



EMT-Special Skill Supraglottic Airway

Required Curricula Supraglottic Airway Endorsement for EMTs

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Contents

Training Aid Guide.....	3
Background / Scope	3
Course Requirements.....	3
Objectives	3
Training Length	3
Training Completion Requirements.....	3
Supraglottic Airway (SGA) Training Curriculum	6
Anatomy and physiology of the respiratory system	6
Airway and breathing assessment	11
Basic Airway Management	14
Airway Management with Supraglottic Airway (SGA) (and other adjuncts)	23
Practical application skills lab	32
Practical application skill evaluation.....	32
Appendices.....	33
Supplies / Equipment List	33
Essay for Skill Lab Evaluators/Examiners	34
Evaluation form.....	36
Acknowledgements/Credits/Resources.....	39

Training Aid Guide

Background / Scope

This training aid was developed by the EMS Education and Certification workgroup to provide a consistent minimum standard for state Supraglottic Airway endorsement.

The purpose of SGA training aid is to teach the proper placement of a supraglottic airway (SGA) device in the patient experiencing an airway or breathing emergency. Any currently certified EMT/AEMT/PM or EMT/AEMT/PM course student is eligible to participate in the class.

Successful completion of the SGA training is required for an EMT to receive endorsement by the Washington State Department of Health. Permission to use the supraglottic airway device is given by each county's Medical Program Director by means of their county protocols.

Course Requirements

Objectives

There are objectives the student must master to ensure the proper care of a patient experiencing an airway or breathing emergency.

1. Demonstrate proper airway management for a patient in respiratory failure or cardiac arrest.
2. Identify the need to place supraglottic airway (SGA) device.
3. Demonstrate the proper technique for placement of a supraglottic airway (SGA) device.
4. Explain the importance of continued monitoring of ventilations, waveform capnography, and airway patency.

Training Length

The length of training may vary depending on number of students, use of pre-requisite online learning/reading, experience level of students. An adequate amount of time should be allowed to meet course objectives, skill labs and evaluations.

Training Completion Requirements

1. Course participants must successfully complete all course objectives.
2. Course participants must pass a written exam and that exam will be reviewed with the class by the instructor.
3. Course participants must pass the SGA practical skill evaluation.

Instructor

SGA training must be conducted by people experienced/credentialed in SGA practical skill instruction, demonstration, and evaluation such as Senior EMS instructors or other people approved by the Medical Program Director.

Training Lab Assistants / Evaluators

SGA training lab assistants and skill exam evaluators must be DOH credentialed EMS Evaluators who are experienced/credentialed in SGA practical skill instruction, demonstration, and evaluation.

Training Application

To conduct standalone SGA training, an SEI must submit a training application through an approved training program. To conduct an SGA class as part of an EMT course the SEI must select the 'Supraglottic Airway Endorsement' box on the initial course application. The course application can be found on [here](#).

Educational Materials

This training aid PowerPoint is on the [DOH website](#). It can also be requested by contacting DOH Emergency Care System at 360-236-2840 or by sending an email to HSQA.EMS@doh.wa.gov

Instructional Needs

The SEI must ensure they provide an environment conducive to the individual student's learning process. Consider these guidelines:

1. Students must receive any pre-requisite online learning/reading, and complete any requirements associated with that pre-work.
2. Classroom amenities are adequate.
3. Sufficient medical equipment based on class size to enable participants to practice skills, see equipment/supply list in Appendices.
4. PowerPoint presentation and IT capability.
5. Copy of local protocols (for student reference).
6. Copies of the following documents for each participant:
 - a. Skill sheet.
 - b. Device specific illustrations.
 - c. Handouts as instructor deems necessary.

Endorsement Requirements

EMS Course Completion Verification (Graduation) Roster Form

The verification form should be completed by indicating all students enrolled in the class (whether they successfully completed or not) and submitted to DOH. The EMT credential number must be inserted on the course completion verification roster form for standalone SGA courses. It can be found [here](#).

Certificate or Letter of Course Completion

The lead instructor must document successful course completion prior to issuing a certificate of course completion. Certificate of completion must meet the requirements listed in DOH 530-126 and must include the individual's EMT number for standalone SGA courses.

Initial SGA Endorsement

The individual must successfully complete an initial SGA training session. The SEI must submit to DOH the EMS Course Completion Verification roster form along with a copy of each student's Certificate or Letter of Course Completion. The Certificate or Letter of Course Completion is used to add the endorsement to the EMT certification.

Renewal of SGA Endorsement

1. EMTs with an SGA endorsement must complete didactic and practical skills training/evaluation during their certification period via the OTEP or CME method.
2. Renewal of the SGA endorsement is 'automatic' when applying for recertification in the Secure Access Washington (SAW) system.

Supraglottic Airway (SGA) Training Curriculum

Introduction

1. Failure to manage the airway patency is a major cause of preventable death in the prehospital setting.
2. Maintaining the patient's oxygenation and supporting ventilation are critical steps to minimize the overall burden of injury and improve the likelihood of a good outcome.
3. Early detection, rapid intervention and continuous reassessment are paramount.
4. Discussion:
 - a. Without a secure airway and adequate oxygenation and ventilation, other resuscitative measures are doomed to failure.
 - b. With the exception of the immediate defibrillation of the cardiac arrest patient, no single resuscitative maneuver takes priority over management of the airway.
 - c. EMS providers' job is to:
 - i. Determine the best method of airway management,
 - ii. Manage the airway minimizing hypoxia, hypercarbia, & aspiration,
 - iii. Rapidly assess the need for airway management & urgency of situation,
 - iv. Recognize when the basic airway intervention has failed and effectively choose/execute an SGA insertion.

Anatomy and physiology of the respiratory system

1. Anatomy of Upper Airway
 - a. Function of the upper airway
 - i. Turbinates warm, filter and humidify air,
 - ii. Sinuses trap bacteria and are tributaries for fluid from eustachian tubes and tear ducts.
 - iii. A patent airway is the first component in the delivery of oxygen to the cells.
 - b. Nasopharynx- formed by the union of facial bones and the orientation of nasal floor is towards the ear not the eye. It is separated by septum and lined with mucous membranes and cilia. Note that improper or overly aggressive placement of nasal airways will cause significant bleeding which may not be controlled by direct pressure.
 - c. Oropharynx- has the teeth, tongue, palate, and adenoids. The teeth require significant force to dislodge but they may fracture or avulse causing obstruction. The tongue is a large muscle attached at the mandible and hyoid bones and is the most common airway obstruction. The palate is the roof of mouth which separates the oro/naso pharynx. The anterior portion is the hard palate and the posterior portion beyond the teeth is the soft palate.
 - d. Hypopharynx- is posterior to the tongue. The epiglottis is located here. The vallecula is the "pocket" formed by the base of the tongue and epiglottis.
 - e. Larynx- is made of cartilage and is attached to the hyoid bone, which is a horseshoe shaped bone between the chin and mandibular angle whose function

is to support the trachea. The larynx components are the: thyroid cartilage which is the first tracheal cartilage and is made of cartilage anteriorly and smooth muscle posteriorly. The laryngeal prominence (Adam's Apple) is the anterior prominence of thyroid cartilage with the glottic opening directly behind it. The glottic opening patency is heavily dependent on muscle tone and contains: the vocal bands which are white bands of cartilage produce that produce the voice; arytenoid cartilage; and pyriform fossae. The cricoid ring is the first tracheal ring and is completely cartilaginous. Compression of cricoid ring occludes esophagus as in the Sellick Maneuver. The cricothyroid membrane is a fibrous membrane between the cricoid and thyroid cartilage. It is the site for advanced surgical and alternative airway placement.

2. Anatomy of Lower Airway

- a. Function of the lower airway- Exchange of O₂ and CO₂.
- b. Trachea- lies in front of the esophagus; it is a rigid tube about 4.5 inches (12 cm) long and 1 inch (2.5 cm) wide. C-shaped rings of cartilage encircle the trachea to reinforce it and keep it from collapsing. The open part of the "C" faces posteriorly, giving the esophagus room to expand during swallowing.
- c. Bronchi-
 - i. Primary bronchi-at the carina, the trachea branches into two bronchi, which are also supported by C-shaped rings of cartilage. The right bronchus is slightly wider and more vertical than the left, making this the most likely location for aspirated food particles and small objects to lodge. Immediately after entering the lungs, the primary bronchi branch into secondary bronchi: one for each of the lung's lobe (two on the left and three on the right).
 - ii. Secondary bronchi branch into smaller tertiary bronchi. The cartilaginous rings surrounding the bronchi become irregular and disappear in the smaller bronchioles.
 - iii. Tertiary bronchi continue to branch, resulting in very small airways called bronchioles. Bronchioles divide further to form thin-walled passages called alveolar ducts which are throughout the lungs and terminate in clusters of alveoli called alveolar sacs.
- d. Alveoli-The lung passages all exist to serve the alveoli, because it's within the alveoli that gas exchange occurs. Deoxygenated blood flows into alveoli through pulmonary arterioles, and oxygenated blood leaves alveoli via pulmonary venules. Alveoli are separated from one another by a thin layer of tissue. A mesh of pulmonary capillaries encases each alveolus. The extremely thin walls of the alveoli, and the closeness of the capillaries, allow for efficient gas exchange. Elastic fibers give alveoli the ability to expand during inhalation and spring back into shape during exhalation. During inspiration, air flows into the alveoli, inflating them like tiny balloons. The ability of alveoli to expand as they fill with air and recoil as they expel air depends on their own elasticity as well as the compliance of surrounding lung tissue. Once alveoli fill with air, oxygen crosses the respiratory membrane and moves into red blood cells in surrounding

capillaries. As red blood cells take up oxygen, they release carbon dioxide, which then passes into the alveoli. Alveoli deflate during expiration, expelling their content of carbon dioxide, which travels back up the conducting airways to be expelled by the lungs.

- e. Lungs- are large, spongy, cone-shaped organs that fill the pleural cavity. Function of the lower airway: actual site for exchange of O₂ and CO₂.
 - i. The primary bronchi and pulmonary blood vessels enter each lung through a slit on the lung's medial surface, called the hilum.
 - ii. The top, or apex, of each lung extends about ½" (1.5 cm) above the first rib; the base of each lung rests on the diaphragm.
 - iii. The right lung is shorter, broader, and larger than the left. It has three lobes (superior, middle, and inferior) and handles 55% of the gas exchange. The right lung contains two fissures: the horizontal fissure and the oblique fissure.
 - iv. The left lung has only two lobes: the superior and inferior. It contains one fissure (the oblique fissure).
 - v. The lobes are made of lung parenchyma which comprises a large number (~700 million) of thin-walled alveoli, forming an enormous surface area, which serves to maintain proper gas exchange. The membranous outer lining is called pleura (visceral pleura covers the lungs and parietal pleura lines the chest wall).
 - vi. Total lung capacity in an adult male is ~6,000 mL/adult female is ~4,000 mL.
 - vii. Not all inspired air enters alveoli as minor diffusion of O₂ takes place in the alveolar ducts and terminal bronchioles.
 - viii. Tidal volume is the volume of gas inhaled or exhaled during a single respiratory cycle which is about 5-7 mL/kg (500 mL normally).
 - ix. Dead space air is air remaining in air passageways, unavailable for gas exchange (Approximately 150 mL). Anatomic dead space is in the trachea & bronchi. Physiologic dead space is formed by factors like disease or obstruction (COPD, Atelectasis).
 - x. Minute volume is the amount of gas moved in and out of the respiratory tract per minute. It is determined by Tidal Volume (amount of air moved in/out of your lung in a single breath) x Respiratory Rate minus the dead space volume.
 - xi. Inspiratory reserve volume is the deepest breath you can take after a normal breath.
 - xii. Expiratory reserve volume is the maximum amount of air you can force out after a normal breath.
 - xiii. Residual volume is the gas that remains in the lungs just to keep them open, it just does not move during ventilation.

3. Physiology of Respiration

- a. Ventilation is mechanical movement,
- b. Oxygenation is circulatory perfusion,

- c. Respiration is gas exchange diffusion.
- d. Definition/Barriers- Courtesy AAOS, Jones & Bartlett

Definition	Barriers
Ventilation	
<ul style="list-style-type: none"> • The physical act of moving air into and out of the lungs 	<ul style="list-style-type: none"> • Chest trauma (impaired muscles: diaphragm, intercostal muscles, or accessory muscles; damage to airway structures) • Burns (impaired airflow into trachea) • Head or spine trauma (damage to respiratory centers) • Neck trauma (physical damage to airway structures) • Medications that depress the central nervous system • Airway obstruction (physical blockage of airway by any substance—foreign body; tongue; fluid; tissue; swelling from allergic reaction, infection, or asthma) • Bronchoconstriction (from allergic reaction, infection, asthma) • Respiratory disease • Cardiac disease • Neuromuscular disorders • Hypoventilation • Hyperventilation
↓	
Oxygenation	
<ul style="list-style-type: none"> • The process of loading oxygen molecules onto hemoglobin molecules in the bloodstream 	<ul style="list-style-type: none"> • Carbon monoxide (prevents oxygen from binding to hemoglobin) • High altitude (insufficient oxygen in the environment) • Confined space (insufficient oxygen in the environment) • Mine (insufficient oxygen in the environment)
↓	
Respiration	
<ul style="list-style-type: none"> • The exchange of oxygen and carbon dioxide in the alveoli and the tissues of the body 	<ul style="list-style-type: none"> • Anaerobic metabolism • Hypoglycemia • Circulatory compromise (blood loss, pulmonary embolism, pneumothorax, hemothorax, hemopneumothorax) • Anemia

- e. Regulatory Center-respiratory controls are usually an involuntary process.
 - i. Medulla is the primary involuntary respiratory center. It is connected to respiratory muscles by vagus nerve.
 - ii. Pons has the:
 - a) Apneustic center which is the secondary control center if medulla fails to initiate respiration
 - b) Pneumotaxic center which controls expiration via stretch receptors.
 - iii. Lung Receptors –
 - a) Irritant receptors are found in the epithelium in the conducting airways, and sensitive to particulates and noxious gas, and initiate the cough reflex.
 - b) Hering-Breuer Reflex receptors are located in sensitive smooth muscles and decrease ventilation rate and volume thus protecting against excess lung inflation.
 - c) J-receptors are located near alveolar capillaries, are sensitive to increased pulmonary capillary pressure, and initiate rapid shallow breathing, hypotension, and bradycardia.

- iv. Chemoreceptors –
 - a) Central receptors are located near the respiratory centers in the brain and are sensitive to very small changes in hydrogen ion concentration in the CSF. CSF pH reflects PaCO₂ because hydrogen ions diffuse across the blood-brain barrier.
 - b) Peripheral receptors are located in the aortic and carotid bodies and arch of the aorta, and are primarily sensitive to oxygen levels. As PaO₂ and pH decreases they signal increased ventilation.
- v. Miscellaneous stimuli – pain, fear, emotion, illness, medications, drugs, and voluntary.
- vi. All feed into the respiratory centers in the medulla and pons that signal increase or decrease in respiration.
- vii. Hypoxic Drive- occurs when the respiratory stimulus is dependent on oxygen rather than carbon dioxide concentration in the blood.
- f. Measurement of gases
 - i. External Respiration-
 - a) Concentration/percentage of gases in the atmosphere = Nitrogen 78.62%, Oxygen 20.84%, CO₂ 0.04%, Water 0.50%.
 - b) Concentration/percentage of gases in the alveola = Nitrogen 74.9%, Oxygen 13.7%, CO₂ 5.2%, Water 6.2%.
 - ii. Total pressure is the combined pressure of all atmospheric gasses and equals 100% or 760 Torr or 1 atm (1 standard atmosphere) and is measured in ‘mmHg’ at sea level.
 - iii. Partial pressure is the amount of gas in air or dissolved in fluid such as blood. It is measured in millimeters of mercury mmHg).
 - a) In the alveoli (in air) the partial pressure of oxygen (PaO₂) is 104 mmHg and carbon dioxide (PaCO₂) is 40 mmHg.
 - b) In the blood (in fluid) the partial pressure of oxygen (PaO₂) is 80-100 mmHg and carbon dioxide (PaCO₂) is 35-45 mmHg.
- g. Exchange and transport of gases in the body
 - i. Diffusion: Passage of Solution from area of higher concentration to lower concentration.
 - ii. In the alveoli (higher concentration site) dissolved oxygen crosses the pulmonary capillary membrane (to lower concentration site) and binds to the hemoglobin (Hgb) of red blood cell. Oxygen is carried on hemoglobin molecule as well as dissolved in plasma. Approximately 97% of total oxygen is bound to hemoglobin. Because hemoglobin carries 97% of the oxygen delivered to the body tissues, oxygen saturation is an indication of the amount of oxygen available to end organs. This will be further discussed when we talk about monitoring the patient.

- iii. This oxygen-rich blood then flows back to the heart, which pumps it through the arteries to oxygen-hungry tissues throughout the body.
- iv. As oxygen-rich (and carbon dioxide-poor) blood travels by a cell the oxygen diffuses through the cell membrane to the area of lower concentration inside the cell. It can do this easily because the oxygen molecule (O₂) is very small and has no charge or polarity. The oxygen is used up rapidly by mitochondria. This rapid consumption causes oxygen to constantly move into the cell from the blood.
- v. The mitochondria create carbon dioxide (CO₂) as a waste product of cellular respiration (the process that makes energy for your body). Because the CO₂ is of a higher concentration in the cell than in the blood passing by, this gas continually diffuses out of the cell. It too is small and uncharged so it can pass through cell membranes easily. Most of the carbon dioxide dissolves in the plasma of the blood and about 33% is bound to hemoglobin. CO₂ is transported in blood as bicarbonate ion and as O₂ crosses into blood, CO₂ diffuses into alveoli where it is exhaled.

Airway and breathing assessment

1. Essential Parameters- Generally if you can hear breathing when you enter there is a problem.
 - a. Patency- is the airway adequate?
 - i. The gag reflex is a protective mechanism and is strongest in the hypopharynx. Up to 30% of people do not have a gag reflex, thus “testing” the gag reflex is NOT a reliable predictor of airway patency.
 - ii. Snoring respirations usually means there is a positioning problem > resolve with repositioning.
 - iii. Gurgling or bubbling means there are fluids such as blood or vomit in the airway > resolve with suctioning.
 - iv. Stridor- obstruction >resolve by removing object or treat causing factor.
 - b. Rate- normal resting is Adult: 12-20, Children (1-12 y/o): 15-30, Infants: 25-50.
 - c. Regularity- is pattern a regular or irregular inhalation/exhalation rhythm? Any irregularity is significant until proven otherwise.
 - d. Effort- how is the work of breathing (WOB)?
 - i. Breathing at rest should be effortless, and speech is a good indicator.
 - ii. If a patient has an increased WOB they will often compensate by preferential positioning such as: sitting upright in a sniffing with head and chin thrust slightly forward; sitting in a tripod position as they become more tired they may slump back.
 - e. Ventilation-
 - i. Are they hyperventilating at a rate slow for their age range?
 - ii. Are they hyperventilating at a rate fast for their age range?
 - iii. Are their breaths’ tidal volume showing normal full chest rise and fall/chest expansion or are they shallow or deep?

- f. Oxygenation & Respiration
 - i. Are they getting oxygen onto hemoglobin in lungs and off at tissues?
 - ii. Are they cyanotic or displaying air hunger? What is the oxygen saturation reading?
- 2. Assessing Patency, Oxygenation and Ventilation
 - a. Visual signs and symptoms:
 - i. level of consciousness,
 - ii. general appearance,
 - iii. patient in a position to help them breathe? i.e., "tripod", upright with dangling feet,
 - iv. patient visibly anxious, restless, or distressed. This can range from mild to extreme.
 - v. rise and fall of chest equal bilaterally, normal, deep, shallow, or absent?
 - vi. color of skin - cyanosis, cherry red, pale, ashen?
 - vii. flaring of nares,
 - viii. gasping,
 - ix. pursed lips,
 - x. retractions: "pulling in of skin" between thoracic skeleton during inspiration: Intercostal, suprasternal notch, supraclavicular fossa, subcostal.
 - b. Auscultation techniques:
 - i. Do you hear air movement at mouth and nose?
 - ii. Use stethoscope to listen under the clothing over the upper lungs, lower lungs, and major airways (midclavicular and midaxillary lines).
 - c. Palpation techniques:
 - i. For an unresponsive patient can you feel air movement at mouth and nose?
 - ii. Is there subcutaneous emphysema on the chest?
 - iii. Encircle chest wall during inhalation and exhalation to feel for full chest excursion, paradoxical motion, retractions, or grating of ribs.
- 3. Inadequate Ventilation, Oxygenation or Respiration
 - a. Terms & Definitions
 - i. Dyspnea - shortness of breath or difficulty breathing
 - ii. Dyspnea may be result of or result in:
 - a) Hypoxia- Lack of oxygen;
 - b) Hypoxemia- Lack of oxygen to tissues;
 - c) Anoxia- Total absence of oxygen.
 - b. Hypoventilation- slow or shallow breathing that increases the blood carbon dioxide level above normal. It is due to upper or lower airway obstruction, chest wall impairment, neurologic impairment; then carbon dioxide accumulates in the blood when the lungs fail to work properly; with the ultimate manifestation is respiratory arrest followed by cardiac arrest.
 - i. Causes of hypoventilation:

- a) Tongue is the most common airway obstruction, causing snoring respirations, and is corrected with positioning.
- b) Foreign objects may cause partial or full obstruction. Symptoms include choking, gagging, stridor, dyspnea, aphonia (unable to speak), dysphonia (difficulty speaking)
- c) Laryngeal spasm which is spasmodic closure of vocal cords and the glottic opening becomes extremely narrow or totally obstructed. It is most frequently caused by epiglottitis (A Bacterial infection of the epiglottis), anaphylaxis, trauma from over aggressive technique during advanced airway placement, or immediately upon extubation especially when patient is semiconscious. It is relieved by aggressive ventilation, forceful upward pull of the jaw, and ALS use of muscle relaxants.
- d) Trauma may occur in the form of a fractured larynx. Remember airway patency is dependent upon muscle tone and if there is fractured laryngeal tissue this increases airway resistance by decreasing airway size through decreasing muscle tone, laryngeal edema and ventilatory effort.
- e) Tension Pneumothorax (TPTX) causes restrictive ability to ventilate.
- f) Trauma may occur from a flail chest thus causing less chest excursion.
- g) CO levels may cause hypoventilation or be caused by hypoventilation.
- h) Carbon monoxide poisoning- the poison replaces the oxygen in your bloodstream causing cells to be starved of oxygen.
- i) Amyotrophic lateral sclerosis (ALS) is a neurodegenerative condition characterized by progressive muscle weakness and wasting. Breathing difficulties are among the first symptoms of ALS, as the chest muscles and diaphragm that control breathing become affected by the disease.
- j) Guillain-Barre affects the body with weakness of inspiratory and expiratory muscles of respiration leading to poor lung compliance, microatelectasis, hypoxemia, and increased risk of infections due to poor coughing ability.
- k) Botulism is a rare serious illness that affects the nervous system. It occurs when poisonous substances called botulinum toxins produce skeletal muscle paralysis. This paralysis can affect the respiratory muscles. Common are foodborne and wound botulism.
- l) Aspiration significantly increases mortality. It obstructs the airway, destroys delicate bronchiolar tissue, introduces pathogens into the body and results in decreased ability to ventilate.

- c. Hyperventilation- rapid or deep breathing that lowers the blood carbon dioxide level below normal. It occurs when people breathe in excess by increasing their rate. It can be triggered by emotional distress or a medical emergency. It causes numbness in hands, feet, and mouth. Having patient rebreathe carbon dioxide can be dangerous. Treatment can include physiological support, but you should always look for an underlying medical cause.
 - i. Causes of hyperventilation:
 - a) Acidosis- Overdose of aspirin, iron, LSD, cocaine, amphetamines, methamphetamine, or asthma medicines can cause hyperventilation. Diabetic Ketoacidosis (DKA) causes metabolic acidosis resulting in rapid respirations.
 - b) Hyperventilation syndrome- this condition occurs as a response to emotional states, such as depression, anxiety, or anger. When hyperventilation is a frequent occurrence, it's known as hyperventilation syndrome.
 - c) Psychogenic - It only occurs as an occasional, panicked response to fear, stress, or a phobia.
 - d) Underlying Illnesses causes-
 - i) A blood clot, such as a deep vein thrombosis (DVT) or pulmonary embolus.
 - ii) Asthma and chronic obstructive pulmonary disease (COPD).
 - iii) Heart failure.
 - iv) Fluid in the lungs, such as pulmonary edema.
 - v) Infection, such as pneumonia.
 - vi) Scarring of the lungs, such as pulmonary fibrosis.
 - vii) Thyroid problems, such as Graves' disease and hyperthyroidism.
 - viii) Shock.
 - ix) Sepsis.
- d. Respiratory rate/pattern changes:
 - i. Cheyne-Stokes- gradually increase of rate and tidal volume followed by gradual decrease and is associated with brain stem insult.
 - ii. Kussmaul- deep, gasping respirations which is common in diabetic coma, increased intracranial pressure.
 - iii. Central Neurogenic Hyperventilation- deep rapid respirations similar to Kussmaul, indicating increased intracranial pressure.

Basic Airway Management

1. Infectious disease considerations
 - a. Standard Precautions means applying a standard set of protections for EMS personnel coming in contact with germs/pathogens carried by patients.
 - b. Personal Protective Equipment (PPE) must be used as a precaution routinely.

- c. Influenza and other diseases can transmit via the ocular surfaces as well as other mucous membranes. Use PPE to protect the mucous membranes of the eyes, nose, and mouth during procedures and patient care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions.
 - d. Select masks, eye protection/goggles, face shields, and combinations of each according to the need anticipated by the task performed.
2. Recognize need for basic airway management
- a. Measurement has two completely different and separate functions:
 - i. Oxygenation is the transport of O₂ via the bloodstream to the cells. Oxygen is required for metabolism and is measured by use of the pulse oximeter.
 - ii. Ventilation is the exhaling of CO₂ via the respiratory tract. Carbon dioxide is a byproduct of metabolism and is measured by use of end-tidal-CO₂ (ETCO₂).
 - b. Pulse Oximetry relies on the principle of spectral analysis which is the method of analyzing physiochemical properties of matter based on their unique light absorption characteristics.
 - i. For blood absorbance of transmitted light is dependent on the concentration of hemoglobin species.
 - ii. Red and infrared wavelengths are emitted. When positioned to traverse or reflect from a cutaneous vascular bed the opposed photo detector measure light intensity of each transmitted signal. Signal processing exploits the pulsatile nature of arterial blood to isolate arterial saturation. The microprocessor averages the data over several pulse cycles and compares the measured absorption to a reference standard curve to determine hemoglobin saturation which is displayed as a percentage of oxyhemoglobin (SPO₂).
 - iii. Pulse Ox readings should be taken before, during and after any treatment; and ongoing with V/S.
 - iv. Normal Pulse Ox values are between 94 to 100% on room air. Values below 93 to 94% are abnormal and may suggest acute or chronic hypoxia, i.e., COPD. Reliability deteriorates with progressive hypotension below SBP 80 and severe hypoxemia < 65%.
 - v. Signal averaging of 4-20 seconds in most monitors. Delay because of sensor anatomic location and abnormal cardiac performance compound the lag relative to central SaO₂. Forehead probes are closer to the heart and respond more quickly than distal extremity probes. Although most sensors lose reliability during hypotension, hypothermia, hypoperfusion, forehead reflectance probes maintain reliability during these conditions. Thus, a forehead probe is often preferred in management of critically ill patients.
 - vi. It is important to keep a patient's oxygen saturation in a normal range, because declines in saturation result in a reduction in oxygen content.

With 90% saturation, PO₂ drops to 60 mm Hg; with 75% saturation, PO₂ drops to 40 mm Hg; with 50% saturation, PO₂ drops to 27 mm Hg.

vii.

CONDITION	CONSEQUENCE
Poor perfusion associated with dehydration, cold environment, shock	Oximeter may not be able to produce readings under low perfusion conditions.
Nail polish, artificial nails	Inaccurate readings or oximeter may not be able to produce readings.
Movement (seizure, tremors, shivering, wiggling)	Oximeter may not be able to produce readings with motion.
Anemia, carbon monoxide poisoning	Oxygen delivery to tissues is reduced, despite normal oximeter readings.
Bright lights	May be associated with falsely low oximeter readings.

- c. End Tidal CO₂ capnography reads carbon dioxide concentration in exhaled gases which is closely approximate arterial PaCO₂ levels (normally range between 35- and 45-mm Hg). Typically, ETCO₂ is approximately 2 to 5 mm Hg lower than arterial PaCO₂.
 - i. A nasal cannula device for monitoring end-tidal carbon dioxide in a spontaneously breathing patient. Those prongs can also be used to administer a small amount of oxygen or applied underneath a non-rebreather or CPAP mask.
 - ii. In patients who require assisted ventilation, another adapter can be attached to a BVM and advanced airway device. Waveform capnography is a useful tool to identify when patients with an altered mental status need assisted ventilation with a bag valve mask. When the brain does not respond appropriately to CO₂ changes, such as from overdose, head injury or seizure, excess CO₂ accumulates in the lungs, though the ETCO₂ reading may be low or high.
 - iii. Some causes of respiratory failure present with adequate tidal volume but slow respiratory rate, and in these cases ETCO₂ would be high (above 45 mm Hg) and continue to rise if not addressed. Other causes of respiratory failure present with inadequate respiratory rate and depth, and since little exhaled air would reach the sensor on the capnography circuit, the ETCO₂ reading would be low. Once ventilation is assisted with a bag valve mask, ETCO₂ would spike until the excess CO₂ is washed out of the lungs.
 - iv. While a rise in CO₂ should stimulate someone to breathe, no effort should be needed to exhale it. Patients with asthma, COPD, CHF, and pneumonia must often exert themselves to exhale with accessory muscles. It is important to understand that patients in respiratory distress

may inhale enough oxygen and have a normal pulse-ox reading, but still struggle to get air out, and progress to respiratory failure from fatigue. In this group of patients means that their effort is not effectively eliminating CO₂ (hypercarbia), and ETCO₂ may rise or fall depending on tidal volume.

- v. Correctly diagnosing the cause of respiratory distress can be difficult and treating the wrong condition may cause harm. Several conditions can cause diminished breath sounds, wheezing may be heard with both asthma and pulmonary edema, and crackles may be heard with pulmonary edema and pneumonia. Adding waveform capnography to history and physical exam findings can help with treatment decisions.
- vi. In healthy patients, a close correlation exists between ETCO₂ and arterial CO₂ such that ETCO₂ is approximately 2-5mmHg less than PaCO₂. Unfortunately change in ventilation and perfusion alter the alveolar to arterial gradient such that absolute PaCO₂ can be difficult to predict based on capnography.
- vii. The shape of the capnography waveform can provide information about abnormal breathing processes such as hypoventilation, hyperventilation, bronchospasm, and rebreathing; or inadvertent extubation.
- viii. Hypoventilation is a condition in which the production of carbon dioxide exceeds elimination. Waveforms are tall and the ETCO₂ value is correspondingly high (greater than 45 mm Hg). Bradypnea produces a prolonged alveolar plateau (phase III [C-D]) and longer-than-normal intervals between waveforms. Causes of hypoventilation include respiratory depression, or a ventilatory rate that is too slow in an intubated patient.
- ix. Hyperventilation is a condition in which the elimination of carbon dioxide exceeds production. Waveforms are small and the ETCO₂ value is correspondingly low (less than 35 mm Hg). Tachypnea produces a short alveolar plateau (phase III [C-D]) and shorter-than-normal intervals between waveforms. Causes of hyperventilation include anxiety/panic attacks, metabolic acidosis, head injury, pulmonary embolism.

3. Manual airway maneuvers

a. Head-tilt/Chin-lift

- i. Most basic airway maneuver:
 - a) Tilt head back, Lift chin forward, Open mouth.
- ii. Indications:
 - a) Unresponsive patients who:
 - (i) Do not have mechanism for c-spine injury,
 - (ii) Unable to protect their own airway.
- iii. Contraindications:
 - a) Awake patients
 - b) Possible c-spine Injury
- iv. Advantages:

- a) No equipment required.
 - b) Simple.
 - c) Safe.
 - d) Non-invasive.
 - v. Disadvantages:
 - a) Should use second rescuer for Bag Valve Mask ventilation.
 - b) Does not protect from aspiration.
- b. Jaw Thrust
 - i. Head maintained neutral:
 - a) Tilt head back Jaw is displaced forward at mandibular angle.
 - ii. Indications:
 - a) Unresponsive.
 - b) Cervical Spine Injury.
 - c) Unable to protect own airway.
 - d) Resistance to opening mouth.
 - iii. Contraindications:
 - a) Awake patients
 - iv. Advantages:
 - a) No equipment required.
 - b) Simple.
 - c) Safe.
 - d) Non-invasive.
 - e) May be used with cervical collar in place.
 - v. Disadvantages:
 - a) Difficult to maintain.
 - b) Requires second rescuer for Bag Valve Mask ventilation.
 - c) Does not protect from aspiration.
- 4. Insertion of basic airway adjuncts
 - a. Oropharyngeal (oral) Airway
 - i. Purposes: Keep tongue from blocking the upper airway & make it easier to suction the mouth.
 - ii. Indications:
 - a) Unresponsive patients without a gag reflex or
 - b) Any apneic patient being ventilated with a BVM.
 - iii. Contraindications:
 - a) Conscious patients,
 - b) Any patient (conscious or unconscious) with an intact gag reflex.
 - iv. Advantages:
 - a) Non-invasive.
 - b) Easily placed.
 - v. Disadvantages:
 - a) Does not prevent aspiration.
 - vi. Complications:
 - a) Miss-sized adjunct may block airway,

- b) Oropharyngeal, pharyngeal, or dental trauma may occur with poor insertion technique,
 - c) Unexpected gag may produce vomiting.
 - vii. Placement:
 - a) Size from corner of mouth to earlobe,
 - b) Open mouth with cross-finger technique,
 - c) Insert airway with tip facing roof of mouth and slide it in until it touches roof of mouth,
 - d) Rotate airway 180° and continue to insert until flange rests on patient's lips/teeth.
 - viii. Alternate placement method:
 - a) Depress tongue with tongue depressor,
 - b) Insert airway at 90° sideways from corner of mouth,
 - c) Rotate airway, insert exerting gentle pressure on the airway until flange rests on patient's lips/teeth, removing tongue depressor.
- b. Oropharyngeal (oral) Airway
 - i. Purpose: Provides pathway for air from nose to the lower airway
 - ii. Indications:
 - a) Unresponsive patients with or without a gag reflex who is unable to maintain their airway,
 - b) Any apneic patient being ventilated with a BVM.
 - iii. Contraindications:
 - a) Patient intolerance,
 - b) Use caution in patient with facial injury so as to not enter cranial cavity. (lack of airway maintenance in head injury patients has been demonstrated thus creating hypoxic states and cerebral edema).
 - iv. Advantages:
 - a) Non-invasive,
 - b) Easily placed,
 - c) Can be suctioned through,
 - d) Can be tolerated by conscious patients,
 - e) Can be safely placed blindly,
 - f) Does not require mouth to be open.
 - v. Disadvantages:
 - a) Does not prevent aspiration.
 - vi. Complications:
 - a) Improper technique may result in severe bleeding which may be difficult to control.
 - vii. Placement:
 - a) Size from tip of nostril to earlobe,
 - b) Diameter roughly equal to patient's little finger,
 - c) Coat with water soluble lubricant.

- d) Insert into larger nostril with bevel toward septum (may need to rotate if using left nostril).
- e) Gently advance airway until flange rests against nostril.
- f) If resistance is felt, you may need to use the other nostril.

5. Suctioning

- a. Purpose: To clear a path for gas exchange while preventing aspiration. A totally obstructed airway will provide no air exchange so be aggressive. Suctioning the upper airway is critical to prevention of aspirate. Mortality increases significantly if aspiration occurs.
- b. One of the most significant complications of suctioning is that suctioning for prolonged periods can cause hypoxemia. If you have a totally obstructed airway, you must be aggressive with suctioning to clear a path, even partially cleared so that hyperoxygenation may be accomplished followed by repeated suctioning.
- c. Portable units, either hand-operated or battery (ac/dc) must provide enough vacuum pressure and flow to effectively suction the mouth and/or nose.
- d. There are different types of suction devices so make sure you are familiar with all your agency's devices so that suction is not delayed:
 - i. Hand-powered,
 - ii. Ambulance wall-mounted vacuum-powered,
 - iii. Battery or ac/dc powered,
 - iv. Oxygen-powered.
- e. Types of suctioning catheters:
 - i. Hard or rigid catheters:
 - a) AKA: "Yankauer" or "Tonsil Tip",
 - b) Suction large volumes of fluid rapidly,
 - c) Standard Size.
 - ii. Soft catheters:
 - a) Can be placed in Oropharynx, Nasopharynx, or down advanced airways,
 - b) Various Sizes,
 - c) Smaller inside diameter than hard tip catheters.
- f. Procedure reminders:
 - i. You may need to preoxygenate before you suction and/or hyperoxygenate after suctioning with high-flow oxygen via NRM / BVM with hi-flow oxygen to achieve an oxygen saturation at or above 95%.
 - ii. Do not apply suction for more than 15 seconds for an adult, 10 for a child, 5 for an infant.
 - iii. When suctioning trachea with Multi-Lumen Airway in place this may necessitate injection of 3 to 5 mLs of sterile water down advanced airway to loosen secretions.
- g. Suction Assisted Laryngoscopy and Airway Decontamination (SALAD)
 - i. Dr. James DuCanto developed his SALAD technique to quickly clear the airway, eliminating the most common source of intubation failure and reducing the mortality rate associated with aspiration.

- ii. The SALAD technique uses aggressive suction to quickly clear the airway, allowing a first responder or another provider to intubate the patient. The catheter can be left in place during intubation, providing an easy route for removing blood or other contaminants during and after intubation. The technique offers easy access to the trachea, even when patients are continuously vomiting or bleeding.
6. Bag-valve-mask
- a. Use it when:
 - i. Patient is not breathing spontaneously,
 - ii. Patient is breathing too slow,
 - iii. Tidal volume is low,
 - iv. Apnea,
 - v. Hypoventilation,
 - vi. Pulmonary edema,
 - vii. Severe SOB if they will let you,
 - viii. If SpO₂ drops below 94% during the apneic period of Rapid Sequence Intubation (RSI).
 - b. Be cautious and attentive as gastric distention occurs when air becomes trapped in the stomach.
 - i. Very common when ventilating non-intubated patients:
 - a) Stomach diameter increases,
 - b) As abdomen increasingly distends it pushes against diaphragm,
 - c) Interferes with lung expansion causing resistance to BVM ventilation.
 - ii. Prevention:
 - a) Ensure patient's airway is properly positioned.
 - b) Ensure you ventilate at proper rate 1 q 5-6 seconds for adult.
 - c) Ventilate only to see chest begin to rise.
 - iii. Management:
 - a) May be reduced by increasing Bag Valve Mask Ventilation time to 1.5-2 seconds for adults, and 1-1.5 seconds for children.
 - b) Prepare for large volume suction.
 - c. Infectious disease considerations-Bacterial/Viral Filter use:
 - i. A good seal with a viral filter can help reduce aerosolization of infectious diseases.
 - ii. In addition to appropriate personal protection equipment, HEPA viral filtration to reduce aerosolization with BVM or SGA placement is recommended.
 - iii. When performing BVM ventilation, the HEPA viral filter is attached directly to the mask, with the bag attached on the opposite side.
 - d. PEEP increases end expiratory pressures.
 - i. Increases alveolar recruitment in patients with shunting as in pneumonia, pulmonary edema, etc.

- ii. Normal PEEP values range from 5 to 10 cm water
- iii. PEEP should initially be set at 5 cm of water which is the amount of PEEP that is normally present in the airway prior to intubation. Once intubated this pressure is taken away.
- iv. Use care with any PEEP increases as there can be adverse complications:
 - a) Decreased BP due to decreased venous return.
 - b) Increased intracranial pressure.
 - c) Increased intrathoracic pressure leading to pneumothorax or tension pneumothorax.
- e. Ventilation technique
 - i. Best If:
 - a) Ensure you use the proper size mask and bag for the patient,
 - b) You have a good mask seal, so for best seal place the face mask on the face before you attach the bag, pull the mask apart and roll it on to the face,
 - c) Two handed thenar grip is the best way to perform BVM ventilation,
 - d) Use two rescuers to ensure adequate seal of the BVM whenever possible,
 - e) Squeeze the bag as some bags don't deliver O₂ unless squeezed,
 - f) Used with a PEEP valve.
 - ii. Watch for symmetrical rise and fall of the chest.
- f. Assess Difficult BVM Ventilation:
 - i. Radiation- Neck radiation is one of the strongest predictors of difficult ventilation. Radiation therapy to the nasopharynx and neck could cause changes in the stability of the airway and the function of the upper airway dilator musculature, which in turn affect upper airway compliance and resistance.
 - ii. Restriction- Restriction refers to lungs that require higher pressures to ventilate as in COPD, ARDS, or reactive airway with medium and small airway obstructions.
 - iii. Obesity- BMI > 26 kg/m², also in 3rd trimester pregnancy. It results in rapid desaturation, resistance from the weight of chest and abdomen, as well redundant tissue causes airflow resistance.
 - iv. Obstruction- Angioedema. Ludwig's, croup, laryngospasm, cancer, hematoma, foreign objects.
 - v. Obstructive Sleep Apnea (OSA)- Strong association with obesity due to redundant tissue. Occurs when the muscles that support the soft tissues in your throat, such as your tongue and soft palate, temporarily relax. When these muscles relax, your airway is narrowed or closed, and breathing is momentarily cut off. Obstructive sleep apnea (OSA) is a breathing disorder during sleep that has implications beyond disrupted sleep. It is increasingly recognized as an independent risk factor for cardiac, neurologic, and perioperative morbidities.

- vi. Mask seal- Bushy beards can prevent good mask seal, you may try lubricating gel on face to improve seal. Disruption of facial continuity will cause mask seal leaks.
- vii. Mallampati is used to rate how difficult airway intubation may be. EMTs do not necessarily need to commit this to memory as it mainly pertains to ET placement but knowing a rate of 3 or 4 will be difficult so an SGA placement may be the first choice of ALS providers.
- viii. Male gender- difficult to match correct mask size, size of jaw protrusion may be a factor.
- ix. Age- Generally an age over 55 is associated with higher risk of difficult BVM. There may be Loss of musculature and upper airway tissues and loss of elasticity of tissues.
- x. No teeth- Leave dentures in during BVM but remove dentures for Intubation. You may consider inserting gauze in cheek to improve mask seal. You may also roll lower lip down towards the chin and seal mask against inner mucosal surface if necessary.

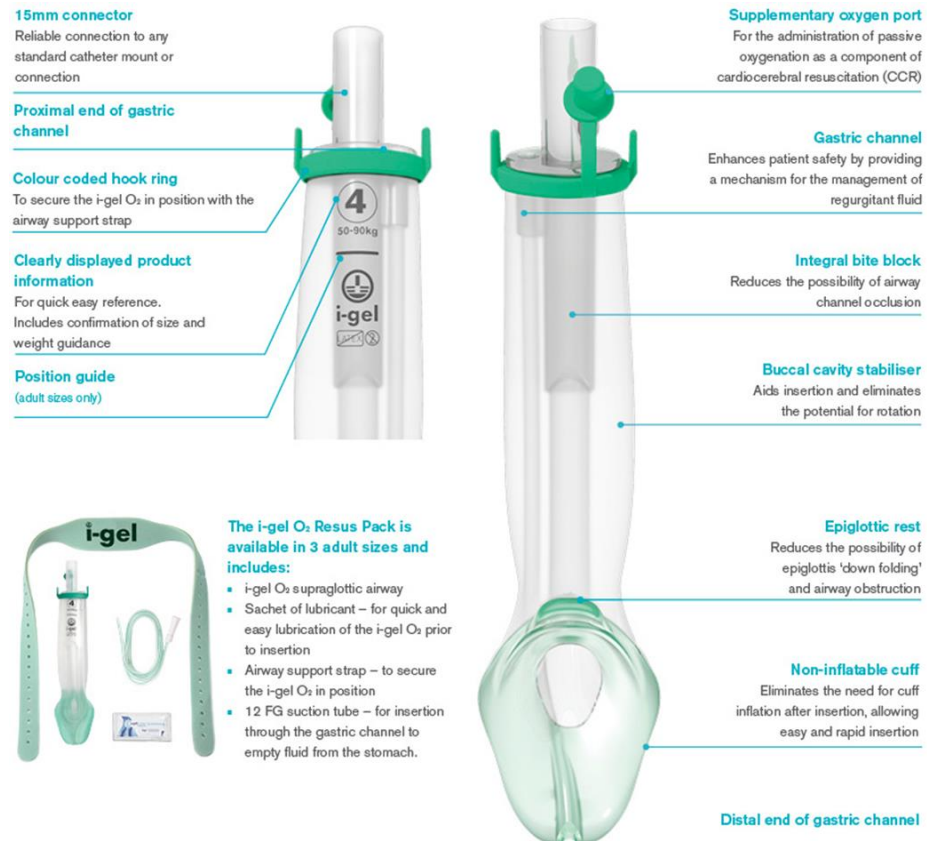
Airway Management with Supraglottic Airway (SGA) (and other adjuncts)

1. Recognize need for advanced airway management.
 - a. Indications
 - i. Failure to protect the airway,
 - ii. Cardiac arrest,
 - iii. Tracheal intubation indicated but unsuccessful or unavailable,
 - iv. Access to the patient is limited (e.g., vehicle entrapment),
 - v. Difficult or emergent airway needed, in which other options may not be feasible.
 - b. Contraindications
 - i. Awake patient,
 - ii. Intact airway reflexes,
 - iii. Caustic substance ingestion,
 - iv. Esophageal trauma or disease,
 - v. Height restriction based on device guidelines.
 - c. Complications
 - i. Aspiration- while the risk of aspiration is lessened, it is not completely eliminated.
 - ii. These devices are designed to isolate the trachea from the esophagus; however, these may not provide a complete seal of the trachea.
 - d. Limitations
 - i. Airway swelling,
 - ii. Airway obstruction,
 - iii. High airway pressures with COPD/asthma.
 - iv. Reports of failure to adequately seat device/ventilate with some devices in the presence of copious secretions, vomitus, bleeding, etc.
2. Supraglottic Airways (SGA) (and other adjuncts) attributes and techniques

a. i-gel- diagram courtesy Intersurgical, Ltd.-

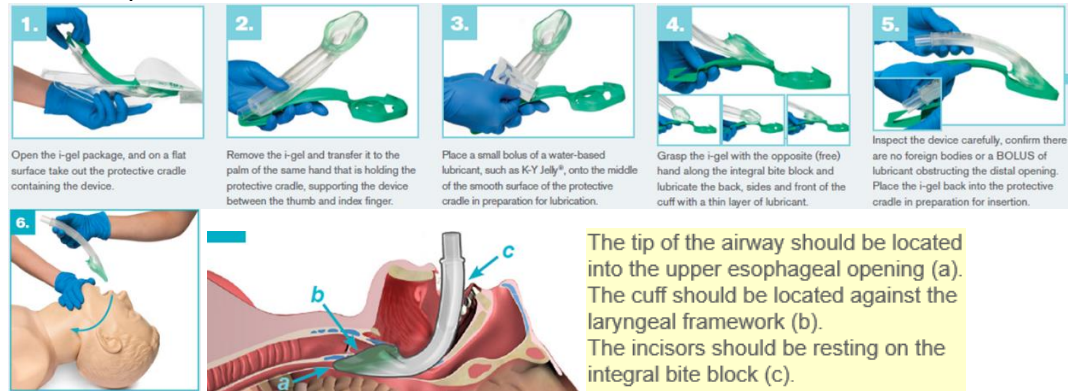
<https://www.intersurgical.com/products/airway-management/i-gel-supraglottic-airway#downloads>

i.



- ii. The i-gel® accurately and naturally positions itself over the laryngeal framework, providing a reliable perilaryngeal seal without the need for an inflatable cuff.
- iii. It provides high seal pressures and reduced trauma, plus incorporates a gastric channel to give additional protection against aspiration.
- iv. The i-gel O₂ Resus Pack contains an i-gel O₂, a sachet of lubricant, airway support strap and gastric tube, all packaged in a specially designed clear, sterile, rigid pack. This unique design ensures protection of the contents, both in transit and in storage.
- v. The color-coded protective cradle ensures the i-gel O₂ is maintained in the correct flexion prior to use. The protective cradle also acts as a base for lubrication.
- vi. Sizes 1 (neonate) to Size 5 (large adult) - 1, 1.5, 2, 2.5, 3, 4, 5.
- vii. Insertion:
Remove the i-gel from the protective cradle or cage pack. Grasp the lubricated i-gel firmly along the integral bite block. Position the device so that the i-gel cuff outlet is facing towards the chin of the patient. The patient should be in the 'sniffing the morning air' position with head

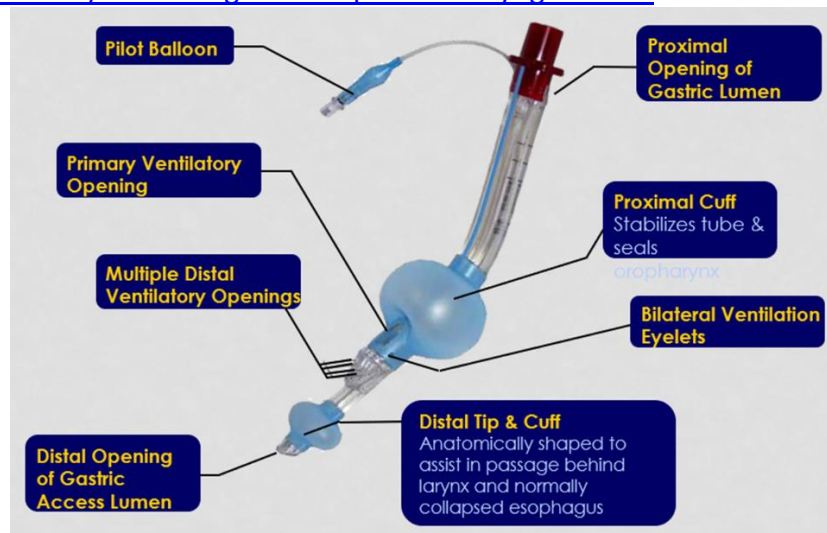
extended and neck flexed. The chin should be gently pressed down before proceeding. Introduce the leading soft tip into the mouth of the patient in a direction towards the hard palate. Glide the device downwards and backwards along the hard palate with a continuous but gentle push until a definitive resistance is felt. Attach bag-valve device to the 15-mm connector. Gently bagging the patient to assess ventilation, confirm proper position by auscultation. Assess for gurgling over the epigastrium, equal chest rise and fall, and bilateral breath sounds. If available, use colorimetric CO₂ detector or end-tidal CO₂ (capnography). Secure the i-gel by taping down onto the patient's face from maxilla to maxilla.



viii. Removal: Once consciousness is regained and protective reflexes such as coughing and swallowing have returned, gently suction around the airway device in the pharynx and hypopharynx. Once the patient is awake or easily arousable with vocal commands, the i-gel can safely be removed by asking the patient to open his/her mouth wide and simply sliding the device out in reverse of the direction it was inserted.

b. King LT-D/LTS-D – diagram courtesy Ambu -

<https://www.ambuusa.com/airway-management-and-anaesthesia/laryngeal-tubes/product/ambu-king-lts-d-disposable-laryngeal-tube>



i.

- ii. The Ambu King LTS-D laryngeal tube is a disposable, simple to use alternative airway device that provides superior patient ventilation. The King LTS-D allows the passage of the gastric tube through a separate channel.
- iii. The King LTS-D is designed with a straightened, beveled distal tip that assists in directing the airway posterior to the larynx and into the upper esophagus. Due to this unique configuration, there is minimal risk of the device entering the trachea.
- iv. A single port inflates both proximal and distal cuffs. The proximal cuff stabilizes the King LTS-D and seals the oropharynx. The distal cuff blocks entry of the esophagus, reducing the possibility of gastric insufflation.
- v. Ventilatory seal pressures of 30cm H₂O or more are achievable with the King LTS-D. Multiple distal ventilatory openings and bilateral ventilation eyelets facilitate air flow.
- vi. Benefits:
 - a) Seals in the esophagus and oropharynx to provide positive pressure ventilation,
 - b) Single inflation port,
 - c) Drain tube for gastric and suction catheters,
 - d) Phthalate and latex free material,
- vii. Color-coded.
- viii. Sizes 0 (neonate) to Size 5 (large adult)- 0, 1, 2, 2.5, 3, 4, 5.
- ix. Insertion:

Open the package and test the integrity of both cuffs. Pull the plunger back on the syringe to the appropriate volume for the size of the King Airway and attach it to the inflation port. Inflate the proximal and distal cuffs and assess for leaks. Deflate the cuffs, leaving the syringe attached. If a leak is found, discard the device and secure another. Lubricate the King Airway with water-soluble lubricant. Preoxygenate the patient when possible. If no spinal injury is suspected, extend the neck, and position the head in a “sniffing position.” Hold the King Airway at the connector with dominant hand. With nondominant hand, hold mouth open and apply chin lift. With the King Airway rotated laterally such that the blue orientation line is touching the corner of the mouth, introduce tip of the King Airway into mouth and advance behind base of the tongue. As the King Airway passes under the tongue, rotate tube back to the midline so that blue orientation line faces the chin. Without exerting excessive force, advance tube until base of connector is aligned with teeth or gums. Using the syringe provided, inflate the cuffs of the King Airway with the appropriate predetermined volume. Attach bag-valve device to the 15-mm color-coded connector. While gently bagging the patient to assess ventilation, simultaneously withdraw the King Airway until ventilation is easy and free flowing. Depth markings are provided at

the proximal end of the King Airway lumen that refer to the distance from the distal ventilatory opening. Confirm proper position by auscultation. Assess for gurgling over the epigastrium, equal chest rise and fall, and bilateral breath sounds. If available, use colorimetric CO₂ detector or end-tidal CO₂ (capnography). Readjust cuff inflation to just seal volume and prevent air leaks. Secure the King Airway to the patient using either tape or a premanufactured tube holder.

Insertion Guide, Step 1

Hold the KLTD/KLTSO at the connector with dominant hand.
 With non-dominant hand, hold mouth open and apply chin lift, unless contraindicated by C-spine precautions or patient position.
 Using a lateral approach, introduce tip into corner of mouth.



Insertion Guide, Step 2

Advance the tip behind the base of the tongue while rotating tube back to midline, so that the blue orientation line faces the chin of the patient.



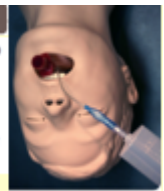
Insertion Guide, Step 3

Without exerting excessive force, advance tube until base of connector is aligned with teeth or gums.



Insertion Guide, Step 4

Inflate cuffs to 60 cm H₂O or to "just seal" volume.
 EMS Kit: Inflate cuffs using the maximum volume of the syringe provided.



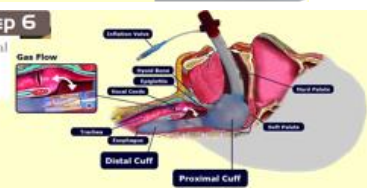
Insertion Guide, Step 5

Attach the breathing circuit/resuscitator bag to the KLTD/KLTSO.
 While gently bagging the patient, withdraw the tube until ventilation is easy and free flowing (large tidal volume with minimal airway pressure).



Insertion Guide, Step 6

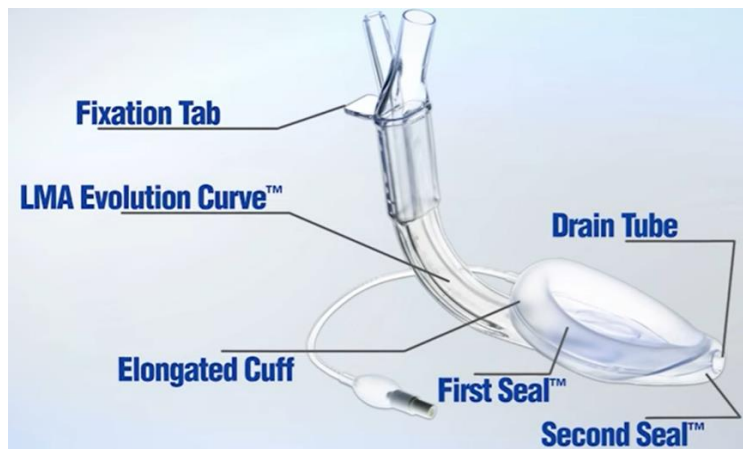
If necessary, add additional volume to cuffs to maximize seal of the airway.



- x. Removal: Once consciousness is regained and protective reflexes such as coughing and swallowing have returned, gently suction around the airway device in the pharynx and hypopharynx. Once the patient is awake or easily arousable with vocal commands, attach the appropriate syringe to the pilot balloon and deflate the cuffs. Suction the pharynx again. Withdraw the device out in reverse of the direction it was inserted.

c. LMA Supreme – diagram courtesy Teleflex Medical, Ltd.
<https://www.lmaco.com/products/lma%20AE-supreme%E2%84%A2-airway>

i.



- ii. LMA Supreme™ is a single use, second generation, gastric access device which forms an effective First Seal™ with the oropharynx (oropharyngeal seal) and an innovative Second Seal™ with the upper esophageal sphincter (the esophageal seal).
- iii. The importance of the Second Seal™ (esophageal seal) is significant: it can minimize gastric insufflation and reduce the risk of aspiration.
- iv. It has a soft, elongated cuff designed to support an effective First Seal™ and Second Seal™.
- v. It has an elliptical and anatomically shaped LMA Evolution Curve™ (airway tube) facilitates insertion success.
- vi. It has a fixation tab and integral bite block.
- vii. Sizes 1 (neonate) to Size 5 (large adult) - 1, 1.5, 2, 2.5, 3, 4, 5.
- viii. Insertion:
 Open the package and test the integrity of device. Deflate the cuff completely. Once deflated, check the cuff for spontaneous inflation. Do not use the airway if the cuff spontaneously inflates. Deflate the device until the tension in the syringe indicates a vacuum has been created in the mask. Keep the syringe under tension while rapidly disconnecting it from the inflation port. This will ensure the mask remains correctly deflated. Lubricate the posterior surface of the mask and airway tube just prior to insertion. Stand behind or beside patient's head. Place the head in the neutral or slight "sniffing" position. Hold the device, inserting into the mouth, pressing the distal tip against the inner aspect of the upper teeth or gums. Slide inwards using a slightly diagonal approach (direct the tip away from the mid-line). Continue to slide inwards rotating the hand in a circular motion so that the device follows the curvature behind the tongue. Resistance should be felt when the distal end of the device meets the upper esophageal sphincter. The device is now fully inserted. Inflate the cuff with air until relevant intra-cuff pressure is reached. Inflate with just enough air to achieve a seal sufficient to permit ventilation without leaks. Correct placement should produce a leak-free seal against the glottis with the mask tip at the upper esophageal sphincter. The integral bite block should lie between the teeth. To facilitate diagnosis of correct mask placement, place a small bolus (1-2mL) of suitably viscous water-soluble lubricant in the proximal end of the drain tube. In a properly placed mask, there should be a slight up-down meniscus movement of the lubricant following the application and release of gentle pressure in the suprasternal notch. This indicates that the distal end of the drain tube is correctly placed so that it seals around the upper esophageal sphincter (the 'suprasternal notch test'). A similar movement may also be seen when gentle manual positive pressure is applied to the airway through the device. Also, confirm proper ventilation

by auscultation. Assess for gurgling over the epigastrium, equal chest rise and fall, and bilateral breath sounds. If available, use colorimetric CO₂ detector or end-tidal CO₂ (capnography). Secure the LMA Supreme™ to patient's face using adhesive tape as follows: Use a piece of adhesive tape 30-40cm long, holding it horizontally by both ends. Press the adhesive tape transversely across the fixation tab, continuing to press downwards so that the ends of the tape adhere to each of the patient's cheeks and the device itself is gently pressed inwards by the tape. Do not rotate the tape around the proximal end of the device.

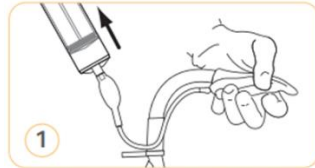


Figure 1: Fully deflate the mask for insertion. Attach a syringe. Compress the distal tip of the mask with thumb and index finger. Apply slight tension to the inflation line while removing all air until a vacuum is felt. Disconnect the syringe.

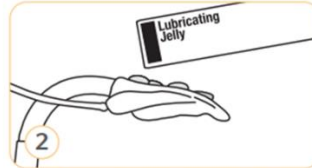


Figure 2: Generously lubricate the posterior surface of the cuff and airway tube.

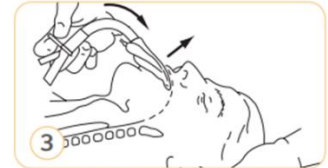


Figure 3: Place the patient's head in a neutral or slight "sniffing" position. Hold the LMA[®] Supreme[™] Airway at the proximal end with the connector pointing downward to the chest and the tip of the distal end pointing toward the palate.



Figure 4: Press the tip of the mask against the hard palate. Maintaining pressure against the palate, continue to rotate the mask inwards in a circular motion following the curvature of the hard and soft palate.



Figure 5: Continue until resistance is felt. The distal end of the mask should now be in contact with the upper esophageal sphincter. The device is now fully inserted.



Figure 6': Maintaining inward pressure, secure the mask into position by taping cheek to cheek across the fixation tab. This should be done prior to inflation. Inflate with the minimum amount of air needed to achieve an effective seal. The recommended intracuff pressure should not exceed 60 cm H₂O.

*Alternatively, taping can be done after the esophageal seal is confirmed. Inward pressure should be applied throughout inflation and ventilation, prior to taping in place.

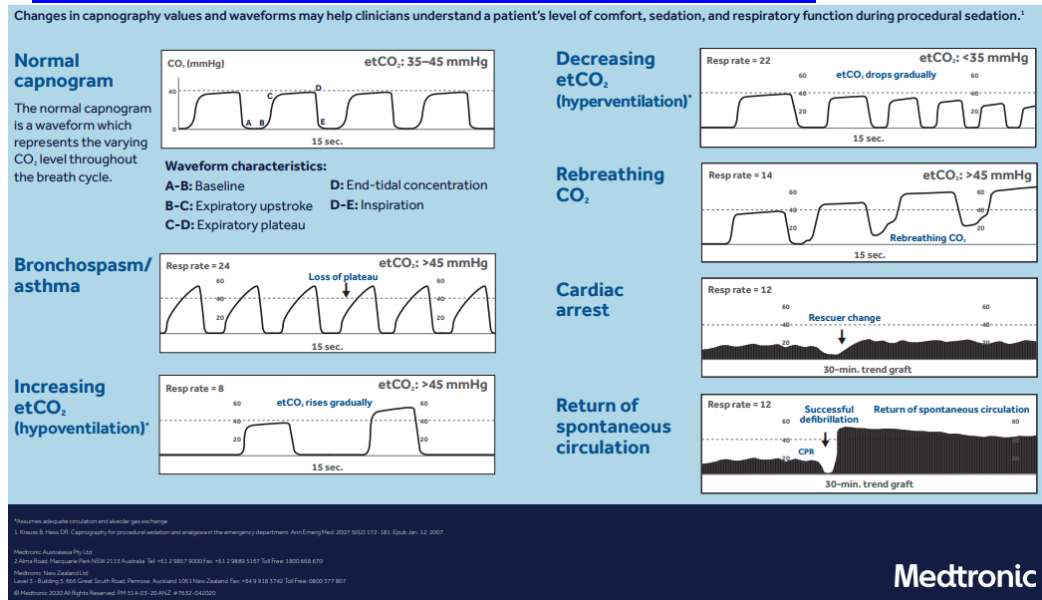
- ix. **Removal:** Once consciousness is regained and protective reflexes such as coughing and swallowing have returned then removal may be considered. It is usually unnecessary to perform suction because the correctly used LMA™ airway protects the larynx from oral secretions. Patients will swallow secretions on removal. Suction equipment should be always available. Deflate the cuff completely just prior to removal, although partial deflation can be recommended to assist in the removal of secretions. Fully deflate the cuff and simultaneously remove the device only when the patient can open the mouth on command.

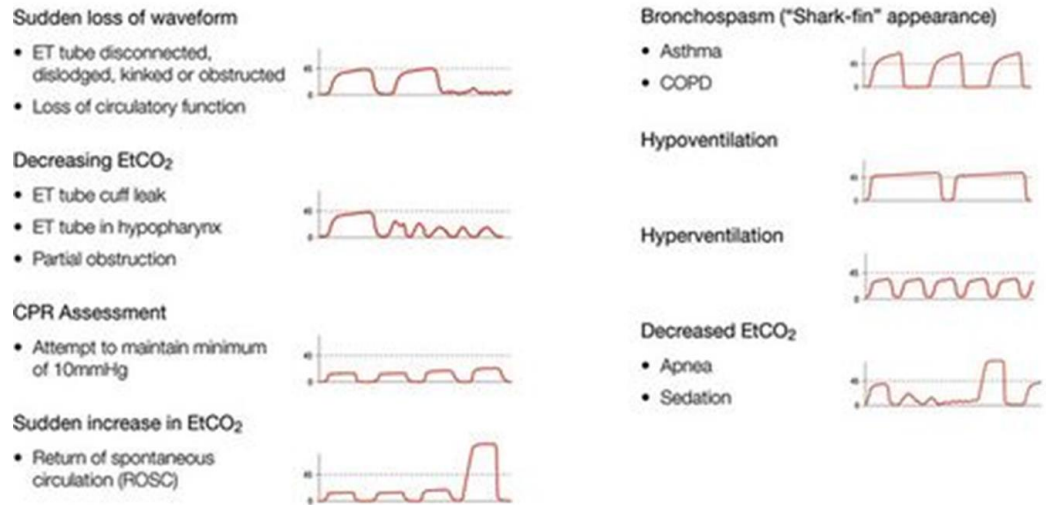
3. Evaluation & ongoing monitoring

- a. Reassessment is a continuous process, and the use of continuous waveform capnography is a must to ensure the SGA is still in place and functioning correctly.
- b. Pulse oximetry measures oxygenation which is the transport of O₂ via the bloodstream to the cells.
 - i. Measures saturation of hemoglobin in the blood.
 - ii. Representative of saturation of heme binding sites (moiety) with oxygen molecules.
 - iii. Each RBC has 4 binding spots for oxygen, so if only 3 binding spots are filling the SPO₂ would be 75%.

- iv. The waveform is called a plethysmograph or “pleth” and should match the pulse so a good pleth makes the number reading more reliable; and a poor pleth should make you question the number.
 - v. It is important to make sure that a waveform is seen on the PO screen and that it coincides with the patient’s pulse. Without a well-defined SpO₂ waveform, there is no way for the machine to accurately perform a reading. If waveform is present, you most likely have a pulse. If it is not present, it means absolutely nothing (unless you had a great reading a second ago).
 - vi. Patients near an SpO₂ of 90% are at risk for precipitous desaturation, as demonstrated by the desaturation the curve.
 - vii. Saturations in the high 90s drop relatively slowly, once the patient hits 88-90 they drop fast, and the blood oxygen levels start to cause damage that may be irreversible.
- c. ETCO₂ capnography measures the ventilation by-product of carbon dioxide via the respiratory system.
- i. Measures CO₂ at the end of exhalation.
 - ii. ETCO₂ matches ventilation rate.
 - iii. Normal number is 35-45 mmHg.
 - iv. Normal form is a box shape.
 - v. Graph courtesy Medtronic.

<https://asiapac.medtronic.com/content/dam/covidien/library/anz/en/pr/oduct/capnography-monitoring/etco2-waveform-poster.pdf>





d. Troubleshooting SGA

- i. These are device dependent.
- ii. If ventilation is adequate but O₂ is inadequate, it could be one/more of these reasons:
 - a) Intrinsic to patient due to tension pneumothorax, mucus plugs or bronchospasm.
 - b) Intrinsic to the device due to an obstruction to the device (mucus, emesis, food) or herniation of the epiglottis into the outlet of SGA.
- iii. Pulmonary edema, infiltrated and high line pressures seen in COPD you may need higher leak pressures than the SGA can provide.

4. Automatic transport ventilator use

- a. Frees hands to perform non-airway-related tasks.
- b. Bag-mask device should always be readily available in case of malfunction.
- c. Most models have adjustments for:
 - i. Respiratory rate, in most cases, is set at the midpoint or average for the patient's age.
 - ii. Tidal volume is estimated using a formula based on 6 to 7 mL/kg.
- d. Delivers a preset volume at a preset ventilatory rate, but it does not guarantee that all of the volume is delivered to the lungs, unless the patient is intubated.
- e. Generally oxygen powered, but some models may require an external power source.
- f. Generally consumes 5 L/min of oxygen; bag-mask device uses 15 to 25 L/min.
- g. Pressure-relief valve can lead to:
 - i. Hypoventilation in patients with inadequate lung compliance.
 - ii. Increased airway resistance.
 - iii. Airway obstruction.
- h. There is a possibility of barotrauma if relief valve fails, or ventilation is overzealous.
- i. Always monitor for proper placement via EtCO₂, SpO₂, chest rise and fall.

- j. Consider aspiration risks and insert a gastric tube if allowed by MPD.
- k. Consider leak pressures from COPD/Asthma, air trapping, or auto PEEP.
- l. Contraindications:
 - i. Airway obstruction,
 - ii. Resistance,
 - iii. Poor lung compliance,
 - iv. Pneumothorax or tension pneumothorax,
 - v. Pulmonary over-pressurization (blast injury, water ascent injury, etc.),
 - vi. Children less than 5 years of age (check manufacturer's recommendations).
- m. Steps for using ATV:
 - i. Attach to oxygen source.
 - ii. Set tidal volume and ventilatory rate per patient's age and condition.
 - iii. Connect to the 15/22-mm fitting on the ET tube or other advanced airway device.
 - iv. Auscultate the patient's breath sounds; observe for equal chest rise.

Practical application skills lab

1. Perform standard precautions during airway management and ventilation
2. Perform manual airway maneuvers
3. Perform technique of suctioning
4. Perform insertion of basic airway adjuncts
5. Perform bag-valve-mask technique
6. Perform insertion of supraglottic airway device(s)
7. Perform removal of supraglottic airway device(s)
8. Demonstrate the techniques to monitor and maintain an SGA device
9. Demonstrate the use of a Bacterial/Viral Filter with an SGA device
10. Demonstrate the use of transport ventilators with an SGA device

Practical application skill evaluation

Supraglottic Airway Device DOH skill form

Skill sheets can also be found in the EMR, EMT, and AEMT level Practical Evaluation Skill Sheet packet, DOH 530-226 [EMR, EMT, AEMT Practical Evaluation Skill Sheets \(wa.gov\)](#)

Appendices

Supplies / Equipment List

You must ensure that all equipment is working adequately throughout the skill lab and examination. All equipment must be disassembled (oxygen supply tubing disconnected, regulator turned off, cuffs deflated with syringes disconnected, etc.) before each student begins. One (1) EMR/EMT Assistant is recommended in this skill.

- PPE equipment- Examination gloves, masks, gowns, and eyewear
- Adult Intubation manikin
- Pediatric Intubation manikin
- Water soluble lubricant (make sure the student knows to verbalize use of this)
- Lubricant (as needed for manikin and SGA type)
- Bag-valve-mask device with reservoir (adult & pediatric)
- End-tidal CO₂ detector capnography monitor
- EDD and/or colorimetric device
- Syringes (10 mL, 20 mL, 35 mL, etc.)
- Oxygen cylinder with regulator (may be empty)
- Oxygen connecting tubing
- Suction device with rigid and flexible catheters and appropriate suction tubing
- Sterile water or saline
- Selection of oropharyngeal airways (pediatric and adult)
- Selection of nasopharyngeal airways (pediatric and adult)
- Supraglottic airway(s) (pediatric and adult):
 - King LT® SGA or similar
 - i-gel SGA
- SGA securing devices (tape or specific to device)
- Tongue blades
- Towels or other appropriate padding
- Stethoscope
- Clipboard
- Pen
- Watch with second hand
- Table for Examiner
- Chair for Examiner
- Skills Sheets for skill
- Essay to be read to the student

Essay for Skill Lab Evaluators/Examiners

This skill is designed to test the student's ability to demonstrate sequentially all procedures from simple maneuvers and adjuncts, ventilation, then placement of a supraglottic airway device on an apneic adult patient with a palpable central pulse and has no other associated injuries. For the purposes of this lab/evaluation, the cervical spine is intact and cervical precautions are not necessary. The manikin(s) must be placed and left on the floor for these skills.

Check all equipment, props, and supplies prior to and during the lab/examination. Brief the EMR/EMT Assistant regarding their level of participation.

Providing consistent and specific testing instructions to each student by reading the "Instructions to the Practical Skills Student" exactly as printed below is recommended.

INSTRUCTIONS TO THE PRACTICAL SKILLS STUDENT FOR SUPRAGLOTTIC AIRWAY

These progressive skills are designed to evaluate your ability to provide immediate and aggressive ventilatory assistance to an apneic adult patient who has no other associated injuries. No trauma is involved, and spinal precautions are unnecessary. You are required to demonstrate sequentially all procedures you would perform, from simple maneuvers and adjuncts to placement of a supraglottic airway device of your choosing.

[Skill examiner now begins to fill out appropriate form and documents which supraglottic airway device the candidate chooses.]

You will have three attempts to successfully place the supraglottic airway device. You must ventilate the manikin for at least 30 seconds with each adjunct and procedure utilized. I will serve as your trained assistant and will be interacting with you throughout these skills. I will correctly carry out your orders upon your direction. Do you have any questions?

Please take a few moments to check your equipment and prepare whatever you feel is necessary.

[After two minutes or sooner if the candidate acknowledges that they are prepared, the skill examiner continues reading the following:]

Upon your arrival to the scene, you observe the patient as he/she goes into respiratory arrest and becomes unresponsive. A palpable carotid pulse is still present. Bystander ventilations have not been initiated. The scene is safe, and no hemorrhage or other immediate problem is found.

You may begin, please tell me when you feel you have completed the skill.

Evaluation form



Supraglottic Airway Device

Candidate Name _____ Date _____

Scenario _____ Actual Time Started: _____ Points Possible _____

Device _____ Points Awarded _____

* Takes or verbalizes appropriate PPE precautions	1	
Opens the airway manually	1	
Elevates tongue, inserts simple adjunct (oropharyngeal or nasopharyngeal airway)	1	
NOTE: The evaluator now informs the candidate, "No gag reflex is present and the patient accepts the adjunct."		
* Ventilates patient immediately with a bag-valve-mask device unattached to oxygen (Award this point if candidate elects to ventilate initially with BVM attached to reservoir & oxygen so long as first ventilation is delivered within 30 seconds)	1	
* Ventilates patient with room air (Award this point if candidate elects to ventilate initially with BVM attached to reservoir & oxygen so long as first ventilation is delivered within 30 seconds)	1	
NOTE: The evaluator now informs the candidate, "Ventilation is being performed without difficulty and the pulse oximetry indicates the patient's blood oxygen saturation is 85%."		
* Attaches oxygen reservoir to bag-valve-mask device and connects to high-flow oxygen regulator (12-15 L/minute)	1	
* Ventilates patient at a rate of 10-12/minute (1 ventilation every 5 - 6 seconds) with appropriate volumes	1	
NOTE: After 30 seconds, the evaluator auscultates and reports "Breath sounds are present and equal bilaterally, and medical direction has ordered insertion of a supraglottic airway. " The evaluator or assistant must now take over ventilation.		
Checks/prepares supraglottic airway device	1	
Lubricates distal tip of the device (may be verbalized)	1	
NOTE: Evaluator/assistant to remove OPA and move out of the way when candidate is prepared to insert device.		
Positions head properly	1	
Performs a tongue-jaw lift	1	
* Inserts device to proper depth	1	
* Secures device in patient [inflates cuff(s) with proper volumes as needed and immediately removes syringe or secures strap]	1	
* Ventilates patient and confirms proper ventilation (correct lumen and proper insertion depth) by auscultation bilaterally over lungs and over epigastrium	1	
Adjusts ventilation as necessary (ventilates through additional lumen or slightly withdraws tube until ventilation is optimized)	1	
Verifies proper tube placement by secondary confirmation such as capnography, capnometry, EDD or colorimetric device	1	
NOTE: The evaluator must now ask the candidate, "How would you know if you are delivering appropriate volumes with each ventilation?"		
Secures device or confirms that the device remains properly secured	1	
Ventilates patient at proper rate and volume while observing capnography/capnometry and pulse oximeter	1	
Passing score is 15 (at least 80%)	TOTAL:	18

Actual Time Ended: _____ Elapsed Time: _____ Max Attempts per Time Allowed: 3 in 6 minutes*

PASS / FAIL

Acknowledgements/Credits/Resources

We want to acknowledge and give credit to the innumerable sources & resources used in the development of this not-for-profit WA DOH SGA training aid.

AAOS-Nancy Caroline's Emergency Care in the Streets- Jones & Bartlett
AAOS-Nancy Caroline's Emergency Care & Transport of the Sick and Injured- Jones & Bartlett
AIME Training
Ambu
American Heart Association
Benjamin Cummings, imprint of Addison Wesley Longman, Inc
BMJ Learning
C.A.M.P. Hilton Head; Jim DuCanto MD, Robert Barrix, Gene Benoit
Capnography.com
Division of Emergency Medicine, Cape Town, South Africa- University of Cape Town; University
Stellerbosch
Elsevier, Drake et al: Grey's Anatomy for Students
EMTPrep.com
Impact Instrumentation
Intersurgical, Ltd
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