# Medical Control Guideline: AIRWAY MANAGEMENT AND MONITORING

## DEFINITIONS:

**Advanced Airway Maneuvers:** Use of a cuffed endotracheal tube (ET) or supraglottic airway (SGA), e.g., i-gel, to facilitate ventilation and/or oxygenation in a patient who is unable to protect his/her own airway or maintain spontaneous ventilation.

**Attempt Advanced Airway Placement:** Insertion of the laryngoscope into the mouth for the purposes of intubation (for endotracheal intubation (ETI)); insertion of the SGA into the mouth.

**Basic Airway Maneuvers:** Manual airway positioning, obstructed airway maneuvers, bag-mask-ventilation (BMV), and/or use of airway adjuncts (nasopharyngeal or oropharyngeal airways) to provide ventilation and/or to facilitate oxygenation in a patient who is unable to maintain adequate spontaneous ventilation.

**Emerging Infectious Disease (EID):** Infectious diseases that have newly appeared in a population or have existed but are rapidly increasing in incidence or geographic range, or that are caused by one of the National Institute of Allergy and Infectious Diseases (NIAID) Category A, B, or C priority pathogens.

**Hypoxia**: Lower than normal oxygen ($O_2$) concentration in the blood resulting in diminished availability of $O_2$ to the body tissues.

**Hyperoxia:** Exposure of cells, tissues and organs to an excess supply of oxygen.

**Hypoventilation**: Ventilation that is inadequate to support gas exchange in the lung.

**Manageable Airway**: Ventilation is effective, such that one of the following holds true:
a. Patient is breathing adequately through a patent airway.
b. Patient is mechanically ventilated effectively via bag-mask-ventilation (BMV), SGA or ET.

**Unmanageable Airway**: The patient is not able to breathe adequately, and EMS personnel are not able to maintain the patient's airway and/or cannot ventilate the patient effectively via BMV, SGA or ET.

**Secure Airway**: The patient's trachea is isolated from the risk of aspiration via a cuffed ET in the trachea.

**Successful Advanced Airway Placement:** Placement of the device such that the patient can be ventilated with minimal or no air leak, confirmed primarily with end-tidal $CO_2$ measurement with capnography. Secondary confirmation methods include visible chest rise during ventilation and air movement on pulmonary auscultation.

## PRINCIPLES:

1. Signs and symptoms of hypoxia may include $O_2$ saturation ($SpO_2$) < 94% with respiratory distress, altered mental status or changes in skin signs.

2. Providing $O_2$ to emergency medical services (EMS) patients may be a lifesaving procedure. Both hypoxia and hyperoxia are potentially harmful; therefore, $O_2$ should be treated like any other drug and administered when indicated.

3. Hypoventilation results in high arterial carbon dioxide ($CO_2$). In general, this results in an end-tidal $CO_2$ > 45mmHg on capnography, but end-tidal $CO_2$ may not reflect arterial $CO_2$ when lung disease and/or increased dead space are present.

4. Basic airway maneuvers should be performed prior to advanced airway maneuvers on patients with hypoventilation.

5. Techniques and procedures utilized for airway management may vary based on operational environment, patient condition and the EMS personnel's level of training and expertise.

6. Patients with unmanageable airway shall be transported to the most accessible receiving facility.

7. In Los Angeles County, endotracheal intubation (ETI) and the supraglottic airway (SGA) i-gel are approved advanced airway options.

8. ETI provides a secure airway. SGAs may not protect the patient from aspiration. However, the device is easier to place than an ET and can provide effective ventilations to most patients in need of an advanced airway.

9. SGA placement is recommended when a patient's medical condition or anatomy predicts likely failure of ETI and in situations where prehospital personnel attempt but are unable to successfully perform ETI. If ventilation via SGA is effective, it should not be removed and replaced with an ET.

10. SGA is the preferred advanced airway for patients experiencing cardiac arrest.

11. Advanced airway placement must be verified and continually monitored.

12. Pulse oximetry and capnography are essential tools for monitoring the effectiveness of airway management. While pulse oximetry monitors oxygenation, it does not assess adequacy of ventilation. Capnography is necessary to monitor ventilation. Capnography is most accurate with proper two-person BMV technique or advanced airway.

13. Hyperventilation (end-tidal $CO_2$ <30 mmHg), by rate or volume or both, should be avoided.

    a. Hyperventilation, when applied inappropriately, increases intrathoracic pressure reducing venous return and cardiac output, and is particularly harmful in low-flow states including cardiac arrest. It results in low arterial carbon dioxide ($CO_2$), which is harmful in multiple conditions, such as mild or moderate traumatic brain injury. Further, it can cause pulmonary injury including barotrauma and increased incidence of acute respiratory distress syndrome (ARDS).

14. Under rare circumstances, targeted mild hyperventilation (end-tidal $CO_2$ 30-35 mmHG) may be indicated for comatose patients with signs of severe traumatic brain injury and impending herniation or to match a patient's physiology in cases of severe metabolic acidosis.

**GUIDELINES:**

1. If pulse oximetry is not available (BLS Unit) and the patient is in mild or moderate respiratory distress, provide $O_2$ with nasal cannula at 2-6 liters per minute.

2. When available, use pulse oximetry to guide oxygen therapy. The desired $SpO_2$ for most non-critical patients is 94-98%. Document pulse oximetry reading.

3. Initiate immediate high-flow $O_2$ (15 L/min) for the following conditions:
   a. Respiratory Arrest (impending or actual)
   b. Cardiac Arrest
   c. Shock/Poor Perfusion (including anaphylactic shock)
   d. Traumatic Brain Injury
   e. Carbon Monoxide Exposure
   f. Suspected Pneumothorax
   g. Hypoxia <94% not corrected with nasal cannula or simple mask

4. If high-flow $O_2$ is indicated, use one of the following $O_2$ delivery system based on the patient's condition:
   a. Non-rebreather mask (NRB)
   b. BMV with reservoir
   c. Endotracheal tube (ET)
   d. Supraglottic airway (SGA)
   e. CPAP per *MCG 1315*

5. For stable patients with mild hypoxia ($SpO_2$ less than 94%), start $O_2$ with nasal cannula at 2-6 L/min or simple mask at 8-10 L/min if available. If patient is unable to tolerate nasal cannula or mask, use blow-by technique with $O_2$ flowing at 15 L/min.

6. Consider the following special populations when titrating oxygen therapy:
   a. Chronic Obstructive Pulmonary Disease (COPD) – goal $SpO_2$ is 88 – 92%
   b. Newborns in need of positive-pressure ventilation – ventilate for 90 seconds with room air, if heart rate remains less than 100 beats per minute, start $O_2$ at 15 L/min
   c. Pediatric Congenital Heart Disease – use $O_2$ with caution if known history of low baseline $O_2$ saturation

7. Continue to monitor $SpO_2$ and titrate $O_2$ therapy as appropriate for the patient's clinical condition until transfer of patient care.

8. Document the $SpO_2$, $O_2$ delivery system used, and the liters per minute administered.

9. If suctioning is required, pre-oxygenate (as applicable) prior to suctioning and do not suction longer than 10 seconds per occurrence. For tracheal suctioning, maintain sterile procedures.

10. Considerations for oropharyngeal airway:
    a. Unresponsive patient requiring BMV – should be utilized in all such patients where gag reflex is absent

b. In pediatric patients, placement may not be necessary to achieve adequate ventilation

11. Considerations for nasopharyngeal airway:
    a. Spontaneously breathing patients who require assistance in maintaining a patent airway (e.g., seizure patient, intoxication)
    b. Unresponsive patients requiring BMV in whom an oropharyngeal airway cannot be inserted

12. Considerations for BMV:
    a. Apnea or agonal respirations
    b. Altered level of consciousness with hypoventilation or hypoxia despite maximal supplemental $O_2$

13. Considerations for ETI:
    Adults or Pediatrics 12 years or greater, or longer than the length-based resuscitation tape (e.g., Broselow Tape™)
    a. Ineffective ventilation with BMV
    b. Prolonged transport time
    c. Risk for aspiration
    d. Other determined need for advanced airway and SGA contraindicated

14. Considerations for SGA i-gel:
    a. Adult and pediatric patients experiencing respiratory and/or cardiac arrest with ineffective BMV
    b. Adult and pediatric patients experiencing respiratory arrest after initial BMV
    c. Adult and pediatric patients experiencing cardiac arrest after initial priorities of the resuscitation are met including:
        - Shockable rhythms: defibrillation x2
        - Nonshockable rhythms: epinephrine x1 and reversible causes addressed prn
        - Traumatic arrest: hemorrhage control and transport initiated
    d. Adult and pediatric patients after return of spontaneous circulation
    e. Need for advanced airway and suspected difficult ETI based on assessment and anatomical features
    f. Unsuccessful attempts (maximum three attempts) at ETI (with or without the use of a flexible introducer guide)

15. i-gel size is based on patients ideal body weight *(MCG 1309).* Patients in between sizes may require changing sizes if the initial selection results in leak. Initial size should be based on the table below.

| i-gel size selection | | |
|---|---|---|
| **Patient Weight** | **Patient Size** | **i-gel Size** |
| 2-5 kg | Neonate | 1 |
| 5-12 kg | Infant | 1.5 |
| 10-25 kg | Small Pediatric | 2 |
| 25-35 kg | Large Pediatric | 2.5 |
| 30-60 kg | Small Adult (short <5ft) | 3 |

| | | |
|---|---|---|
| 50-90 kg | Medium Adult (average 5-6ft) | 4 |
| 90+ kg | Large Adult (tall >6ft) | 5 |

16. Considerations for stoma intubation:
    Adult patients with obstruction unrelieved by suctioning and replacing inner cannula. For pediatric patients, and for adult patients in which a new tube cannot be placed, utilize bag mask ventilation via mouth (while covering the stoma) or stoma (if no chest rise with mask over mouth).

17. Verify endotracheal tube or SGA placement utilizing capnography. In case of device failure use an End-tidal $CO_2$ detector. Document the method used for placement verification.

18. Additional confirmation of endotracheal tube placement shall include **all** of the following:
    a. Bilateral lung sounds
    b. Bilateral chest rise
    c. Absent gastric sounds
    d. Pulse oximetry

19. Continuously assess ventilation status and monitor capnography for all patients requiring BMV or advanced airway placement. Report capnography reading to the base hospital and document capnography reading as follows:
    a. Every five minutes during transport
    b. After any patient movement
    c. With any change in patient condition
    d. Upon transfer of care

20. Ventilation should be performed at the correct rate and tidal volume according to the age and size of the patient.
    a. Rate should target the lower range of normal by age.
    b. Tidal volumes should be 6-8ml/kg, which is approximated by squeezing the bag just sufficiently to observe chest rise.
    c. Ventilation shall be regulated by use of a manometer and/or airflow meter device.
        i. To ensure appropriate ventilatory pressure, a manometer at target pressures of <20 $cmH_2O$ is recommended, with pressure >40 cm most harmful. Pressures between 20-40 cm may be needed to ventilate some patients but with caution.
        ii. To ensure appropriate ventilatory volume, use of an airflow meter device is recommended, especially when using a bag with >1000mL volume.

| Approximate Ventilation Rates and Volumes | | |
|---|---|---|
| **Patient Size** | **Rate (bpm)** | **Tidal Volume (mL)** |
| Neonate | 40 | 30 (2 tbsp) |
| Infant | 30 | 40-80 (3-5 tbsp) |
| Small Pediatric | 20-25 | 150-250 |
| Large Pediatric | 20-25 | 250-350 |
| Small Adult (short <5ft) | 10-12 | 400-450 |

| | | |
|---|---|---|
| Medium Adult (average 5-6ft) | 10-12 | 450-500 |
| Large Adult (tall >6ft) | 10-12 | 500-550 |

21. Apply a viral filter during positive-pressure ventilation for patients with suspected communicable respiratory illness (e.g., COVID-19, influenza) and to all patients during periods of respiratory or emerging infectious disease surge (as supplies allow).

22. Sedation may be administered by paramedics as needed during transport of intubated patients. This sedation may only be administered after the patient is intubated and may not be administered to facilitate intubation.
    Adult Dose:
    **Midazolam (5mg/mL) 5mg**, may repeat in 5 min x1, maximum total dose prior to Base contact 10 mg
    Pediatric Dose:
    **Midazolam (5mg/mL)** per *MCG 1309*, may repeat in 5 min prn x1, maximum 2 doses prior to Base contact