**Airway Management**
(Class 6)

*Airway*

- **Definition**
  - An uninterrupted path between the atmosphere and the alveoli

- **Methods of opening the airway**
  - **Positioning**
  - **Maneuvers**
    - Head-tilt chin-lift when no neck injury suspected - review technique learned in BLS course
    - Jaw thrust when EMT-Basic suspects spinal injury - review technique learned in BLS course
    - Chin lift

- **Methods of opening the airway**
  - **Airway Adjuncts**
    - Nasopharyngeal (nasal) airways
      - Nasopharyngeal airways are less likely to stimulate vomiting and may be used on patients who are responsive but need assistance keeping the tongue from obstructing the airway. Even though the tube is lubricated, this is a painful stimulus.
    - Oropharyngeal (oral) airways
      - Oropharyngeal airways may be used to assist in maintaining an open airway on unresponsive patients without a gag reflex. Patients with a gag reflex will vomit.
    - Double lumen airways

- **Suctioning**
  - **Purpose**
    - Remove blood, other liquids and food particles from the airway
    - Some suction units are inadequate for removing solid objects like teeth, foreign
bodies and food
- A patient needs to be suctioned immediately when a gurgling sound is heard with artificial ventilation
- Types of units
  - Suction devices
    - Mounted
    - Portable
    - Electrical
    - Hand operated
- Suction catheters
  - Hard or rigid ("tonsil sucker," "tonsil tip")
    - Used to suction the mouth and oropharynx of an unresponsive patient
    - Should be inserted only as far as you can see
    - Use rigid catheter for infants and children, but take caution not to touch back of airway
  - Soft (French)
    - Useful for suctioning the nasopharynx and in other situations where a rigid catheter cannot be used
    - Should be measured so that it is inserted only as far as the base of the tongue
- Suctioning should be limited, if at all possible, to no more than 15 seconds
  - Air is removed from the body just as liquid materials are removed during suctioning
  - Suctioning may be performed in any position, but having the patient in left lateral recumbent position during suctioning provides additional protection to the patient’s airway
  - A properly functioning suction unit will generate a vacuum of about 300 mmHg

**Breathing**

- Adequate breathing
  - Normal Rate
    - Adult
      - 12-20/minute
    - Child
      - 15-30/minute
    - Infant
      - 25-50/minute
  - Rhythm
• Regular
  - Quality
  • Breath sounds
    - Present and equal
  • Chest expansion
    - Adequate and equal
  • Minimum effort of breathing
    - No use of accessory muscles
  - Depth (tidal volume)
    • Adequate

• Inadequate breathing
  - Rate - outside of normal ranges
    • Agonal respirations (occasional gasping breaths) may be seen just before death
  - Rhythm
    • Irregular
  - Quality
    • Breath sounds - diminished or absent
    • Chest expansion - unequal or inadequate
    • Increased effort of breathing
      - Retractions
      - Nasal flaring may be present, especially in children
      - In infants, there may be "seesaw" breathing where the abdomen and chest move in opposite directions
    - Depth (tidal volume) - inadequate/shallow
    - The skin may be pale or cyanotic (blue) and cool and moist (clammy)

• Artificial Ventilation
  - Method of creating breathing in the absence of spontaneous respiration

• Adequate artificial ventilation
  - The chest rises and falls with each artificial ventilation
  - The rate is sufficient, approximately 12 per minute for adults and 20 times per minute for children and infants
  - Heart rate returns to normal with successful artificial ventilation

• Inadequate artificial ventilation
  - The chest does not rise and fall with artificial ventilation
  - The rate is too slow or too fast
  - Heart rate does not return to normal with artificial ventilation

• Methods
  - In order of preference:
    • Mouth-to-mask
    • Two-person bag-valve-mask
• Flow restricted, oxygen-powered ventilation device
• One-person bag-valve-mask
• Mouth-to-mouth

• Mouth-to-mask
  - The mask should be connected to high flow oxygen (15 liters per minute “LPM”) flow rate
  - Keep a tight seal
• Bag-valve-mask
  - The bag-valve-mask consists of a self-inflating bag, one-way valve, face mask, oxygen reservoir. It needs to be connected to oxygen to perform most effectively

• Bag-valve-mask issues
  - Volume of approximately 1,600 milliliters
  - Provides less volume than mouth-to-mask
  - Single EMT-Basic may have difficulty maintaining an airtight seal
  - Two EMT-Basics using the device will be more effective
  - Must position self at top of patient’s head for optimal performance
  - Adjunctive airways (oral or nasal) may be necessary in conjunction with bag-valve-mask

• The bag-valve-mask should have:
  - A self-refilling bag that is easily cleaned and sterilized
  - A non-jam valve that allows a maximum oxygen inlet flow of 15/LPM
  - No pop-off valve, or the pop-off valve must be disabled. Failure to do so may result in inadequate artificial ventilations
  - Standardized 15/22 mm fittings
  - An oxygen inlet and reservoir to allow for high concentration of oxygen
  - Infant, child and adult sizes available

• Flow restricted, oxygen-powered ventilation devices
  - Flow restricted, oxygen-powered ventilation devices (for use in adults only) should provide
    • A peak flow rate of 100% oxygen at up to 40 LPM
    • An inspiratory pressure relief valve that opens at approximately 60 centimeters water and vents any remaining volume to the atmosphere or ceases gas flow
• An audible alarm that sounds whenever the relief valve pressure is exceeded
• A trigger positioned so that both hands of the EMT-Basic can remain on the mask to hold it in position

**Oxygen**

• Characteristics
  - Gas at room temperature
  - Colorless
  - Odorless
  - Tasteless
  - 21% of ambient air is oxygen
  - 16% of exhaled air is oxygen
  - Abbreviated “O₂”

• Medical hazards
  - Oxygen toxicity
    • High concentrations of O₂ (80%) or more
    • Long exposure (usually 24 hours or more)
    • Atelectasis
      - Alveolar collapse
      - Alveoli constrict in presence of high concentrations of oxygen
    • CNS changes

• Medical hazards
  - Retrolental fibroplasia
    • Premature infants
    • High concentrations of O₂ (80%) or more
    • Long exposure (usually 24 hours or more)
    • Retinas scarred
    • Blindness

• Medical hazards
  - Carbon dioxide narcosis
    • Normal humoral drive is CO₂ at medulla
    • COPD increases CO₂ level
    • Drive to breath shifts to aorta and carotids
    • Drive to breath now is based on O₂ level rather than CO₂
    • Increasing O₂ level will decrease rate and depth of breathing
    • Limit O₂ to 24% by venturi mask or
    • 1 to 2 LPM by nasal cannula
• Environmental hazards
  - Stored under pressure
    • Full cylinder contains 2100 PSI
  - Supports combustion
    • No cigarettes or open flame when O₂ is being used
    • “NO SMOKING” sign
    • Oxygen itself will not burn
    • Will cause other substances to burn fiercely
  - Never allow to mix with oil under pressure
    • Can cause explosion

• Storage and delivery
  - Cylinders (tanks)
    • Pressure at full is 2000-2100 PSI
    • Tanks should be positioned to prevent falling and blows to the valve-gauge assembly and secured during transport
    • Need to handle carefully since their contents are under extreme pressure
    • Video

• Storage and delivery
  - Humidity
    • Dry oxygen not harmful in short term; humidifier needed only for patient on oxygen for a long time
    • Not generally needed for prehospital care

• Storage and delivery
  - Colors
    • Oxygen
      - Green (usual color)
      - White
      - Yellow
        » Careful! May be industrial oxygen or oxidizer
    • Other gases
      - Nitrous oxide
        » Blue
        » Used by MFD
        » “Laughing gas”
        » Analgesic

• Storage and delivery
  - Sizes
    • “A” (smallest and very portable)
• “E” (small 625 liters and very portable)
  – Usually used as portable oxygen on ambulance
• “G” or “H”
  – Large size
    » G - 5,300 Liters
    » H - 6,900 Liters
  – Not portable
  – Fixed supply on ambulance

• Regulators
  – Purpose
    • Decreases pressure
    • Controls liter flow

• Regulators
  – Types
    • Bourdon
      – Types
        » Single stage (reduces pressure only)
        » Dual stage (reduces pressure & controls liter flow)
      – Functions well in any position (portability)
      – Inaccurate at low flow rates
    • Pressure compensated
      – Accurate at most flow rates
      – Gravity dependent & must remain upright at all times
      – Usually used for fixed supply

• Regulators
  – Mating cylinder and regulator
    • Pin index system
      – Ensures that O2 regulator doesn't end up on some other type of gas
    – Usually used on portable systems
    – Fixed supply system

• Time to depletion
  – Formula
    • p.s.i. (pounds per square inch)
    – Current pressure in tank
• srp (safe residual pressure)
  – ALWAYS at least 200 p.s.i.
• k (Constant)
  – Accommodates increased size of tank
    – “D” cylinder – 0.16
    – “E” cylinder – 0.28
    – “M” cylinder – 1.56
    – “G” cylinder – 2.41
    – “H” cylinder – 3.14
• LPM (Liters Per Minute)
  – Current flow rate being delivered to patient
  – Answer is minutes left until tank pressure equals 200 p.s.i.

• Masks
  – Simple
  – Venturi
  – Partial-rebreather
  – Non-rebreather
• When oxygen is delivered to a patient by any mask other than a venturi mask, the
  minimum flow rate should be 6 LPM

• Masks
  – Non-rebreather
  • Preferred method of giving oxygen to prehospital patients
  • Up to 90% oxygen can be delivered
  • Non-rebreather bag must be full before mask is placed on patient
  • Flow rate should be adjusted so that when patient inhales, bag does not collapse
    (15 LPM)

• Masks
  – Non-rebreather
  • Patients who are cyanotic, cool, clammy or short of breath need oxygen  Concerns
    about the dangers of giving too much oxygen to patients with history of chronic
    obstructive pulmonary disease and infants and children have not been shown to be
    valid in the prehospital setting  Patients with chronic obstructive pulmonary disease
    and infants and children who require oxygen should receive high concentration
    oxygen with close monitoring
  • Masks come in different sizes for adult, children and infants  Be sure to select the
    correct size mask

• Nasal cannula
- Rarely the best method of delivering adequate oxygen to the prehospital patient
- Should be used only when patients will not tolerate a non-rebreather mask, despite coaching from the EMT-Basic

- Skill Video
  - Supplemental Oxygen Administration
  - Skills Manual, pages 2 & 3
  - Video

- Skill Video
  - Mouth to Mask with Supplemental Oxygen
  - Skills Manual, pages 4 & 5
  - Video

- Skill Video
  - Bag-Valve-Mask (Apneic with Pulse)
  - Skills Manual, pages 6 & 7
  - Video

- Skill Video
  - Upper Airway Adjuncts and Suctioning
  - Skills Manual, pages 8 - 10
  - Video

- Skill Video
  - Dual Lumen Device Insertion (PTL)
  - Skills Manual, pages 11 & 12
  - Video

- Skill Video
  - Dual Lumen Device Insertion (Combitube)
  - Skills Manual, pages 11 & 13
  - Video