

**2002 Supplemental
Airway Modules
for the
1994 Emergency Medical
Technician-Basic: NSC**

April 2002

Introduction

Since the release of the 1994 EMT-Basic National Standard Curriculum, observations have been made about student performance on written and practical examinations, as well as performance in patient care delivery. Some EMT-Basics appear to have a misunderstanding of the concepts and procedures of airway management, oxygenation and ventilation of patients. While unquantified, discussions as to why this has occurred have resulted in a number of hypotheses. As a result of these observations, the National Highway Traffic Safety Administration, in conjunction with the national EMS community, decided to revisit Section 2.1 and 4.2 of the 1994 EMT-Basic: National Standard Curriculum to determine whether clarification of the material was needed.

A taskforce of the EMS community was convened in February 2002 and they reviewed the curriculum. They determined that additional clarification could be useful to the instructor. The following document was produced and is intended for use by the EMT-Basic instructor to clarify and bring together this information. This document is not intended to change, modify or revise the current curriculum. It is intended to offer support material in an alternative format to assist the instructor in the presentation of airway management, oxygenation and ventilation concepts. We encourage the State Emergency Medical Services Offices and members of the EMS education community to distribute this document to all EMT-Basic Instructors.

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MODULE 2

Lesson 2-1

Airway

Objectives

OBJECTIVES LEGEND

C=Cognitive P=Psychomotor A=Affective

1 = Knowledge level

2 = Application level

3 = Problem-solving level

COGNITIVE OBJECTIVES

At the completion of this lesson, the EMT-Basic student will be able to:

- 2-1.1 Name and label the major structures of the respiratory system on a diagram. (C-1)
- 2-1.2 List the signs of adequate breathing.(C-1)
- 2-1.3 List the signs of inadequate breathing.(C-1)
- 2-1.4 Describe the steps in performing the head-tilt chin-lift.(C-1)
- 2-1.5 Relate mechanism of injury to opening the airway. (C-3)
- 2-1.6 Describe the steps in performing the jaw thrust.(C-1)
- 2-1.7 State the importance of having a suction unit ready for immediate use when providing emergency care.(C-1)
- 2-1.8 Describe the techniques of suctioning.(C-1)
- 2-1.9 Describe how to artificially ventilate a patient with a pocket mask.(C-1)
- 2-1.10 Describe the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask while using the jaw thrust.(C-1)
- 2-1.11 List the parts of a bag-valve-mask system.(C-1)

- 2-1.12 Describe the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask for one and two rescuers.(C-1)
- 2-1.13 Describe the signs of adequate artificial ventilation using the bag-valve-mask.(C-1)
- 2-1.14 Describe the signs of inadequate artificial ventilation using the bag-valve-mask.(C-1)
- 2-1.15 Describe the steps in artificially ventilating a patient with a flow restricted, oxygen-powered ventilation device.(C-1)
- 2-1.16 List the steps in performing the actions taken when providing mouth-to-mouth and mouth-to-stoma artificial ventilation.(C-1)
- 2-1.17 Describe how to measure and insert an oropharyngeal (oral) airway. (C-1)
- 2-1.18 Describe how to measure and insert a nasopharyngeal (nasal) airway. (C-1)
- 2-1.19 Define the components of an oxygen delivery system.(C-1)
- 2-1.20 Identify a nonrebreather face mask and state the oxygen flow requirements needed for its use.(C-1)
- 2-1.21 Describe the indications for using a nasal cannula versus a nonrebreather face mask. (C-1)
- 2-1.22 Identify a nasal cannula and state the flow requirements needed for its use.(C-1)

AFFECTIVE OBJECTIVES

At the completion of this lesson, the EMT-Basic student will be able to:

- 2-1.23 Explain the rationale for basic life support artificial ventilation and airway protective skills taking priority over most other basic life support skills.(A-3)
- 2-1.24 Explain the rationale for providing adequate oxygenation through high inspired oxygen concentrations to patients who, in the past, may have received low concentrations.(A-3)

PSYCHOMOTOR OBJECTIVES

At the completion of this lesson, the EMT-Basic student will be able to:

- 2-1.25 Demonstrate the steps in performing the head-tilt chin-lift. (P-1,2)
- 2-1.26 Demonstrate the steps in performing the jaw thrust.(P-1,2)
- 2-1.27 Demonstrate the techniques of suctioning.(P-1,2)

- 2-1.28 Demonstrate the steps in providing mouth-to-mouth artificial ventilation with body substance isolation (barrier shields).(P-1,2)
- 2-1.29 Demonstrate how to use a pocket mask to artificially ventilate a patient.(P-1,2)
- 2-1.30 Demonstrate the assembly of a bag-valve-mask unit.(P-1,2)
- 2-1.31 Demonstrate the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask for one and two rescuers.(P-1,2)
- 2-1.32 Demonstrate the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask while using the jaw thrust.(P-1,2)
- 2-1.33 Demonstrate artificial ventilation of a patient with a flow restricted, oxygen-powered ventilation device.(P-1,2)
- 2-1.34 Demonstrate how to artificially ventilate a patient with a stoma.(P-1,2)
- 2-1.35 Demonstrate how to insert an oropharyngeal (oral) airway.(P-1,2)
- 2-1.36 Demonstrate how to insert a nasopharyngeal (nasal) airway.(P-1,2)
- 2-1.37 Demonstrate the correct operation of oxygen tanks and regulators.(P-1,2)
- 2-1.38 Demonstrate the use of a nonrebreather face mask and state the oxygen flow requirements needed for its use.(P-1,2)
- 2-1.39 Demonstrate the use of a nasal cannula and state the flow requirements needed for its use.(P-1,2)
- 2-1.40 Demonstrate how to artificially ventilate the infant and child patient.(P-1,2)
- 2-1.41 Demonstrate oxygen administration for the infant and child patient.(P-1,2)

The following lesson plan contains the cognitive information present in the National Highway Traffic Safety Administrations Emergency Medical Technician: Basic National Standard Curriculum Module 2-1: Airway. EMS educators may choose to use this document in lieu of pages 2-3 through 2-14 of the EMT-Basic National Standard Curriculum.

I. Anatomy review

A. Airway Anatomy

1. Nose and mouth
2. Pharynx
 - a) Oropharynx
 - b) Nasopharynx
3. Epiglottis - a leaf-shaped structure that prevents food and liquid from entering the trachea during swallowing.
4. Trachea (windpipe)
5. Cricoid cartilage - firm cartilage ring forming the lower portion of the larynx.
6. Larynx (voice box)
7. Bronchi - two major branches of the trachea to the lungs.
8. Bronchioles – branches of the bronchi that lead to the alveoli. Bronchioles have no cartilage rings and are subjected to collapse in some disease processes
9. Alveoli

B. Airway Functions

1. The airway is a passage that allows air to move from the atmosphere to the alveoli.
2. No matter what the patient condition, the airway must remain patent at all times.
3. Anything (food, blood, swollen tissue, vomit) that blocks the airway will cause some level of decrease of available oxygen to the body.
4. The size of obstruction affects the available air exchange. For example, snoring will reduce air exchange while a food bolus can actually stop air exchange.

II. Opening the Upper Airway

A. Technique

1. Head-Tilt-Chin-Lift
2. Jaw Thrust
3. Use of Suction
4. Use of a Nasal Pharyngeal Airway
5. Use of an Oral Pharyngeal Airway

B. Techniques for Opening the Airway

1. Head Tilt-Chin-Lift Maneuver

a) Assess the need for the Head-Tilt Chin-Lift Maneuver

- (1) Used when no neck injury suspected
- (2) No matter what the patient condition, the airway must remain patent at all times
- (3) Use of the Head-Tilt Chin-Lift Maneuver is temporary and must be replaced with an upper airway adjunct unless the patient begins adequate spontaneous ventilation.

b) Technique

- (1) Place one hand on the victims forehead and apply firm, backward pressure with the palm of your hand causing the head to tilt backward.
- (2) Place the fingers of your other hand under the bony part of the victim's lower jaw near the chin. Lift the jaw upward to bring to bring the victim's chin forward and the teeth almost to occlusion.

c) Examples of patients needing the Head-Tilt Chin-Lift Maneuver

- (1) Any unresponsive patient without history of mechanism of trauma
- (2) Cardiac arrest patients without signs of trauma
- (3) Apneic patients without signs of trauma

2. Jaw Thrust Maneuver

a) Assess the need for the Jaw Thrust Maneuver

- (1) Used when EMT-Basic suspects spinal injury
- (2) No matter what the patient condition, the airway must remain patent at all times.
- (3) Use of Jaw thrust is temporary and must be replaced with an upper airway adjunct (oral pharyngeal airway)

b) Technique

- (1) Place one hand on each side of the victim's head, resting your elbows on the surface on which the victim's is lying
- (2) Grasp the angles of the victim's lower jaw and lift with both hands
- (3) If the victim's lips close, you can retract the lower lip with your thumbs.

c) Examples of patients needing the Jaw Thrust Maneuver

- (1) Unresponsive trauma patient
- (2) Unresponsive patient with an undetermined mechanism of injury (MOI)

C. Techniques of Suctioning

1. Body substance isolation

2. Purpose

- a) Remove blood, other liquids and food particles from the airway.
- b) Some suction units are inadequate for removing solid objects like teeth, foreign bodies and food.
- c) A patient needs to be suctioned immediately when a gurgling sound is heard with artificial ventilation.
- d) Suction devices may not be able to remove large obstructing particles in the airway.

3. Types of Suction devices

- a) Mounted
- b) Portable
 - (1) Electrical
 - (2) Hand operated

4. Suction catheters

- a) Hard or rigid (“tonsil sucker,” “tonsil tip”)
 - (1) Used to suction the mouth and oropharynx of an unresponsive patient.
 - (2) Should be inserted only as far as you can see.
 - (3) Use rigid catheter for infants and children, but take caution not to touch back of airway.
- b) Soft (French)
 - (1) Useful for suctioning the nasopharynx and in other situations where a rigid catheter cannot be used.
 - (2) Should be measured so that it is inserted only as far as the base of the tongue.
 - (3) Useful for suctioning nasopharynx and tracheostomy tube.

5. Techniques of use

- a) Suction device should be inspected on a regular basis before it is needed. A properly functioning unit with a gauge should generate 300 mmHg vacuum. A battery operated unit should have a charged battery.
- b) Turn on the suction unit.
- c) Attach a catheter.
 - (1) Use rigid catheter when suctioning mouth of an infant or child.
 - (2) Often will need to suction nasal passages; should use a bulb suction or French catheter with low to medium suction.
- d) Insert the catheter into the oral cavity without suction, if possible. Insert only to the base of the tongue.
- e) Apply suction. Move the catheter tip side to side.
- f) Suction for no more than 15 seconds at a time.

- (1) In infants and children, shorter suction time should be used.
- (2) If the patient has secretions or emesis that cannot be removed quickly and easily by suctioning, the patient should be log rolled and the oropharynx should be cleared.
- (3) If patient produces frothy secretions as rapidly as suctioning can remove, suction for 15 seconds, artificially ventilate for two minutes, then suction for 15 seconds, and continue in that manner. Consult medical direction for this situation.
- g) If necessary, rinse the catheter and tubing with water to prevent obstruction of the tubing from dried material.

6. Assess the Need for Suctioning

- a) No matter what the patient condition, the airway must remain patent at all times.
- b) Examples of airway obstructions needing suctioning
 - (1) Blood
 - (2) Vomit
 - (3) Food Particles
 - (4) Any fluid that can pass through the catheter should be suctioned.

D. Nasopharyngeal (nasal) airways

- 1. 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.
- 2. Technique
 - a) Select the proper size: Measure from the tip of the nose to the tip of the patient's ear. Also consider diameter of airway in the nostril.
 - b) Lubricate the airway with a water-soluble lubricant.
 - c) Insert it posteriorly. Bevel should be toward the base of the nostril or toward the septum.
 - d) If the airway cannot be inserted into one nostril, try the other nostril.

3. Assess the Need for Nasal Pharyngeal Airway
 - a) No matter what the patient condition, the airway must remain patent at all times.
 - b) Placed after opening the airway using a manual maneuver (allows the EMT to continue assessment and treatment).
4. Examples of patients needing nasal pharyngeal airways
 - a) Unresponsive patients who are snoring
 - b) Unresponsive patients with a gag reflex

E. Oropharyngeal (oral) airways

1. 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.
2. Technique
 - a) Select the proper size: To approximate the correct size measure from the corner of the patient's lips to the bottom of the earlobe or angle of jaw.
 - b) Open the patient's mouth.
 - c) In adults, to avoid obstructing the airway with the tongue, insert the airway upside down, with the tip facing toward the roof of the patient's mouth.
 - d) Advance the airway gently until resistance is encountered. Turn the airway 180 degrees so that it comes to rest with the flange on the patient's teeth.
 - e) Another method of inserting an oral airway is to insert it right side up, using a tongue depressor to press the tongue down and forward to avoid obstructing the airway. This is the preferred method for airway insertion in an infant or child.

3. Assess the Need for Oral Pharyngeal Airway

- a) No matter what the patient condition, the airway must remain patent at all times.
- b) Placed after opening the airway using a manual maneuver (allows the EMT to continue assessment and treatment).
- c) Examples of patients needing oral pharyngeal airways
 - (1) Unresponsive, apneic patients (with or without trauma)
 - (2) Any apneic patient being ventilated with a BVM
- d) While these devices are helpful in the maintenance of an airway manual maneuvers are often still needed to assure that the airway remains patent.

F. Other Advanced Airways

1. All manual maneuvers and upper airway adjuncts have limitations. They are not definitive airway devices. Patients that vomit or have active bleeding in the airway must be frequently suctioned in order to maintain an open airway.
2. A definitive airway intervention, such as endotracheal intubation, protects the airway.

III. Anatomy and Physiology Review

A. Pulmonary Anatomy

1. Lungs/Alveoli
2. Diaphragm
3. Chest Wall

B. Physiology of Ventilation

1. Inhalation (active)
 - a) Diaphragm and intercostal muscles contract, increasing the size of the thoracic cavity.
 - (1) Diaphragm moves slightly downward, flares lower portion of rib cage.
 - (2) Chest wall moves upward/outward.
 - b) Air flows into the lungs.

2. Exhalation (passive)
 - a) Diaphragm and intercostal muscles relax, decreasing the size of the thoracic cavity.
 - (1) Diaphragm moves upward.
 - (2) Chest wall moves downward/inward.
 - b) Air flows out of the lungs.

C. Respiratory physiology

1. Alveolar/capillary exchange
 - a) Oxygen-rich air enters the alveoli during each inspiration.
 - b) Oxygen-poor blood in the capillaries passes into the alveoli.
 - c) Oxygen enters the capillaries as carbon dioxide enters the alveoli.
2. Capillary/cellular exchange
 - a) Cells give up carbon dioxide to the capillaries.
 - b) Capillaries give up oxygen to the cells.
3. Tidal volume – Amount of air inspired in each breath.
4. Minute Volume – Tidal volume multiplied by the respiratory rate.

D. Signs of Adequate Ventilatory status (breathing)

1. Normal Respiratory Rate
 - a) Adult - 12-20/minute
 - b) Child - 15-30/minute
 - c) Infant - 25-50/minute
2. Rhythm
 - a) Regular – consistent rise and fall of the chest wall over an extended period of time
 - b) Irregular – inconsistent rise and fall of chest wall, that may include short periods of apnea.

3. Quality
 - a) Breath sounds - present and equal
 - b) Movement of air at mouth and nose
 - c) Chest expansion - adequate and equal
 - d) Minimum effort of breathing - use of accessory muscles - predominantly in infants and children
 4. Depth (tidal volume)
- E. Signs of inadequate ventilatory status (breathing)
1. Rate - Adult – Less than 12 or greater than 20/minute
 2. Rhythm—irregular, such as a patient taking a series of deep breaths followed by periods of apnea.
 3. Quality
 - a) Auscultated breath sounds—diminished, noisy or absent
 - b) Reduced flow of expired air at the nose and mouth
 - c) Chest expansion - unequal or inadequate – results in reduced tidal volume and minute volume. Inadequate chest expansion may result from trauma (fractured ribs), hypoxia (muscles necessary for breathing the oxygen needed to function properly), or other conditions.
 - d) Increased effort of breathing – use of accessory muscles.
 4. Depth (tidal volume) - shallow (impaired depth).
 5. The skin may be pale or cyanotic (blue) and cool and clammy.
 6. There may be retractions above the clavicles, between the ribs and below the rib cage, especially in children.
 7. Nasal flaring may be present, especially in children.
 8. In infants, there may be “seesaw” breathing where the abdomen and chest move in opposite directions.
 9. Agonal ventilation is a reduced minute volume (rate) and tidal volume (depth) typically before the onset of respiratory failure.
 10. Patients exhibiting signs and symptoms of inadequate ventilation (breathing) must be considered to be experiencing respiratory distress.

IV. Techniques of Ventilation

A. In order of preference, the methods for ventilating a patient by the EMT-Basic are as follows: (This order of preference has been stated because research has shown that personnel who infrequently ventilate patients have great difficulty maintaining an adequate seal between the mask and the patients face.

1. Mouth-to-mask with one-way-valve, oxygen inlet port and supplemental oxygen –The advantage of this device is that a single rescuer technique that allows both hands to be placed on the mask thereby creating an adequate seal during ventilations. A disadvantage of this device is that it is viewed as an increase risk of infection.
2. Two-person bag-valve-mask with oxygen reservoir and supplemental oxygen– The advantage of this technique is that an adequate seal between mask and the patients face can be maintained while the second rescuer uses two hands to deliver adequate tidal volume. A disadvantage is that this technique requires the presence of two EMTs which may not be possible on all EMS calls.
3. Flow restricted, oxygen-powered ventilation device (Manually triggered ventilator) – The major advantages of this device are that it provides high concentrations of oxygen while allowing the EMT to use two hands to maintain the mask to face seal. The major disadvantages of this device are that it is not well understood and therefore is not carried on every EMS vehicle. In addition it may not be used with all types of patients (children).
4. One-person bag-valve-mask with oxygen reservoir and supplemental oxygen– The advantage of the device is that only one rescuer is required The disadvantage of this device is that it requires a skilled rescuer. Only the highly skilled and frequent users are able to obtain and maintain an adequate mask to face seal.

- B. Body substance isolation
- C. Select the appropriate mask
- D. Mouth-to-mouth

- 1. Technique

- a) Perform the head-tilt chin-lift maneuver when spinal injury is not suspected
 - b) Using the thumb and index finger of the hand on the victim's forehead, pinch the victims nose closed.
 - (1) If the mechanism of injury requires the use of a jaw-thrust maneuver to open the airway, close the victim's nose by placing your check tightly against the nostrils.
 - (2) This technique is fatiguing and technically difficult for most rescuers.
 - c) Take a deep breath and then seal your lips around the victim's mouth, creating an airtight seal.
 - d) Give slow breaths by blowing your exhaled air into the victim's mouth.
 - (1) Breaths should be given over 2 seconds.
 - (2) The victim's chest should rise with each breath.

- E. Mouth-to-mask

- 1. The mask should be connected to high flow oxygen = 15 liters per minute.

- 2. Technique

- a) Method #1 (no suspected spine injury)
 - (1) Position yourself directly above the victim's head
 - (2) Apply the mask to the victim's face using the bridge of the victim's nose as a guide for correct position.
 - (3) Place your thumbs along the lateral edge of the mask and the index fingers of both hands under the victim's mandible.
 - (4) Lift the jaw into the mask as you tilt the victim's head backward and place your remaining fingers under the angle of the jaw.

- (5) While lifting the jaw, squeeze the mask with your thumbs to achieve an airtight seal between the mask and the victim's face.
 - (6) Give slow breaths by blowing your exhaled air into the one-way valve attached to the mask.
 - (a) Breaths should be given over 2 seconds.
 - (b) The victim's chest should rise with each breath.
- b) Method #2 (suspected spine injury)
- (1) Position yourself directly above the victim's head
 - (2) Apply the mask to the victim's face using the bridge of the victim's nose as a guide for correct position.
 - (3) Use the thumb and first finger of each of your hands to make a complete seal around the edge of the mask
 - (4) Use your remaining fingers to lift the angle of the jaw and extend the victim's neck.
 - (5) While lifting the jaw, squeeze the mask with your thumbs and index fingers to achieve an airtight seal between the mask and the victim's face.
 - (6) Give slow breaths by blowing your exhaled air into the one-way valve attached to the mask.
 - (a) Breaths should be given over 2 seconds.
 - (b) The victim's chest should rise with each breath.
- c) Method #3 (no suspected spine injury)
- (1) Position yourself beside the victim's head
 - (2) Apply the mask to the victim's face using the bridge of the victim's nose as a guide for correct position.
 - (3) Seal the mask by placing your index finger and thumb of the hand closer to the top of the victim's head along the border of the mask and placing the thumb of your other hand along the lower margin of the mask.
 - (4) Place your remaining fingers of your hand closer to the victim's feet along the bony margin of the jaw.

- (5) Lift the jaw while performing the head-tilt chin-lift maneuver.
- (6) Compress firmly and completely around the outside margin of the mask to provide a tight seal.
- (7) Give slow breaths by blowing your exhaled air into the one-way valve attached to the mask.
 - (a) Breaths should be given over 2 seconds.
 - (b) The victim's chest should rise with each breath.

F. Bag-valve-mask

1. The bag-valve-mask consists of a self-inflating bag, one-way valve, and face mask, oxygen reservoir. It needs to be connected to oxygen to perform most effectively.
2. Bag-valve-mask issues
 - a) Volume of approximately 1,600 milliliters
 - b) Provides less volume than mouth-to-mask
 - c) Single EMT-Basic may have difficulty maintaining an airtight seal.
 - d) Two EMT-Basics using the device will be more effective.
 - e) Position self at top of patient's head for optimal performance.
 - f) Adjunctive airways (oral or nasal) may be necessary in conjunction with bag-valve-mask.
3. The bag-valve-mask should have:
 - a) A self-refilling bag that is easily cleaned and sterilized.
 - b) A non-jam valve that allows a maximum oxygen inlet flow of 15/lpm.
 - c) No pop-off valve, or the pop-off valve must be disabled. Failure to do so may result in inadequate artificial ventilations.
 - d) Standardized 15/22 mm fittings.
 - e) An oxygen inlet and reservoir to allow for high concentration of oxygen.
 - f) Should perform in all environmental conditions and temperature extremes.
 - g) Available in infant, child and adult sizes.

4. Technique for use when no trauma is suspected.
 - a) After opening airway, insert correct size oral or nasal airway and attach the correct mask size (adult, infant or child).
 - b) Position thumbs over top half of mask, index and middle fingers over bottom half.
 - c) Place apex of mask over bridge of nose, then lower mask over mouth and upper chin. If mask has large round cuff surrounding a ventilation port, center port over mouth.
 - d) Use ring and little fingers to bring jaw up to mask.
 - e) Connect bag to mask if not already done.
 - f) Have assistant squeeze bag with two hands until chest rises.
 - g) If alone, form a “C” around the ventilation port with thumb and index finger; use middle, ring and little fingers under jaw to maintain chin lift and complete the seal.
 - h) Repeat a minimum of every 5 seconds for adults and every 3 seconds for children and infants.
 - i) If chest does not rise and fall, re-evaluate.
 - (1) If chest does not rise, reposition head.
 - (2) If air is escaping from under the mask, reposition fingers and mask.
 - (3) Check for obstruction.
 - (4) If chest still does not rise and fall, use alternative method of artificial ventilation, e.g., pocket mask, manually triggered device.
 - j) If necessary, consider use of adjuncts.
 - (1) Oral airway
 - (2) Nasal airway

5. Technique for use with suspected trauma
 - a) After opening airway, insert correct size oral or nasal airway and attach the correct mask size (adult, infant or child).
 - b) Immobilize head and neck, e.g., have an assistant hold head manually or use your knees to prevent movement.
 - c) Position thumbs over top half of mask, index and middle fingers over bottom half.
 - d) Place apex of mask over bridge of nose, then lower mask over mouth and upper chin. If mask has large round cuff surrounding a ventilation port, center port over mouth.
 - e) Use ring and little fingers to bring jaw up to mask without tilting head or neck.
 - f) Connect bag to mask if not already done.
 - g) Have assistant squeeze bag with two hands until chest rises.
 - h) Repeat every 5 seconds for adults and every 3 seconds for children and infants, continuing to hold jaw up without moving head or neck.
 - i) If chest does not rise, re-evaluate.
 - (1) If abdomen rises, reposition jaw.
 - (2) If air is escaping from under the mask, reposition fingers and mask.
 - (3) Check for obstruction.
 - (4) If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.
 - j) If necessary, consider use of adjuncts.
 - (1) Oral airway
 - (2) Nasal airway

G. Bag to stoma or tracheostomy tube

1. Definition of tracheostomy - an artificial permanent opening in the trachea.
2. If unable to artificially ventilate, try suction, then artificial ventilation through mouth and nose; sealing stoma may improve ability to artificially ventilate from above or may clear obstruction.
3. Need to seal the mouth and nose when air is escaping when artificially ventilating at the stoma.

H. Bag-valve-mask to stoma- use infant and child mask to make seal. Technique otherwise very similar to artificially ventilating through mouth. Head and neck do not need to be positioned.

I. Flow restricted, oxygen-powered ventilation devices (manually triggered ventilator)

1. Flow restricted, oxygen-powered ventilation devices (for use in adults only) should provide.
 - a) A peak flow rate of 100% oxygen at a maximum of 40 lpm.
 - b) An inspiratory pressure relief valve that opens at approximately 60 centimeters water and vents any remaining volume to the atmosphere or ceases gas flow.
 - c) An audible alarm that sounds whenever the relief valve pressure is exceeded.
 - d) Satisfactory operation under ordinary environmental conditions and extremes of temperature.
 - e) A trigger positioned so that both hands of the EMT-Basic can remain on the mask to hold it in position.
2. Use when no neck injury is suspected
 - a) After opening airway, insert correct size oral or nasal airway and attach adult mask.
 - b) Position thumbs over top half of mask, index and middle fingers over bottom half.
 - c) Place apex of mask over bridge of nose, then lower mask over mouth and upper chin.
 - d) Use ring and little fingers to bring jaw up to mask.

- e) Connect flow restricted, oxygen-powered ventilation device to mask if not already done.
 - f) Trigger the flow restricted, oxygen-powered ventilation device until chest rises.
 - g) Repeat every 5 seconds.
 - h) If chest does not rise, re-evaluate.
 - (1) If abdomen rises, reposition head.
 - (2) If air is escaping from under the mask, reposition fingers and mask.
 - (3) If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.
 - (4) Check for obstruction.
3. Use when there is suspected neck injury.
- a) After opening airway, attach adult mask.
 - b) Immobilize head and neck, e.g., have an assistant hold head manually or use your knees to prevent movement.
 - c) Position thumbs over top half of mask, index and middle fingers over bottom half.
 - d) Place apex of mask over bridge of nose, then lower mask over mouth and upper chin.
 - e) Use ring and little fingers to bring jaw up to mask without tilting head or neck.
 - f) Connect flow restricted, oxygen-powered ventilation device to mask, if not already done.
 - g) Trigger the flow restricted, oxygen-powered ventilation device until chest rises.
 - h) Repeat every 5 seconds.
 - i) If necessary, consider use of adjuncts.

- j) If chest does not rise and fall, re-evaluate.
 - (1) If chest does not rise and fall, reposition jaw.
 - (2) If air is escaping from under the mask, reposition fingers and mask.
 - (3) If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.
 - (4) Check for obstruction.
- J. Techniques to provide assisted ventilations to a patient who is breathing
 - 1. Assess the need to provide ventilatory support .
 - a) Any patient with a reduced minute volume (breathing rate and depth) must receive ventilatory support and supplemental oxygen.
 - b) Some patients will be in respiratory arrest and will require 12 ventilations per minute.
 - c) Some patients will have reduced tidal volume and a rapid rate (hyperventilation) and will need rate and volume support through assisted ventilations.
 - d) Some patients will have reduced minute volume (hypoventilation) and will require their respiratory rate and volume to be assisted by ventilation.
 - 2. A patient who is hyperventilating
 - a) Explain the procedure to responsive patients.
 - b) Place the mask over the patient's nose and mouth.
 - c) Initially assist ventilation at the rate at which the patient has been breathing. Squeeze the bag each time the patient begins to inhale.
 - d) Over the next 5-10 breaths, slowly adjust the rate and the delivered tidal volume until an adequate minute volume is achieved.

3. A patient who is hypoventilating
 - a) Place the mask over the patient's nose and mouth.
 - b) Squeeze the bag at the time the patient begins to inhale.
 - c) Over the next 5-10 breaths, slowly adjust the rate and the delivered tidal volume until an adequate minute volume is achieved (12 breaths per minute).
4. Special Considerations
 - a) Patients with laryngectomies (stomas)
 - (1) A breathing tube may be present. If it is obstructed, suction it.
 - (2) Some patients have partial laryngectomies. If, upon artificially ventilating stoma, air escapes from the mouth or nose, close the mouth and pinch the nostrils.
 - b) Infant and child patients
 - (1) Place head in correct neutral position for the infant and extend a little past neutral for a child.
 - (2) Avoid excessive hyperextension of the head.
 - (3) Avoid excessive bag pressure - use only enough to make chest rise.
 - (4) Ventilate with bag-valve-mask until adequate chest rise occurs. Do not use pop-off valve, must be disabled (placed in closed position) in order to adequately ventilate child or infant.
 - (5) Gastric distention is more common in children.
 - (6) An oral or nasal airway may be considered when other procedures fail to provide a clear airway.
 - c) Facial injuries
 - (1) Because the blood supply to the face is so rich, blunt injuries to the face frequently result in severe swelling.
 - (2) For the same reason, bleeding into the airway from facial injuries can be a challenge to manage.

d) Obstructions

- (1) Review the foreign body airway obstruction (FBAO) procedures that the students learned in their BLS training.
- (2) When foreign body airway obstruction persists, EMT-Basics should perform three cycles of the FBAO procedure, then transport, continuing the FBAO procedure en route.

e) Dental appliances

- (1) Dentures - ordinarily dentures should be left in place.
- (2) Partial dentures (plates) may become dislodged during an emergency. Leave in place, but be prepared to remove it if it becomes dislodged.

MODULE 4

Medical/Behavioral and Obstetrics/Gynecology

Lesson 4-2

Respiratory Emergencies

OBJECTIVES

OBJECTIVES LEGEND

C=Cognitive P=Psychomotor A=Affective

1 = Knowledge level

2 = Application level

3 = Problem-solving level

COGNITIVE OBJECTIVES

At the completion of this lesson, the EMT-Basic student will be able to:

- 4-2.1 List the structure and function of the respiratory system.(C-1)
- 4-2.2 State the signs and symptoms of a patient with breathing difficulty.(C-1)
- 4-2.3 Describe the emergency medical care of the patient with breathing difficulty.(C-1)
- 4-2.4 Recognize the need for medical direction to assist in the emergency medical care of the patient with breathing difficulty.(C-3)
- 4-2.5 Describe the emergency medical care of the patient with breathing distress.(C-1)
- 4-2.6 Establish the relationship between airway management and the patient with breathing difficulty.(C-3)
- 4-2.7 List signs of adequate air exchange.(C-1)
- 4-2.8 State the generic name, medication forms, dose, administration, action, indications and contraindications for the prescribed inhaler.(C-1)
- 4-2.9 Distinguish between the emergency medical care of the infant, child and adult patient with breathing difficulty.(C-3)
- 4-2.10 Differentiate between upper airway obstruction and lower airway disease in the infant and child patient.(C-3)

AFFECTIVE OBJECTIVES

At the completion of this lesson, the EMT-Basic student will be able to:

- 4-2.11 Defend EMT-Basic treatment regimens for various respiratory emergencies.(A-1)
- 4-2.12 Explain the rationale for administering an inhaler.(A-3)

PSYCHOMOTOR OBJECTIVES

At the completion of this lesson, the EMT-Basic student will be able to:

- 4-2.13 Demonstrate the emergency medical care for breathing difficulty.(P-1,2)
- 4-2.14 Perform the steps in facilitating the use of an inhaler.(P-2)

The following lesson plan contains the cognitive information present in the National Highway Traffic Safety Administrations Emergency Medical Technician: Basic National Standard Curriculum Module 4/Lesson 4-2: Respiratory Emergencies. EMS educators may choose to use this document in lieu of pages 4-10 through 4-14 of the EMT-Basic National Standard Curriculum.

V. Anatomy review

A. Airway Anatomy

1. Nose and mouth
2. Pharynx
 - a) Oropharynx
 - b) Nasopharynx
3. Epiglottis - a leaf-shaped structure that prevents food and liquid from entering the trachea during swallowing.
4. Trachea (windpipe)
5. Cricoid cartilage - firm cartilage ring forming the lower portion of the larynx.
6. Larynx (voice box)
7. Bronchi - two major branches of the trachea to the lungs.
8. Bronchioles – branches of the bronchi that lead to the alveoli. Bronchioles have no cartilage rings and are subjected to collapse in some disease processes
9. Alveoli

B. Airway Functions

1. The airway is a passage that allows air to move from the atmosphere to the alveoli.
2. No matter what the patient condition, the airway must remain patent at all times.
3. Anything (food, blood, swollen tissue, vomit) that blocks the airway will cause some level of decrease of available oxygen to the body.
4. The size of obstruction affects the available air exchange. For example, snoring will reduce air exchange while a food bolus can actually stop air exchange.

VI. Breathing Difficulty

A. Signs and symptoms

1. Shortness of breath
2. Increased work of breathing
3. Restlessness
4. Increased pulse rate
5. Increased ventilatory rate
6. Decreased ventilatory rate
7. Noisy breathing
 - a) Crowing
 - (1) A harsh sound heard during breathing
 - (2) Upper airway obstruction
 - b) Audible wheezing
 - c) Gurgling
 - d) Snoring
 - e) Stridor
8. Difficulty/Inability to speak due to breathing efforts.
9. Retractions - use of accessory muscles.
10. Decreased tidal volume
11. Abdominal breathing (diaphragm only)
12. Coughing
13. Irregular breathing rhythm
14. Patient position
 - a) Tripod position (Add picture)
 - b) Sitting with feet dangling, leaning forward.
15. Skin color changes
 - a) Cyanotic (blue-gray)
 - b) Pale
 - c) Flushed (red)
 - d) Barrel chest

B. Signs of inadequate ventilatory status (breathing)

1. Rate - Adult – Less than 12 or greater than 20/minute
2. Rhythm – irregular, such as a patient taking a series of deep breaths followed by periods of apnea.
3. Quality
 - a) Breath sounds – diminished, noisy or absent
 - b) Reduced flow of expired air at the nose and mouth
 - c) Chest expansion - unequal or inadequate – results in reduced tidal volume and minute volume. Inadequate chest expansion may result from trauma (fractured ribs), hypoxia (muscles necessary for breathing the oxygen needed to function properly), or other conditions.
 - d) Increased effort of breathing – use of accessory muscles.
 - e) Depth (tidal volume) - shallow (impaired depth).
 - f) The skin may be pale or cyanotic (blue) and cool and clammy.
 - g) Agonal ventilation is a reduced minute volume (rate) and tidal volume (depth) typically before the onset of respiratory failure.
4. Patients exhibiting signs and symptoms of inadequate ventilation (breathing) must be considered to be experiencing respiratory distress.

VII. Assess and manage the Patient's Breathing.

A. Complete the initial assessment and manage all existing life threats

B. If the initial patient assessment reveals respiratory distress then proceed to the following steps:

1. If the patient is responsive and the breathing is adequate (good rate, quality and volume), oxygen may be indicated.
2. If the patient is responsive and breathing is inadequate (poor rate, quality or volume) open and maintain the airway, place an airway adjunct if needed (NPA) and assist the patient's ventilation using Mouth-to-Mask, Bag-Valve-Mask (1 or 2 person) or a Manually Triggered Ventilator.
3. If the patient is unresponsive and the breathing is adequate (good rate, quality and volume), open the airway, place an airway adjunct (OP/NP), suction the airway as needed, provide high concentration oxygen and frequently reassess.

4. If the patient is unresponsive and breathing is inadequate (poor rate, quality or volume), open the airway, place an airway adjunct (OP/NP), suction the airway as needed, assist the patient's ventilation using Mouth-to-Mask, Bag-Valve-Mask (1 or 2 person) or a Manually Triggered Ventilator and frequently reassess.
5. If the patient is not breathing, open the airway, place an airway adjunct (OP/NP), suction the airway as needed, assist the patient's ventilation using Mouth-to-Mask, Bag-Valve-Mask (1 or 2 person) or a Manually Triggered Ventilator and frequently reassess.

C. Complete the Focused History and Physical Exam

1. Important questions to ask
 - a) Onset
 - b) Provocation
 - c) Quality
 - d) Radiation
 - e) Severity
 - f) Time
 - g) Interventions
2. Mild Breathing difficulty
 - a) May be hypoxic but can move an adequate tidal volume.
 - b) Can answer your questions, speak in sentences and is alert.
 - c) Administer high concentration oxygen via non-rebreather mask.
 - d) Start to treat the underlying cause with the patient's prescribed multi-dose inhaler.
3. Moderate breathing difficulty
 - a) May be hypoxic and may be moving an adequate tidal volume.
 - b) Having difficulty answering questions, speaking in choppy sentences.
 - c) Still awake but may be restless/ irritable.
 - d) May not let you assist their breathing at this time.
 - e) Administer high concentration oxygen via a non-rebreather mask.

- f) Get ready to assist ventilations with a bag-valve-mask device if needed.
 - g) Start to treat the underlying cause.
 - h) Patient may not be able to inspire an adequate dose of a multi-dose inhaler.
4. Severe difficulty (respiratory failure)
- a) Getting sleepy
 - b) Not speaking or speaking with very few words
 - c) Previously wild patient who now seems “cooperative”
 - d) Start assisting ventilations with a BVM with oxygen
 - e) Patient usually sitting upright
 - f) Mask seal
 - g) Time bag-valve-mask ventilation with the patient’s ventilatory efforts
 - h) Interpose extra ventilations if necessary
5. If the patient has a prescribed inhaler and the clinical signs indicate possible benefit from its use
- a) Consult medical direction
 - b) Facilitate administration of inhaler
 - (1) Repeat as indicated.
 - (2) Continue focused assessment.
6. If the patient does not have prescribed inhaler - continue with focused assessment.

VIII. Relationship to Airway Management - should be prepared to intervene with appropriate oxygen administration and artificial ventilation support.

IX. Medications

A. Prescribed inhaler

1. Medication name

- a) Generic - albuterol, isoetharine, metaproteranol, etc.
- b) Trade - Proventil, Ventolin, Bronkosol, Bronkometer, Alupent, Metaprel, etc.

2. Indications - meets all of the following criteria:
 - a) Exhibits signs and symptoms of respiratory emergency,
 - b) Has physician prescribed handheld inhaler, and
 - c) Specific authorization by medical direction.
3. Contraindications
 - a) Inability of patient to use device.
 - b) Inhaler is not prescribed for the patient.
 - c) No permission from medical direction.
 - d) Patient has already met maximum prescribed dose prior to EMT-Basic arrival.
4. Medication form - handheld metered dose inhaler
5. Dosage - number of inhalations based upon medical direction's order or physician's order based upon consultation with the patient.
6. Administration
 - a) Obtain order from medical direction either on-line or off-line.
 - b) Assure right medication, right patient, right route, patient alert enough to use inhaler.
 - c) Check the expiration date of the inhaler.
 - d) Check to see if the patient has already taken any doses.
 - e) Assure the inhaler is at room temperature or warmer.
 - f) Shake the inhaler vigorously several times.
 - g) Remove oxygen adjunct from patient.
 - h) Have the patient exhale deeply.
 - i) Have the patient put his lips around the opening of the inhaler.
 - j) Have the patient depress the handheld inhaler as he begins to inhale deeply.
 - k) Instruct the patient to hold his breath for as long as he comfortably can (so medication can be absorbed).
 - l) Replace oxygen on patient.
 - m) Allow patient to breathe a few times and repeat second dose per medical direction.

- n) If patient has a spacer device for use with his inhaler, it should be used. A spacer device is an attachment between inhaler and patient that allows for more effective use of medication.
- 7. Actions - Beta agonist bronchodilators - dilates bronchioles reducing airway resistance.
- 8. Side effects
 - a) Increased pulse rate
 - b) Tremors
 - c) Nervousness
- 9. Re-assessment strategies
 - a) Gather vital signs and focused reassessment.
 - b) Patient may deteriorate and need positive pressure artificial ventilation.
- 10. Infant and child considerations
 - a) Use of handheld inhalers is very common in children.
 - b) Retractions are more commonly seen in children than adults.
 - c) Cyanosis (blue-gray) is a late finding in children.
 - d) Very frequent coughing may be present rather than wheezing in some children.
 - e) Emergency care with usage of handheld inhalers is the same if the indications for usage of inhalers are met by the ill child.

B. Oxygen

- 1. Oxygen cylinders
 - a) Different sizes
 - (1) D cylinder has 350 liters
 - (2) E cylinder has 625 liters
 - (3) M cylinder has 3,000 liters
 - (4) G cylinder has 5,300 liters
 - (5) H cylinder has 6,900 liters

- b) Need to handle carefully since their contents are under pressure.
- c) Tanks should be positioned to prevent falling and blows to the valve-gauge assembly and secured during transport.

2. Pressure regulators

- a) Full tank approximately 2000 psi. Varies with ambient temperature.
- b) Dry oxygen not harmful in short term; humidifier needed only for patient on oxygen for a long time. Not generally needed for prehospital care.

C. Operating procedures

1. Remove protective seal.
2. Quickly open, then shut, the valve.
3. Attach regulator-flowmeter to tank.
4. Attach oxygen device to flowmeter.
5. Open flowmeter to desired setting.
6. Apply oxygen device to patient.
7. When complete, remove device from patient, then turn off valve and remove all pressure from the regulator.

D. Equipment for oxygen delivery to patients who are breathing adequately

1. Nonrebreather mask

- a) Preferred method of giving oxygen to prehospital patients.
- b) Up to 90% oxygen can be delivered.
- c) Nonrebreather bag must be full before mask is placed on patient.
- d) Flow rate should be adjusted so that when patient inhales, bag does not collapse (15 lpm).
- e) 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.

- f) Masks come in different sizes for adult, children and infants. Be sure to select the correct size mask.
2. Nasal cannula - rarely the best method of delivering adequate oxygen to the prehospital patient. Should be used only when patients will not tolerate a nonrebreather mask, despite coaching from the EMT-Basic.