
• External respiration (pulmonary respiration)
  – Brings fresh air into the respiratory system
  – Exchanges oxygen and carbon dioxide between alveoli and blood in pulmonary capillaries

38 Respiration (3 of 4)
• Internal respiration
  – Exchange of oxygen and carbon dioxide between systemic circulatory system and cells

39 Respiration (4 of 4)
• Eventually all cells will die if deprived of oxygen.

40 Pathophysiology of Respiration (1 of 7)
• Factors in the nervous system
  – Chemoreceptors monitor levels of:
    • Oxygen
    • Carbon dioxide
    • Hydrogen ions
    • pH of cerebrospinal fluid
  – Provide feedback to the respiratory centers

41 Pathophysiology of Respiration (2 of 7)
• Ventilation/perfusion ratio and mismatch
  – Air and blood flow must be directed to the same place at the same time.
  – Ventilation and perfusion must be matched.
  – Failure to match is the cause of most abnormalities of oxygen and carbon dioxide exchange.

42 Pathophysiology of Respiration (3 of 7)
• Ventilation/perfusion ratio and mismatch (cont’d)
  – Gas exchange does not take place.
  – Lack of O₂ in bloodstream
  – CO₂ is recirculated within bloodstream
  – Severe hypoxemia can occur

43 Pathophysiology of Respiration (4 of 7)
• Factors affecting pulmonary ventilation
  – Maintaining a patent airway is critical.
  – Intrinsic factors:
    • Infections
    • Allergic reactions
    • Unresponsiveness (tongue obstruction)
  – Extrinsic factors:
    • Trauma
    • Foreign body airway obstruction

44 Pathophysiology of Respiration (5 of 7)
• Factors affecting respiration
  – External factors:
• Atmospheric pressure
• Partial pressure of $O_2$
  – Internal factors:
    • Pneumonia
    • Pulmonary edema
    • COPD/emphysema

Pathophysiology of Respiration (6 of 7)
• Circulatory compromise
  – Trauma emergencies typically obstruct blood flow to individual cells and tissue:
    • Pulmonary embolism
    • Simple or tension pneumothorax
    • Open pneumothorax
    • Hemothorax
    • Hemopneumothorax

Pathophysiology of Respiration (7 of 7)
• Circulatory compromise (cont’d)
  – Other causes:
    • Blood loss
    • Anemia
    • Hypovolemic shock
    • Vasodilatory shock

Patient Assessment (1 of 7)
• Recognizing adequate breathing
  – Between 12 and 20 breaths/min
  – Regular pattern of inhalation and exhalation
  – Bilateral clear and equal lung sounds
  – Regular, equal chest rise and fall
  – Adequate depth (tidal volume)

Patient Assessment (2 of 7)
• Recognizing abnormal breathing
  – Fewer than 12 breaths/min
  – More than 20 breaths/min
  – Irregular rhythm
  – Diminished, absent, or noisy auscultated breath sounds
  – Reduced flow of expired air at nose and mouth

Patient Assessment (3 of 7)
• Recognizing abnormal breathing (cont’d)
  – Unequal or inadequate chest expansion
  – Increased effort of breathing
  – Shallow depth
  – Skin that is pale, cyanotic, cool, or moist
  – Skin pulling in around ribs or above clavicles during inspiration

Patient Assessment (4 of 7)
• A patient may appear to be breathing after the heart has stopped.
  – Called agonal gasps
• Cheyne-Stokes respirations are often seen in patients with stroke or head injury.

### Patient Assessment (5 of 7)

- Ataxic respirations
  - Irregular or unidentifiable pattern
  - May follow serious head injuries
- Kussmaul respirations
  - Deep, rapid respirations
  - Common in patients with metabolic acidosis
- Patients with inadequate breathing need to be treated immediately.

### Patient Assessment (6 of 7)

- Assessment of respiration
  - Even though the patient may be ventilating appropriately, respiration may be compromised.
  - Level of consciousness and skin color are excellent indicators of respiration.

### Patient Assessment (7 of 7)

- Assessment of respiration (cont’d)
  - Also consider oxygenation
    - Pulse oximetry is considered a routine vital sign
    - Can be used as part of any patient assessment

### Opening the Airway (1 of 3)

- Emergency medical care begins with ensuring an open airway.
- Rapidly assess whether an unconscious patient has an open airway and is breathing adequately.
  - Position the patient correctly.
  - Supine position is most effective.

### Opening the Airway (2 of 3)

- Unconscious patients should be moved as a unit.
  - Most common airway obstruction is the tongue.

### Opening the Airway (3 of 3)

- Other causes of airway obstruction:
  - Dentures (false teeth)
  - Blood
  - Vomitus
  - Mucus
  - Food
  - Other foreign objects

### Head Tilt–Chin Lift Maneuver (1 of 2)

- Will open the airway in most patients
- For patients who have not sustained or are not suspected of having sustained trauma

### Head Tilt–Chin Lift Maneuver (2 of 2)

- Follow these steps:
– With the patient supine, position yourself beside the patient’s head.
– Place the heel of one hand on the forehead, and apply firm backward pressure with the palm.
– Place the fingertips of the other hand under the lower jaw.
– Lift the chin upward, with the entire lower jaw.

Jaw-Thrust Maneuver (1 of 4)
• If you suspect a cervical spine injury, use this maneuver.
• Follow these steps:
  – Kneel above the patient’s head.
  – Place your fingers behind the angles of the lower jaw.
  – Move the jaw upward.
  – Use your thumbs to help position the jaw.

Jaw-Thrust Maneuver (2 of 4)
• Once the airway has been opened, look at the chest and observe for movement.
• With complete airway obstruction, there will be no movement of air.
  – Chest wall movement alone does not indicate that breathing is adequate.

Jaw-Thrust Maneuver (3 of 4)
• Even if the airway is opened, the mouth may be closed.
• For the cross-finger technique:
  – Place the tips of your index finger and thumb on the patient’s teeth.
  – Push your thumb on the lower teeth.
  – Push index finger on the upper teeth.
  – The index finger and the thumb cross over each other.

Jaw-Thrust Maneuver (4 of 4)

Suctioning (1 of 2)
• You must keep the airway clear to ventilate properly.
• Portable, hand-operated, and fixed equipment is essential for resuscitation.

Suctioning (2 of 2)
• A portable or fixed unit should have:
  – Wide-bore, thick-walled, nonkinking tubing
  – Plastic, rigid pharyngeal suction tips
  – Nonrigid plastic catheters
  – A nonbreakable, disposable collection bottle
  – Water supply for rinsing the tips

Techniques of Suctioning (1 of 4)
• Inspect the equipment regularly.
• To operate the suction unit:
  – Check the unit for proper assembly of its parts.
  – Test the suctioning unit to ensure vacuum pressure of more than 300 mm Hg.
  – Select and attach the appropriate suction catheter to the tubing.

Techniques of Suctioning (2 of 4)
• Never suction the mouth or nose for more than 15 seconds at one time for adult patients, 10 seconds for children, and
5 seconds for infants.
  – Suctioning can result in hypoxia.

**Techniques of Suctioning (3 of 4)**

• When patients have secretions or vomitus that cannot be suctioned easily:
  – Remove the catheter from the patient’s mouth.
  – Log roll the patient to the side.
  – Clear the mouth carefully with a gloved finger.

**Techniques of Suctioning (4 of 4)**

• If the patient produces frothy secretions as quickly as you can suction them:
  – Suction the airway for 15 seconds (less in infants and children).
  – Ventilate for 2 minutes.
  – Continue this alternating pattern until all secretions have been cleared.

**Basic Airway Adjuncts (1 of 4)**

• Prevent obstruction by the tongue and allow for passage of air and oxygen to the lungs
  – Oropharyngeal airways
    – Keep the tongue from blocking the upper airway
    – Make it easier to suction the oropharynx if necessary

**Basic Airway Adjuncts (2 of 4)**

• Oropharyngeal airways (cont’d)
  – Indications:
    • Unresponsive patients without a gag reflex
    • Apneic patients being ventilated with a bag-valve mask (BVM)
  – Contraindications:
    • Conscious patients
    • Any patient who has an intact gag reflex

**Basic Airway Adjuncts (3 of 4)**

• Nasopharyngeal airways
  – Indications:
    • Patient who is unresponsive or has an altered LOC
    • Patient who has an intact gag reflex
    • Patient who is unable to maintain his or her own airway spontaneously

**Basic Airway Adjuncts (4 of 4)**

• Nasopharyngeal airways (cont’d)
  – Indications:
    • Semiconscious or unconscious patients with an intact gag reflex
    • Patients who will not tolerate an oropharyngeal airway
  – Contraindications:
    • Severe head injury with blood in the nose
    • History of fractured nasal bone

**Maintaining the Airway (1 of 2)**

• Use the recovery position.
  – Used to help maintain a clear airway in an unconscious patient who is not injured and is breathing on his or her own

**Maintaining the Airway (2 of 2)**
• Take the following steps:
  – Roll the patient onto either side so that the head, shoulder, and torso move at the same
time without twisting.
  – Extend the patient’s lower arm and place the upper hand under his or her cheek.
• Not appropriate for patients with suspected spinal injuries

**Supplemental Oxygen (1 of 9)**

• Always give oxygen to patients who are hypoxic/
  – Some tissues and organs need a constant supply of oxygen to function normally.
• Never withhold oxygen from any patient who might benefit from it.

**Supplemental Oxygen (2 of 9)**

• Supplemental oxygen equipment
  – Become familiar with how oxygen is stored.
  – Oxygen cylinders contain compressed gas.
  – Liquid oxygen is becoming a more commonly used alternative.

**Supplemental Oxygen (3 of 9)**

• Safety considerations
  – Handle gas cylinders carefully.
  – Make sure the correct pressure regulator is firmly attached before transport.
  – A puncture hole in a tank can turn it into a deadly missile.
  – Secure cylinders when stored on ambulance and when in use during transport.

**Supplemental Oxygen (4 of 9)**

• Pin-indexing system
  – Prevents such mistakes as an oxygen regulator being accidentally connected to a carbon
dioxide cylinder
  – Every cylinder of a specific gas type has a given pattern and a given number of pins.

**Supplemental Oxygen (5 of 9)**

• Pressure regulators
  – Reduce the cylinder’s pressure to a useful therapeutic range
  – Usually 40 to 70 psi
  – Final attachment for delivering the gas is either a quick-connect female fitting or a
flowmeter.

**Supplemental Oxygen (6 of 9)**

• Flowmeters
  – Usually permanently attached to pressure regulators on emergency medical equipment
  – Pressure-compensated flowmeter
  – Bourdon-gauge flowmeter

**Supplemental Oxygen (7 of 9)**

• Hazards of supplemental oxygen:
  – Combustion
  – Oxygen toxicity

**Supplemental Oxygen (8 of 9)**

• Combustion
  – Oxygen does not burn or explode, but does speed up the combustion process.
– Keep any sources of fire away.
– Make sure the area is adequately ventilated.
– Never leave an oxygen cylinder standing unattended.

83  **Supplemental Oxygen (9 of 9)**

- **Oxygen toxicity**
  - Not all patients need high concentrations of oxygen.
  - Oxygen can have detrimental effects in patients with certain illnesses (COPD).
  - When pulse oximetry available, tailor oxygen therapy; administer the minimum amount necessary to maintain oxygen saturation at or above 94%.

84  **Oxygen-Delivery Equipment**

- Nonrebreathing masks
- Bag-valve masks
- Nasal cannulas

85  **Nonrebreathing Masks (1 of 2)**

- Preferred way to give oxygen in the prehospital setting
  - To patients who are breathing adequately but are suspected of having hypoxia
- Combination mask and reservoir bag system

86  **Nonrebreathing Masks (2 of 2)**

- Make sure the reservoir bag is full before placing the mask on the patient.
- Adjust the flow rate so the bag does not collapse when the patient inhales.
  - Usually 10 to 15 L/min
- When oxygen therapy is discontinued, remove the mask.

87  **Nasal Cannulas (1 of 2)**

- Deliver oxygen through two small, tubelike prongs that fit into the nostrils
- Can provide 24% to 44% inspired oxygen when the flowmeter is set at 1–6 L/min

88  **Nasal Cannulas (2 of 2)**

- When you anticipate a long transport time, consider using humidification.
- Limited use in the prehospital setting
  - A patient who breathes through the mouth, or has a nasal obstruction, will not benefit.
  - Always try to give high-flow oxygen through a nonrebreathing mask.

89  **Partial Rebreathing Masks**

- Similar to nonrebreathing masks
  - There is no one-way valve between the mask and the reservoir.
  - Patients rebreathe a small amount of exhaled air.
  - Advantageous if patient is hyperventilating

90  **Venturi Masks (1 of 2)**

- A number of settings can vary the percentage of oxygen while a constant flow is maintained.
  - Accomplished by the Venturi principle

91  **Venturi Masks (2 of 2)**

- Medium-flow devices that deliver 24% to 40% oxygen
• Useful in long-term management of physiologically stable patients

92 ▶️ Tracheostomy Masks (1 of 2)
• Patients with tracheostomies do not breathe through their mouth and nose.

93 ▶️ Tracheostomy Masks (2 of 2)
• Tracheostomy masks cover the tracheostomy hole and have a strap that goes around the neck.
  – May not be available in an emergency setting
  – Improvise by using a face mask instead, placed at the tracheostomy opening.

94 ▶️ Humidification
• Some EMS systems provide humidified oxygen.
  – During extended transport
    • Many EMS systems do not use humidified oxygen in the prehospital setting.
    • For certain conditions such as croup
  – Dry oxygen is not considered harmful for short-term use.

95 ▶️ Assisted and Artificial Ventilation (1 of 17)
• Probably the most important skills in EMS at any level
• Basic airway and ventilation techniques are extremely effective.
  – Follow standard precautions as needed when managing a patient’s airway.

96 ▶️ Assisted and Artificial Ventilation (2 of 17)
• Assisting ventilation in respiratory distress/failure
  – Intervene quickly to prevent further deterioration.
  – Two treatment options: assisted ventilation and CPAP

97 ▶️ Assisted and Artificial Ventilation (3 of 17)
• Signs and symptoms of inadequate ventilation:
  – Altered mental status
  – Inadequate minute volume
  – Excessive accessory muscle use and fatigue

98 ▶️ Assisted and Artificial Ventilation (4 of 17)
• When assisting with a BVM:
  – Explain the procedure to the patient.
  – Place the mask over the nose and mouth.
  – Squeeze the bag each time the patient breathes.
  – After the initial 5 to 10 breaths, deliver an appropriate tidal volume.
  – Maintain an adequate minute volume.

99 ▶️ Assisted and Artificial Ventilation (5 of 17)
• Artificial ventilation
  – Patients in respiratory arrest need immediate treatment to live.
  – Once a patient is not breathing, begin artificial ventilation immediately via:
    • Mouth-to-mask technique
    • One- or two-person BVM
    • Manually triggered ventilation device

100 Assisted and Artificial Ventilation (6 of 17)
• Normal ventilation versus positive-pressure ventilation
– In normal breathing, the diaphragm contracts and negative pressure is generated in the chest cavity.
– Positive-pressure ventilation generated by a device (such as a BVM) that forces air into the chest cavity.

**Assisted and Artificial Ventilation (7 of 17)**

- With positive-pressure ventilation:
  – Increased intrathoracic pressure reduces the blood pumped by the heart.
  – More volume is required to have the same effects as normal breathing.
  – Air is forced into the stomach, causing gastric distention.

**Assisted and Artificial Ventilation (8 of 17)**

- Mouth-to-mouth and mouth-to-mask ventilation
  – Barrier device is routinely used in mouth-to-mouth ventilations
  – Mask with an oxygen inlet provides oxygen during mouth-to-mask ventilation

**Assisted and Artificial Ventilation (9 of 17)**

- Signs of adequate ventilations:
  – Patient’s color improves
  – Chest rises adequately
  – No resistance when ventilating
  – You hear and feel air escape as the patient exhales

**Assisted and Artificial Ventilation (10 of 17)**

- Bag-valve mask
  – Most common method used to ventilate patients in the field
  – Provides less tidal volume than mouth-to-mask ventilation
  – An experienced EMT can provide adequate tidal volume.

**Assisted and Artificial Ventilation (11 of 17)**

- Bag-valve mask (cont’d)
  – If you have difficulty ventilating with a BVM, switch to another method.
  – The volume of oxygen is based on observing chest rise and fall.
  – Whenever possible, work with your partner to provide BVM ventilation.

**Assisted and Artificial Ventilation (12 of 17)**

- Gastric distention
  – Occurs when artificial ventilation fills the stomach with air
  – Most commonly affects children
  – Most likely to occur when you ventilate the patient too forcefully or too rapidly
  – May also occur when the airway is obstructed

**Assisted and Artificial Ventilation (13 of 17)**

- Gastric distention (cont’d)
  – To prevent or alleviate distention:
    – Ensure the patient’s airway is appropriately positioned
    – Ventilate at the appropriate rate
    – Ventilate with the appropriate volume
  – If the stomach appears distended, recheck and reposition the head and perform rescue breathing.

**Assisted and Artificial Ventilation (14 of 17)**
Chapter 10 - Airway Management

- Passive ventilation
  - Expansion and contraction create a “pump” for air movement.
  - Benefits patients who are receiving chest compressions
  - Can be enhanced using oropharyngeal airway and supplemental oxygen

**Assisted and Artificial Ventilation (15 of 17)**
- Manually triggered ventilation devices
  - Also known as flow-restricted, oxygen-powered ventilation devices
  - Allow a single rescuer to use both hands to maintain the mask-to-face seal while providing positive-pressure ventilation
    - Reduces rescuer fatigue

**Assisted and Artificial Ventilation (16 of 17)**
- Manually triggered ventilation devices (cont’d)
  - May be difficult to maintain adequate ventilation without assistance
  - Should not be used routinely
  - Should not be used in patients with COPD or suspected cervical spine or chest injuries

**Assisted and Artificial Ventilation (17 of 17)**
- Automatic transport ventilator (ATV)/resuscitator
  - Manually triggered device attached to a control box
  - Allows the variables of ventilation to be set
  - Lacks the sophisticated control of a hospital ventilator
  - Frees the EMT to perform other tasks

**Continuous Positive Airway Pressure (CPAP) (1 of 7)**
- Noninvasive ventilatory support for respiratory distress
  - Many people diagnosed with obstructive sleep apnea wear a CPAP unit at night.
  - Becoming widely used at the EMT level

**Continuous Positive Airway Pressure (CPAP) (2 of 7)**
- Mechanism
  - Increases pressure in the lungs
  - Opens collapsed alveoli
  - Pushes more oxygen across the alveolar membrane
  - Forces interstitial fluid back into the pulmonary circulation

**Continuous Positive Airway Pressure (CPAP) (3 of 7)**
- Mechanism (cont’d)
  - Therapy is delivered through a face mask held to the head with a strapping system.
  - Use caution with patients with potentially low blood pressure.

**Continuous Positive Airway Pressure (CPAP) (4 of 7)**
- Indications
  - Patient is alert and able to follow commands
  - Patient displays obvious signs of moderate to severe respiratory distress
  - Patient is breathing rapidly
  - Pulse oximetry reading is less than 90%

**Continuous Positive Airway Pressure (CPAP) (5 of 7)**
- Contraindications
– Patient in respiratory arrest
– Signs and symptoms of pneumothorax or chest trauma
– Patient who has a tracheostomy
– Active gastrointestinal bleeding or vomiting
– Patient who is unable to follow verbal commands.

Continuous Positive Airway Pressure (CPAP) (6 of 7)
• Application
  – Resistance creates back pressure that pushes open smaller airway structures as the patient exhales
  – 7.0 to 10.0 cm H₂O is acceptable.

Continuous Positive Airway Pressure (CPAP) (7 of 7)
• Complications
  – Some patients may find CPAP claustrophobic.
  – Risk of pneumothorax
  – Can lower the patient’s blood pressure
  – If the patient shows signs of deterioration, remove CPAP and begin positive-pressure ventilation using a BVM.

Special Considerations (1 of 3)
• Stomas and tracheostomy tubes
  – Patients who have had a laryngectomy have a permanent tracheal stoma.
  – Known as a tracheostomy

Special Considerations (2 of 3)
• Stomas and tracheostomy tubes (cont’d)
  – Neither the head tilt–chin lift maneuver nor the jaw-thrust maneuver is required.
  – If the patient has a tracheostomy tube, ventilate through the tube with a BVM.

Special Considerations (3 of 3)
• Stomas and tracheostomy tubes (cont’d)
  – If the patient has a stoma but no tube is in place, use an infant or child mask with your BVM to make a seal over the stoma.

Foreign Body Airway Obstruction (1 of 7)
• If a foreign body completely blocks the airway, it is a true emergency.
  – Will result in death if not treated immediately
  – In an adult, usually occurs during a meal
  – In a child, can occur while eating, playing with small toys, or crawling

Foreign Body Airway Obstruction (2 of 7)
• The tongue is the most common airway obstruction in an unconscious patient.
• Causes of airway obstruction that do not involve foreign bodies:
  – Swelling, from infection or acute allergic reaction
  – Trauma (tissue damage from injury)

Foreign Body Airway Obstruction (3 of 7)
• Early recognition is crucial.
• Mild airway obstruction
  – Patients can still exchange air, but will have respiratory distress.
  – Noisy breathing, wheezing, coughing
– With good air exchange, do not interfere with the patient’s efforts to expel the object on
his or her own.

Foreign Body Airway Obstruction (4 of 7)
• Mild airway obstruction (cont’d)
  – With poor air exchange, the patient may have increased difficulty breathing, stridor, and
cyanosis.
  – Treat immediately.

Foreign Body Airway Obstruction (5 of 7)
• Severe airway obstruction
  – Patients cannot breathe, talk, or cough.
  – Patient may use the universal distress signal, begin to turn cyanotic, and have extreme
difficulty breathing.

Foreign Body Airway Obstruction (6 of 7)
• Severe airway obstruction (cont’d)
  – Provide immediate treatment to the conscious patient.
  – If not treated, the patient will become unconscious and die.
  – If the patient is unresponsive, not breathing, and has no pulse, begin CPR with chest
compressions.

Emergency Medical Care for Foreign Body Airway Obstruction
• Perform a head tilt–chin lift maneuver to clear a tongue obstruction.
• Large obstructions should be swept forward out of the mouth with your gloved index
finger.
• Abdominal thrusts are the most effective method of dislodging and forcing out an object.

Dental Appliances
• Can cause an airway obstruction
  – Examples: crown, bridge, dentures, piece of braces
  – Manually remove the appliance before providing ventilations.
  – Leave well-fitting dentures in place.
  – Loose dentures interfere with the process and should be removed.

Facial Bleeding
• Airway problems can be particularly challenging in patients with serious facial bleeding.
• The blood supply to the face is very rich.
  – Injuries can result in severe tissue swelling and bleeding into the airway.
  – Control bleeding with direct pressure, and suction as necessary.

Review
1. Breathing is controlled by an area in the:
   A. lungs.
   B. brain stem.
   C. spinal cord.
   D. diaphragm.

Review
Answer: B
Rationale: The pons and the medulla are the respiratory centers in the brain stem that
control breathing.
Chapter 10 - Airway Management

Review (1 of 2)
1. Breathing is controlled by an area in the:
   A. lungs.
      Rationale: The lungs contain small pockets called alveoli where the exchange of oxygen and carbon dioxide takes place.
   B. brain stem.
      Rationale: Correct answer

Review (2 of 2)
1. Breathing is controlled by an area in the:
   C. spinal cord.
      Rationale: Impulses are sent down the spinal cord from the brain stem.
   D. diaphragm.
      Rationale: The diaphragm receives the impulses that cause it to contract and bring air in.

Review
2. The EMT should assess a patient’s tidal volume by:
   A. observing for adequate chest rise.
   B. assessing the facial area for cyanosis.
   C. counting the patient’s respiratory rate.
   D. measuring the patient’s oxygen saturation.

Answer: A
Rationale: Tidal volume—the volume of air that is moved into or out of the lungs in a single breath—is assessed by observing for adequate chest rise. If shallow chest rise is noted, the patient’s tidal volume is likely reduced.

Review (1 of 2)
2. The EMT should assess a patient’s tidal volume by:
   A. observing for adequate chest rise.
      Rationale: Correct answer
   B. assessing the facial area for cyanosis.
      Rationale: Cyanosis is an indication of hypoxia, rather than tidal volume.

Review (2 of 2)
2. The EMT should assess a patient’s tidal volume by:
   C. counting the patient’s respiratory rate.
      Rationale: Counting the respiratory rate gives you minute volume: the number of times a patient breathes in 1 minute.
   D. measuring the patient’s oxygen saturation.
      Rationale: Oxygen saturation is an indication of tissue perfusion, which is the amount of oxygen attached to the hemoglobin.

Review
3. In an otherwise healthy individual, the primary stimulus to breathe is a(n):
   A. increased level of oxygen in the blood.
   B. decreased level of oxygen in the blood.
   C. increased level of carbon dioxide in the blood.
   D. decreased level of carbon dioxide in the blood.
Review
Answer: C
Rationale: Under control of the brain stem, rising levels of carbon dioxide in arterial blood normally stimulate breathing in an otherwise healthy patient.

Review (1 of 2)
3. In an otherwise healthy individual, the primary stimulus to breathe is a(n):
   A. increased level of oxygen in the blood.
      Rationale: Increased levels of oxygen can be a result of hyperventilation syndrome.
   B. decreased level of oxygen in the blood.
      Rationale: This is typically not normal in healthy individuals. It can be a sign of inadequate breathing and results in hypoxia.

Review (2 of 2)
3. In an otherwise healthy individual, the primary stimulus to breathe is a(n):
   C. increased level of carbon dioxide in the blood.
      Rationale: Correct answer
   D. decreased level of carbon dioxide in the blood.
      Rationale: This is usually not seen in healthy adults. It is typically a result of hyperventilation syndrome.

Review
4. Signs of adequate breathing in the adult include all of the following, EXCEPT:
   A. pink, warm, dry skin.
   B. shallow chest rise.
   C. symmetrical chest movement.
   D. a respiratory rate of 16 breaths/min.

Review
Answer: B
Rationale: Signs of inadequate breathing in the adult include a respiratory rate less than 12 breaths/min or greater than 20 breaths/min, shallow chest rise (reduced tidal volume), cyanosis, and asymmetrical chest movement (both sides of the chest do not move equally).

Review (1 of 2)
4. Signs of adequate breathing in the adult include all of the following, EXCEPT:
   A. pink, warm, dry skin.
      Rationale: This shows that breathing and perfusion are adequate.
   B. shallow chest rise.
      Rationale: Correct answer

Review (2 of 2)
4. Signs of adequate breathing in the adult include all of the following, EXCEPT:
   C. symmetrical chest movement.
      Rationale: This shows that the mechanical process of breathing is adequate, equal, and symmetrical bilaterally.
   D. a respiratory rate of 16 breaths/min.
      Rationale: This is a normal respiratory rate for an adult.

Review
5. During insertion of an oropharyngeal airway into an unconscious patient, she begins to vomit. The first thing you should do is:
A. turn the patient on her side.
B. remove the airway at once.
C. suction the patient’s mouth.
D. use a smaller-sized oral airway.

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**Answer:** A

**Rationale:** Whenever an unconscious patient begins to vomit—whether you are inserting an oropharyngeal airway or not—you should *immediately* turn the patient onto his or her side; this will allow drainage of vomit from the mouth and prevent aspiration. After the patient is on his or her side, remove the oral airway and suction the mouth.

**Review (1 of 2)**

5. During insertion of an oropharyngeal airway into an unconscious patient, she begins to vomit. The first thing you should do is:
   A. turn the patient on her side.
      **Rationale:** Correct answer
   B. remove the airway at once.
      **Rationale:** Remove the airway after the patient has been rolled onto her side.

**Review (2 of 2)**

5. During insertion of an oropharyngeal airway into an unconscious patient, she begins to vomit. The first thing you should do is:
   C. suction the patient’s mouth.
      **Rationale:** This must be completed after the patient is positioned and the airway is removed.
   D. use a smaller-sized oral airway.
      **Rationale:** Oropharyngeal airways are contraindicated if the patient has a gag reflex.

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6. In which of the following patients would a nasopharyngeal airway be contraindicated?
   A. A semiconscious patient with a gag reflex
   B. An unconscious patient with an intact gag reflex
   C. A patient who fell 20 feet and landed on his or her head
   D. An unconscious patient who gags when you insert an oral airway

152  **Review**

**Answer:** C

**Rationale:** Nasopharyngeal (nasal) airways are contraindicated in patients with severe head or facial injuries and should be used with caution in patients who have delicate nasal membranes or are prone to nosebleeds. The nasal airway is better tolerated in patients who are semiconscious and/or those with a gag reflex.

**Review (1 of 2)**

6. In which of the following patients would a nasopharyngeal airway be contraindicated?
   A. A semiconscious patient with a gag reflex
      **Rationale:** This airway works best with an intact gag reflex.
   B. An unconscious patient with an intact gag reflex
      **Rationale:** This airway works best with an intact gag reflex.

**Review (2 of 2)**

6. In which of the following patients would a nasopharyngeal airway be contraindicated?
   C. A patient who fell 20 feet and landed on his or her head
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Rationale: Correct answer
D. An unconscious patient who gags when you insert an oral airway
   Rationale: This airway can be used when the patient gags with an oral airway.

Review
7. You are delivering oxygen to a patient with a nasal cannula at 4 L/min when he begins to complain of a burning sensation in his nose. You should:
   A. remove the nasal cannula.
   B. apply a nonrebreathing mask.
   C. attach an oxygen humidifier.
   D. increase the flow rate to 6 L/min.

Review (1 of 2)
7. You are delivering oxygen to a patient with a nasal cannula at 4 L/min when he begins to complain of a burning sensation in his nose. You should:
   A. remove the nasal cannula.
   Rationale: The oxygen should be humidified.
   B. apply a nonrebreathing mask.
   Rationale: This can still cause an irritation due to providing “dry” oxygen.

Review (2 of 2)
7. You are delivering oxygen to a patient with a nasal cannula at 4 L/min when he begins to complain of a burning sensation in his nose. You should:
   C. attach an oxygen humidifier.
   Rationale: Correct answer
   D. increase the flow rate to 6 L/min.
   Rationale: The oxygen should be humidified.

Review
8. A patient is found unconscious after falling from a third-floor window. His respirations are slow and irregular. You should:
   A. place him in the recovery position.
   B. apply oxygen via a nonrebreathing mask.
   C. suction his airway for up to 15 seconds.
   D. assist his breathing with a bag-mask device.

Review
Answer: D
Rationale: The patient is not breathing adequately. Slow, irregular respirations will not result in adequate oxygenation. You should assist the patient’s breathing with a bag-valve mask attached to 100% oxygen. Suctioning is indicated if the patient has blood or other liquids in the airway; there is no evidence of this in the scenario.

Review (1 of 2)
8. A patient is found unconscious after falling from a third-floor window. His respirations are slow and irregular. You should:
A. place him in the recovery position.
   Rationale: Due to the significant MOI, the patient should be placed supine on a long
   backboard with the head immobilized.
B. apply oxygen via a nonrebreathing mask.
   Rationale: A BVM device is indicated if the patient’s respirations are less than 8
   breaths/min.

Review (2 of 2)
8. A patient is found unconscious after falling from a third-floor window. His respirations are
slow and irregular. You should:
   C. suction his airway for up to 15 seconds.
      Rationale: Suction is indicated if a patient has blood or other secretions in the airway.
   D. assist his breathing with a bag-mask device.
      Rationale: Correct answer

Review
9. When ventilating an apneic adult with a bag-valve mask, you should squeeze the bag:
   A. until it is empty.
   B. over a period of 2 seconds.
   C. at a rate of 20 breaths/min.
   D. until visible chest rise is noted.

Review
Answer: D
Rationale: When ventilating any apneic patient with a bag-valve mask, you should squeeze
the bag over a period of 1 second and observe for visible chest rise. Ventilate the apneic
adult at a rate of 10 to 12 breaths/min (one breath every 5 seconds). Ventilate infants and
children at a rate of 12 to 20 breaths/min (one breath every 3 seconds).

Review (1 of 2)
9. When ventilating an apneic adult with a bag-valve mask, you should squeeze the bag:
   A. until it is empty.
      Rationale: An appropriately sized bag for an adult will not totally empty.
   B. over a period of 2 seconds.
      Rationale: You should squeeze the bag over a period of 1 second.

Review (2 of 2)
9. When ventilating an apneic adult with a bag-valve mask, you should squeeze the bag:
   C. at a rate of 20 breaths/min.
      Rationale: Ventilate the apneic adult at a rate of 10 to 12 breaths/min (one breath
      every 5 seconds).
   D. until visible chest rise is noted.
      Rationale: Correct answer

Review
10. You and your partner are ventilating an apneic adult when you notice that his stomach is
    becoming distended. You should:
    A. suction his airway for up to 15 seconds.
    B. reposition his head.
    C. increase the rate and volume of your ventilations.
    D. decrease your ventilation rate but use more volume.
Answer: B
Rationale: Gastric distention occurs when air enters the stomach. Severe gastric distention can result in vomiting and aspiration if not recognized and treated. To minimize the amount of air that enters the stomach during ventilations, you should reposition the patient’s head.

Review (1 of 2)
10. You and your partner are ventilating an apneic adult when you notice that his stomach is becoming distended. You should:
   A. suction his airway for up to 15 seconds.
      Rationale: Suctioning is indicated when there is blood or secretions in the airway.
   B. reposition his head.
      Rationale: Correct answer

Review (2 of 2)
10. You and your partner are ventilating an apneic adult when you notice that his stomach is becoming distended. You should:
   C. increase the rate and volume of your ventilations.
      Rationale: This action may result in even more air going into the stomach.
   D. decrease your ventilation rate but use more volume.
      Rationale: This action may result in even more air going into the stomach.