Airway Management, Respiration and Artificial Ventilation

EMR

Applies knowledge (fundamental depth, foundational breadth) of general anatomy and physiology to assure a patent airway, adequate mechanical ventilation, and respiration while awaiting additional EMS response for patients of all ages.

EMT

Applies knowledge (fundamental depth, foundational breadth) 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.

AEMT

Applies knowledge (fundamental depth, foundational breadth) of additional upper airway 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.

Paramedic

Integrates complex knowledge of anatomy, physiology, and pathophysiology into the assessment to develop and implement a treatment plan with the goal of assuring a patent airway, adequate mechanical ventilation, and respiration for patients of all ages.

Airway Management

EMR

Fundamental depth, simple breadth

Within the scope of practice of the EMR

- Airway Anatomy
  - Upper Airway Tract
    - Nose
    - Mouth and oral cavity
    - Jaw
    - Throat/pharynx
  - Lower Airway Tract
    - Trachea/windpipe
    - Bronchi
    - Lungs
- Airway Assessment
  - Signs of Adequate Airway
    - Airway is open, can hear and feel air move in and out
    - Patient is speaking in full sentences
    - Sound of the voice is normal for the patient
  - Signs of Inadequate Airway
    - Unusual sounds are heard with breathing (i.e. stridor or snoring)
    - Awake patient is unable to speak or voice sounds hoarse

        - No air movement
        - Apnea
        - Airway obstruction
    - Swelling Due to Trauma or Infection
- Techniques of Assuring a Patent Airway (refer to current American Heart Association guidelines)
    - Manual Airway Maneuvers
        - Head tilt/chin lift
        - Jaw thrust maneuver
        - Modified chin lift
    - Mechanical Airway Devices
        - Oropharyngeal
    - Relief of Foreign Body Airway Obstruction
    - Upper Airway Suctioning
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure
        - Limitation
- Consider Age-Related Variations in Pediatric and Geriatric Patients

EMT: EMR Material PLUS:

Fundamental depth, foundational breadth

The EMT Instructional Guidelines in this section include all the topics and material at the EMR level PLUS the following material:

- Airway Anatomy
    - Upper Airway Tract
        - Nose – warm and humidify air
        - Mouth and oral cavity
        - Jaw
        - Pharynx
        - Larynx
    - Lower Airway Tract
        - Trachea
        - Carina – the bifurcation of the trachea into the two mainstem bronchi
        - Bronchi
        - Lungs
- Airway Assessment
    - Signs of Adequate Airway
        - Airway is open, can hear/feel air move in and out
        - Patient is speaking in full sentences
        - Sound of the voice is normal for the patient

    - Signs of Inadequate Airway (*Not every sign listed below is present in every patient who has inadequate airway)*
        - Unusual sounds are heard with breathing
        - Awake patient is unable to speak or sounds hoarse
        - No air movement (apnea)
        - Airway obstruction
    - Swelling Due to Trauma or Infection
- Techniques of Assuring a Patent Airway
    - Manual Airway Maneuvers -- review and elaborate on the manual airway maneuvers used by EMRs
    - Mechanical Airway Devices
        - Review and elaborate on the mechanical airway maneuvers used by EMRs
        - Nasopharyngeal
    - Relief of Foreign Body Airway Obstruction (refer to current American Heart Association guidelines)
    - Upper Airway Suctioning -- review and elaborate on all material from the EMR Level
- Consider Age-Related Variations in Pediatric and Geriatric Patients (see Special Patient Populations Section)

AEMT: EMT Material PLUS:

Fundamental depth, foundational breadth

The AMT Instructional Guidelines in this section include all the topics and material at the EMT level PLUS the following material:

- Airway Anatomy
    - Sinuses
    - Upper Airway Tract
        - Nose
        - Mouth and Oral Cavity
        - Jaw
        - Pharynx
        - Larynx
    - Jugular Notch
    - Lower Airway Tract
        - Trachea
        - Carina
        - Bronchi
        - Lungs
    - Support Structures
        - Chest Cage
        - Phrenic nerve
        - Mediastinum
- Airway Assessment
    - Purpose

        - Identify inadequate airway
        - Identify an unstable airway
        - Identify potentially difficult airways
    - Procedure
        - Gag Reflex
        - Airway obstruction
        - Work of breathing
        - Laryngospasm
        - Laryngeal edema
        - Penetrating injuries
- Techniques of Assuring a Patent Airway
    - Manual Airway Maneuvers
    - Mechanical Airway Devices
    - Relief of Foreign Body Airway Obstruction (Refer to Current American Heart Association Guidelines)
    - Upper Airway Suctioning
        - Review and elaborate on the upper airway suctioning material from the EMR and EMT levels
        - Procedure for lower airway suctioning of the previously intubated patient
    - Blind Insertion Airway Devices
        - Esophageal obturation (e.g., Combitube, PTL, Easytube, King LTD)
        - Supraglottic devices (e.g., LMA, COBRA)
- Consider Age-Related Variations in Pediatric and Geriatric Patients

Paramedic: AEMT Material PLUS:
Complex depth, comprehensive breadth

The Paramedic Instructional Guidelines in this section include all the topics and material at the AEMT level PLUS the following material:

- Airway Anatomy
    - Sinuses
        - Frontal
        - Sphenoid
        - Ethmoid
        - Maxillary
    - Upper Airway Tract
        - Nose
        - Mouth and Oral Cavity
        - Jaw
        - Pharynx
        - Larynx
    - Jugular notch
    - Lower Airway Tract
        - Trachea -- Spatial relationship to esophagus
        - Carina -- Angle of Louis

        - Bronchi
        - Lungs
    - Support Structures
        - Chest Cage
        - Phrenic nerve
        - Mediastinum
- Airway Assessment
    - Purpose
        - Identify inadequate airway
        - Identify an unstable airway
        - Identify potentially difficult airways
    - Procedure
        - Gag Reflex
        - Airway obstruction
        - Work of breathing
        - Laryngospasm
        - Laryngeal edema
        - Penetrating injuries
    - Anticipating the difficult airway
        - Trauma/bleeding
        - Vomiting
        - History
        - Mouth opening
        - Mandibular length
        - Mallampati classifications
        - Obstructions
        - Neck mobility
        - Facial hair
- Techniques of assuring a patent airway
    - Manual airway maneuvers
    - Mechanical airway devices
    - Relief of Foreign Body Airway Obstruction
        - Refer to current American Heart Association guidelines
        - Removal of foreign body airway obstructions using direct laryngoscopy
        - Airway suctioning
    - Blind insertion airway devices
    - Endotracheal intubation
        - Direct laryngoscopy (visualized)
        - Non-visualized
    - Percutaneous cricothyrotomy
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure (including confirmation techniques)
        - Limitations

- Consider age-related variations in pediatric and geriatric patients
    - See Special Patient Populations section

Respiration

EMR

Fundamental depth, simple breadth

- Anatomy of the Respiratory System
  - Includes All Airway Anatomy Covered in the Airway Management Section
  - Additional Respiratory System Anatomy
  - Vascular Structures That Support Respiration
    - Pulmonary capillaries
    - Heart and blood vessels
- Physiology of Respiration
  - Pulmonary Ventilation
  - Oxygenation
  - Respiration
- Pathophysiology of Respiration
  - Pulmonary Ventilation
    - Interruption of nervous control
    - Structural damage to the thorax
    - Bronchoconstriction
    - Disruption of airway patency
  - Oxygenation
  - Respiration
    - External respiration
    - Internal respiration
    - Cellular respiration
- Assessment of Adequate and Inadequate Respiration (refer to current American Heart Association Guidelines)
  - Unresponsive Patient
  - Responsive Patient
- Management of Adequate and Inadequate Respiration
  - Assure Patent Airway (techniques described in Airway Management section)
  - Techniques for Assuring Adequate Respirations
- Supplemental Oxygen Therapy
  - Portable Oxygen Cylinder
  - Oxygen Delivery Devices
- Consider Age-Related Variations in Pediatric and Geriatric Patients

EMT; EMR Material PLUS:

Fundamental depth, foundational breadth

The EMT Instructional Guidelines in this section include all the topics and material at the EMR level PLUS the following material:

- Anatomy of the Respiratory System
  - Includes All Airway Anatomy Covered in the Airway Management Section
  - Additional Respiratory System Anatomy

        - Chest cage
        - Ribs
        - Muscles
        - Pleura
        - Phrenic nerve innervations
    - Vascular Structures Which Support Respiration
        - Pulmonary capillary structures
        - The heart
        - Arteries, arterioles, capillaries, venules, veins
        - Tissue/cellular beds
    - Cells
        - All cells perform a specific function
        - Cells require chemicals in order to function, including oxygen, glucose, and electrolytes
        - Respiratory regulation – influenced by carbon dioxide and oxygen levels in the blood and spinal fluid
        - Respiration; pulmonary ventilation – the movement of air in and out of the lungs
- Physiology of Respiration
    - Pulmonary Ventilation
        - Ventilation is the movement of air in and out of the lungs
        - Adequate ventilation is necessary for, but does not assure, adequate respiration
        - The mechanics of ventilation
        - Alveolar Ventilation
    - Oxygenation
        - Oxygenation is the process of loading oxygen molecules onto hemoglobin molecules in the bloodstream
        - Oxygenation is required for, but does not assure, internal respiration
    - Respiration
        - Respiration is the exchange of oxygen and carbon dioxide and is essential for life
        - Adequate ventilation is required for, but does not assure, external respiration
        - Adequate external ventilation and perfusion are required for, but do not assure, internal respiration
- Pathophysiology of Respiration
    - Pulmonary Ventilation
        - Interruption of nervous control
        - Structural damage to the thorax
        - Bronchoconstriction
        - Disruption of airway patency
    - Oxygenation
    - Respiration
        - External
        - Internal

        - Cellular
    - Circulation compromise
        - Pathology typically related to derangement of pulmonary and systemic perfusion and oxygenation
        - Typical disease processes
    - Cells
        - Hypoxia
        - Hypoglycemia
        - Infection
- Assessment of Adequate and Inadequate Ventilation
    - Internal Respiration is Necessary for Life
    - It Is Sometimes Difficult to Assess Internal Respiration
    - It May Be Difficult to Determine If You Have a Respiration, Ventilation, or Oxygenation Problem as They May Coexist and One Can Cause Another
    - Assessment of Ventilation
        - Signs of adequate ventilation
        - Signs of inadequate ventilation (*not every sign listed below is present in every patient who has inadequate ventilation and/or oxygenation)*
    - Assessment of Respiration
        - Ambient air is abnormal
        - Level of consciousness
        - Skin color/mucosa is not normal
        - Assessment of oxygenation
- Management of Adequate and Inadequate Respiration
    - Assure an Adequate Airway
    - Supplemental Oxygen Therapy
        - Ambient air is
            - Oxygen
            - Nitrogen
            - Carbon dioxide
        - Supplemental oxygen therapy replaces some of the inert gas with oxygen and can improve internal respiration
        - Oxygen sources
        - Oxygen delivery devices
    - Assisting Ventilation in Respiratory Distress/Failure
        - Purpose
        - Indications
        - Complications
        - Procedure
- Consider Age-Related Variations in Pediatric and Geriatric Patients (see Special Patient Populations)

AEMT: EMT Material PLUS:

Complex depth, foundational breadth

- Anatomy of the respiratory system

Fundamental depth, comprehensive breadth

- Physiology and pathophysiology of respiration
- Pulmonary ventilation
- Oxygenation
- Respiration
- External
- Internal
- Cellular
- Assessment and management of adequate and inadequate respiration
- Supplemental oxygen therapy

The AMT Instructional Guidelines in this section include all the topics and material at the EMT level PLUS the following material:

- Anatomy of the Respiratory System
    - Includes All Airway Anatomy Covered in the Airway Management Section
    - Additional Respiratory System Anatomy
    - Chest Cage
        - Ribs
        - Muscles of respiration
        - Pleura
    - Phrenic Nerve
    - Mediastinum
- Physiology of Respiration
    - Mechanics of Respiration
        - Pulmonary ventilation
        - Gas exchange
        - Oxygenation
        - Respiration
        - Lung compliance
- Pathophysiology of Respiration
    - Pulmonary Ventilation
        - Interruption of nervous control
        - Structural damage to the thorax
        - Bronchoconstriction
        - Disruption of airway patency
    - Oxygenation
    - Respiration
        - External
        - Internal
        - Cellular
- Assessment of Adequate and Inadequate Respiration
- Management of Adequate and Inadequate Respiration
    - Respiratory Compromise
        - Assure an adequate airway
        - Review supplemental oxygen therapy

        - Assisted positive pressure ventilations
- Supplemental Oxygen Therapy
    - Review of Oxygen Delivery Devices Used by EMTs
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedures
- Age-Related Variations in Pediatric and Geriatric Patients

Paramedic: AEMT Material PLUS:
Complex depth, comprehensive breadth

The Paramedic Instructional Guidelines in this section include all the topics and material at the AEMT level PLUS the following material:

- Anatomy of the Respiratory System
    - Includes all airway anatomy covered in the Airway Management section
    - Additional Respiratory System Anatomy
        - Chest Cage
        - Phrenic nerve
        - Mediastinum
- Physiology of Respiration
    - Control of Respiration
        - Nervous Control of Respiration
        - Conscious Control of Respiration
        - Chemical Control of Respiration
    - Mechanics of Respiration
        - Pulmonary Ventilation
        - Gas Exchange
        - Gas Transport
        - Ventilation perfusion ratio
    - Blood volume circulation disturbances due to Cardiac, Trauma, Systemic Vascular Resistance
        - Orthostatic hypotension
        - Oncotic fluid pressure
        - Hydrostatic fluid pressure
        - Capacitance of the venules and veins
    - Cardiac output and the role in adequate circulation maintenance
        - Cardiac rate
        - Stroke volume
        - Role of alpha stimulation in the heart
        - Role of beta stimulation in the heart
        - Atrioventricular Synchronization
        - Total peripheral Resistance
    - Buffer systems

        - Blood
        - Respiratory
        - Renal
- Pathophysiology of Respiration
    - Pulmonary ventilation
        - Interruption of Nervous Control
        - Structural Damage to the Thorax
        - Bronchoconstriction
        - Disruption of airway patency
    - Oxygenation
    - Respiration
        - External
        - Internal
        - Cellular
    - Rapid ventilation, exhaustion, dead space air movement
    - Mechanical ventilation
    - Breathing against an elevated diaphragm
    - Decreases in lung compliance such as pneumonia, emphysema, and trauma
    - Ventilation-perfusion mismatch
        - Ventilation defects
        - Perfusion defects
    - Disruptions in oxygen transport associated with diminished oxygen carrying capacity
        - Anemia
        - Blood loss
    - Disruptions in effective circulation
        - Shock
        - Emboli
        - Increased capillary permeability
    - Disruptions at the cellular level
        - Acid-base balance
        - Poisons/toxins
        - Blood sugar changes
        - Hormone effects
        - Drugs
        - Hypoxia
- Assessment of Adequate and Inadequate Respiration
    - Capnometry/Capnography
        - Purpose/definition
        - Indications
        - Contraindications
        - Complications
        - Procedure
- Management of Adequate and Inadequate Respiration
    - Respiratory Compromise
        - Assure an adequate airway

        - Review supplemental oxygen therapy
        - Continuous Positive Airway Pressure (CPAP)/Bi-Level Positive Airway Pressure (BiPAP)
        - Assisted positive pressure ventilations
- Supplemental Oxygen Therapy
    - Review and elaborate on the oxygen delivery devices used by EMRs, EMTs and AEMTs
    - Oxygen administration and the patient with hypercapnia
- Age-Related Variations in Pediatric and Geriatric Patients

Artificial Ventilation

EMR

Fundamental depth, simple breadth

- Assessment of Adequate and Inadequate Ventilation
  - Adequate
    - Respiratory rate is normal
    - Respiration depth is normal
    - Effort of breathing is normal
  - Inadequate
    - Abnormal work (effort) of breathing
    - Abnormal breathing sounds
    - Depth of breathing
    - Rate of breathing
    - Chest wall movement or damage
    - Irregular respiratory pattern
- Oxygenation
  - Adequate
    - Mental status considered normal for patient
    - Skin color normal
  - Inadequate
    - Ambient air is abnormal
    - Mental status considered abnormal or altered for patient
    - Skin color/mucosa is not normal
- Management of Adequate and Inadequate Ventilation
  - Patients With Adequate Ventilation
  - Patients With Inadequate Ventilation
    - May be conscious or unconscious
    - EMR must assist ventilation during respiratory distress/failure
- Ventilation of an Apneic Patient
  - To Oxygenate and Ventilate the Patient
  - Indications
    - No breathing is noted
    - Occasional gasping breathing is noted
  - Monitoring Patient
  - Limitation
- Differentiate Normal Ventilation From Positive Pressure Ventilation
  - Air Movement
    - Normal ventilation
    - Positive pressure ventilation with pocket mask or bag-mask
  - Blood Movement
    - Normal ventilation
    - Positive pressure ventilation
  - Esophageal Opening Pressure
    - Normal ventilation
    - Positive pressure ventilation with a pocket mask or bag-mask

    - Excess Rate or Depth of Ventilation Using Pocket Mask or Bag-Mask Can Harm the Patient as ventilating too fast or too deep may cause low blood pressure, vomiting, or decreased blood flow when the chest is compressed during CPR
- Consider Age-Related Variations in Pediatric and Geriatric Patients

EMT: EMR Material PLUS:

Fundamental depth, foundational breadth

The EMT Instructional Guidelines in this section include all the topics and material at the EMR level PLUS the following material:

- The Management of Inadequate Ventilation
    - Assure an Adequate Airway
    - Supplemental Oxygen Therapy
    - Artificial Ventilation Devices
        - Bag-valve-mask with reservoir
        - Manually triggered ventilation device
        - Automatic Transport Ventilator/Resuscitator
    - Ventilation of an Apneic Patient
        - Purpose
        - Indications
        - Contraindications
        - Procedure
    - Ventilation of the Protected Airway
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure
- The Differences Between Normal and Positive Pressure Ventilation
    - Air Movement
        - Normal ventilation
        - Positive pressure ventilation
    - Blood Movement
        - Normal ventilation
        - Positive pressure ventilation
    - Airway Wall Pressure
        - Normal ventilation
        - Positive pressure ventilation
    - Esophageal Opening Pressure
        - Normal ventilation
        - Positive pressure ventilation
        - Sellick's maneuver (cricoid pressure)
    - Over Ventilation (Either by Rate or Volume) Can Be Detrimental to the Patient
        - Positive pressure ventilation may cause
            - Hypotension

        - Gastric distention
        - Other unintended consequences
- Consider Age-Related Variations in Pediatric and Geriatric Patients (see Special Patient Considerations)

AEMT: EMT Material PLUS:
Complex depth, foundational breadth

The AMT Instructional Guidelines in this section include all the topics and material at the EMT level PLUS the following material:

- Comprehensive Ventilation Assessment
    - Purpose
    - Procedure
    - Minute Volume
    - Alveolar Volume
    - Evaluating the Effects of Artificial Ventilation
    - Pulse Oximetry
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure
- The Management of Inadequate Ventilation
    - Assure an Adequate Airway
    - Supplemental Oxygen Therapy
    - Artificial Ventilation Devices
        - Bag-valve-mask with reservoir
        - Manually triggered ventilation device
        - Automatic Transport Ventilator/Resuscitator
    - Ventilation of an Apneic Patient
        - Purpose
        - Indications
        - Contraindications
        - Procedure
    - Ventilation of the Protected Airway
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure
- The Differences Between Normal and Positive Pressure Ventilation
    - Air Movement
        - Normal ventilation
        - Positive pressure ventilation
    - Blood Movement

        - Normal ventilation
        - Positive pressure ventilation
    - Airway Wall Pressure
        - Normal ventilation
        - Positive pressure ventilation
    - Esophageal Opening Pressure
        - Normal ventilation
        - Positive pressure ventilation
    - Over Ventilation (Either by Rate or Volume) Can Be Detrimental to the Patient
        - Hypotension
        - Gastric distention
        - Other unintended consequences
- Consider Age-Related Variations in Pediatric and Geriatric Patients

PARAMEDIC: AEMT Material PLUS:
Complex depth, comprehensive breadth

The Paramedic Instructional Guidelines in this section include all the topics and material at the AEMT level PLUS the following material:

- Comprehensive ventilation assessment
    - Purpose
    - Procedure
    - Minute Volume
    - Alveolar Volume
    - Evaluating the effects of artificial ventilation
    - Pulse oximetry
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure
    - Blood gas analysis
        - pH
        - PaCO2
        - PaO2
        - Bicarbonate
        - Base déficit
    - Capnography Review
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure
- Review of ventilation devices used by EMRs, EMTs and AEMTs
    - Manual devices

        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedures
    - Mechanical devices
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedures
- Assisting patient ventilations
    - Review of techniques used by EMRs, EMTs and AEMTs
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedures
    - Review of the physiologic differences between normal and positive pressure ventilation
    - BiPAP/CPAP
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure
    - Positive End Expiratory Pressure (PEEP)
        - Purpose
        - Indications
        - Contraindications
        - Complications
        - Procedure
- Age Related Variations in Pediatric and Geriatric Patients