Airway management and ventilation are the first and most critical steps in the initial assessment of every patient you will encounter.

Respiration and Ventilation
- **Respiration:**
  - Exchange of gases between a living organism and its environment
- **Pulmonary Respiration:**
  - Occurs in the lungs when gases are exchanged between the alveoli and RBCs
- **Cellular Respiration:**
  - Occurs in the peripheral capillaries when gases are exchanged between the RBCs and body tissues
- **Ventilation:**
  - Mechanical process in which air is taken in and out of the lungs

Upper Airway Review

The Glottic Opening

Anatomy Review
Regulation of Respiration
- Both Voluntary and Involuntary
- Medulla Oblongata
- Pons
  - Apneustic Center
  - Pneumotaxic Center
- Stretch Receptors
- Chemoreceptors
- Diaphragm/Intercostal Muscles

Gas Exchange in the Lungs

Breathing Process: Inhalation
- Active part of breathing
- Diaphragm and intercostal muscles contract, allowing the lungs to expand.
- The decrease in pressure allows lungs to fill with air.
- Air travels to the alveoli where exchange of gases occurs.

Breathing Process: Exhalation
- Does not normally require muscular effort
- Diaphragm and intercostal muscles relax.
- The thorax decreases in size, and ribs and muscles assume their normal positions.
- The increase in pressure forces air out.

The Body's Need for Oxygen

Normal vs. Hypoxic Drive
- Normal monitors Carbon Dioxide Levels
- Hypoxic monitors Oxygen Levels
- Why does this happen?
- What does this mean?
- Does it effect our treatment?
Hypoxia

- Signs
  - Nervousness, irritability, and fear
  - Tachycardia
  - Mental status changes
  - Use of accessory muscles for breathing
  - Difficulty breathing, possible chest pain

Conditions Resulting in Hypoxia

- Myocardial infarction
- Pulmonary edema
- Acute narcotic overdose
- Smoke inhalation
- Stroke
- Chest injury
- Shock
- Lung disease
- Asthma

Recognizing Adequate Breathing

- Normal rate and depth
- Regular pattern
- Regular and equal chest rise and fall
- Adequate depth

Tidal vs. Minute Volume

- Tidal Volume: 500cc
- Dead Space Volume: 150cc
- Alveolar Volume: 350cc
- Minute Volume: $V_{\text{min}} = V_a \times R_{\text{respiratory}}$

Normal Respiration Rates

- Adults: 12 to 20 breaths/min
- Children: 15 to 30 breaths/min
- Infants: 25 to 30 breaths/min

Recognizing Inadequate Breathing

- Labored breathing
- Use of accessory muscles
- Pale or blue skin
- Cool, clammy skin
- Irregular respirations
- Abnormal lung sounds
Positioning An Unconscious Patient

- Kneel beside the patient.
- Straighten the patient’s legs and move nearer arm across the chest.

Positioning An Unconscious Patient

- Turn patient by pulling the distant hip and shoulder.
- Control the head and neck so they move as a unit with the torso.

Positioning An Unconscious Patient

- Roll onto backboard if available.
- Open patient’s airway and assess breathing.

Opening the Airway

- Head tilt-chin lift
  - Nontrauma patients, medical patients
- Jaw-thrust
  - Suspected spinal injury
Basic Airway Adjuncts

Oropharyngeal airways (OPA)
- Keep the tongue from blocking the upper airway
- Allow for easier suctioning of the airway
- Used in conjunction with BVM device
- Used on unconscious patients without a gag reflex

Inserting an Oropharyngeal Airway

Nasopharyngeal airways (NPA)
- Used on conscious patients who can’t maintain an airway
- Can be used on patients with a gag reflex
- Should not be used on patients with possible skull fractures

Inserting a Nasopharyngeal Airway
**Suctioning Equipment**

**Suction Catheters**
- Tonsil-tip catheter
- French, or whistle-tip, catheter

**Suctioning Technique**
- Check the unit and turn it on.
- Select and measure proper catheter to be used.
- Open the patient’s mouth and insert tip.
- Suction as you withdraw the catheter.
- Never suction for more than 15 seconds.

**Recovery Position**
Supplemental Oxygen

- All patients in cardiac arrest should get oxygen.
- Any patient with a respiratory or cardiac emergency needs oxygen.

Supplemental Oxygen Equipment

- Oxygen cylinders
  - Available as a compressed combustible gas
  - Available in several sizes
  - Pin-indexing safety system
  - Oxygen regulators
  - Humidified oxygen

Oxygen Flowmeters

- Pressure-compensated flowmeter
  - Affected by gravity; must be kept upright
- Bourdon-gauge flowmeter
  - Not affected by gravity; can be used in any position

Using Supplemental Oxygen

- Inspect cylinder and markings.
- “Crack” the cylinder.
- Attach the regulator/flowmeter.
- Open the cylinder.
- Attach proper delivery device to flowmeter.

Using Supplemental Oxygen

- Adjust flowmeter to desired flow rate.
- Apply the oxygen device to the patient.
- When done, discard the delivery device.
- Turn off the flowmeter.
Hazards of Oxygen

- Oxygen supports combustion.
- Keep possible ignition sources away from the area.
- Oxygen tanks are under high pressure.

Oxygen Delivery Equipment

- Nonrebreathing Mask (NRB)
  - Provides up to 90% oxygen
  - Used at 10 to 15 L/min
- Nasal Cannula (NC)
  - Provides 24% to 44% oxygen
  - Used at 1 to 6 L/min

Pulse Oximetry

- Evaluates the effectiveness of oxygenation
- Probe is placed on finger or earlobe.
- Pulse oximetry is a tool.
- Does not replace good patient assessment.

Artificial Ventilation

- One- or two-person bag-value-mask (BVM)
- Mouth-to-mask ventilation
- Oxygen-powered ventilation device

Rate of Artificial Ventilations

- Adult — 1 breath every 5 seconds
- Children — 1 breath every 3 seconds
- Infants — 1 breath every 3 seconds
Assisted and Artificial Ventilation

You know that you are providing adequate ventilations if:
- Patient’s color improves
- Chest rises adequately
- You do not meet resistance when ventilating
- You hear and feel air escape as the patient exhales

Mouth-to-Mask Technique
- Kneel at patient’s head and open airway.
- Place the mask on the patient’s face.
- Take a deep breath and breathe into the patient for 1 1/2 to 2 seconds.
- Remove your mouth and watch for patient’s chest to fall.

Bag-Valve-Mask Device
- Can deliver more than 90% oxygen
- Delivers less tidal volume than mouth-to-mask
- Requires practice to be proficient
- May be used with advanced airways
Bag-Valve-Mask Components

Two-Person BVM Technique
- Insert an oral airway.
- One caregiver maintains seal while the other delivers ventilations.
- Place mask on patient’s face.
- Squeeze bag to deliver ventilations.

Two-Person BVM Technique

One-Person BVM Technique

Flow-Restricted, Oxygen-Powered Devices
Assisted and Artificial Ventilation

- Automatic transport ventilator (ATV)
  - 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

- Manually triggered ventilation devices (cont'd)
  - Reduces rescuer fatigue
  - May be difficult to maintain adequate ventilation without assistance
  - Should not be used routinely
  - Should not be used with COPD or suspected cervical spine or chest injuries

Assisted and Artificial Ventilation (cont'd)

- Also known as flow-restricted, oxygen-powered ventilation devices
- Widely available
- Allow single rescuer to use both hands to maintain mask-to-face seal while providing positive-pressure ventilation

Continuous Positive Airway Pressure (CPAP)

- 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)

- Mechanism
  - Increases pressure in the lungs
  - Opens collapsed alveoli
  - Pushes more oxygen across the alveolar membrane
  - Forces interstitial fluid back into the pulmonary circulation

- Therapy is delivered through a face mask held to the head with a strapping system.
- Use caution with patients with potentially low blood pressure
  - High pressure in the intrathoracic cavity can decrease BP.
Continuous Positive Airway Pressure (CPAP)

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%.

Contraindications
- Patient in respiratory arrest
- Signs and symptoms of pneumothorax or chest trauma
- Patient who has a tracheostomy
- Active gastrointestinal bleeding or vomiting
- Patient is unable to follow verbal commands.

Application
- During the expiratory phase, the patient exhales against a resistance called positive end-expiratory pressure (PEEP).

Complications
- Some patients may find CPAP claustrophobic.
- Possibility of causing a pneumothorax
- Can lower a patient’s blood pressure
- If the patient shows signs of deterioration, remove CPAP and begin positive-pressure ventilation using a bag-mask device.

Ongoing Assessment of Ventilation

Adequate Ventilation
- Equal chest rise and fall
- Ventilating at appropriate rate
- Heart rate returns to normal

Inadequate Ventilation
- Minimal or no chest rise and fall
- Ventilations too fast or slow
- Heart rate does not return to normal

Cricoid Pressure

Use on unconscious patients to prevent gastric distention.
Place pressure on cricoid with thumb and index finger.
Gastric Distention
- Artificial ventilation fills stomach with air.
- Occurs if ventilations are too forceful or too frequent or when airway is blocked
- May cause patient to vomit

Stomas and Tracheostomy Tubes
- Ventilations are delivered through the stoma.
- Attach BVM device to tube or use infant mask.
- Stoma may need to be suctioned.

Tracheostomy Masks
- Patients with tracheostomies do not breathe through their mouth and nose.

Tracheostomy Masks
- 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.
Humidification

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

What is the most common airway obstruction in an unconscious person?

Causes of Foreign Body Obstruction

- Relaxation of the tongue
- Vomited stomach contents
- Blood clots, bone fragments, damaged tissue
- Swelling caused by allergic reactions
- Foreign objects

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.
- Blood supply to the face is rich.
  - Injuries can result in severe tissue swelling and bleeding into the airway.
  - Control bleeding with direct pressure, and suction as necessary.

Recognizing an Obstruction

- Obstruction may be partial or complete.
- Is patient able to speak or cough?
- If patient is unconscious, attempt to deliver artificial ventilation.
Removing an Obstruction

- Perform Heimlich maneuver.
- Use suction if needed.
- If attempts to clear the airway are unsuccessful, transport rapidly.

Questions?