	EMS STANDARD OPERATING GUIDELINES	
	SUBJECT	**End-Tidal CO_2 Detection/Monitoring**
	TOPIC:	**Capnography**
	REFERENCE NUMBER	**SOG-08-03**
	EFFECTIVE DATE	**October 1, 2008**
	Signature of Approval	Frank E. Wright, Fire & Rescue Chief
	Signature of Approval	C. Christopher Turnbull, MD Operational Medical Director

Introduction: Providing quality Emergency Medical Treatment to the community is a priority of the Winchester Fire and Rescue Department. Advancing technologies in Emergency Medical Treatment will provide us with opportunities to advance the quality of service provided. Through research of new technology and treatments, proactive training, and active involvement from our Operational Medical Director we can provide our community with quality Emergency Medical Treatment.

Purpose: To establish a guideline outlining when End-Tidal CO_2 Detection/Monitoring (Capnography) should be utilized during patient treatment activities.

Responsibility: All Emergency Medical Services personnel should be familiar with the equipment, supplies, methods, and reasoning for End-Tidal CO_2 Detection/Monitoring. Although this is a valuable tool in providing quality treatment to patients, End-Tidal CO_2 Detection/Monitoring is not used for diagnostic purposes.

Indications

1. Confirmation, monitoring and documentation of endotracheal and King LT-D intubation.
2. Assessment, monitoring and documentation of the respiratory status of the non-intubated patient experiencing respiratory distress including, but not limited to asthma and COPD.

Contraindications

None

Procedure – Intubated Patients

1. Confirm tube placement via auscultation over the epigastrium, auscultation of the chest at the bases and apices for equal bilateral lung sounds, observe for symmetrical rise and fall of the chest, look for condensation in the tube with an exhaled breath.
2. Use a secondary confirmation device to verify proper tube placement (i.e. End-Tidal CO_2 Detection, Colormetric, and Esophageal Detector Device).

3. After verifying proper tube placement, replace the secondary confirmation device with the capnography device.
4. Secure the endotracheal tube and resume ventilations at the appropriate rate. Do not use continuous hyperventilation.
5. Observe the waveform and numerical values that appear during exhalation after a total of 6 ventilations.
6. $ETCO_2$ numerical values and corresponding capnograph should be compared to normal values and morphology.

Procedure – Non-Intubated Patients

1. Patients should be assessed, oxygenated and ventilated with the appropriate delivery device dependent upon their presenting degree of respiratory distress or obstruction.
2. Interface the End-Tidal CO_2 sampling device with the oxygen delivery device being used (i.e., nasal sampling device used under a non-rebreather mask, $ETCO_2/O_2$ nasal cannula used on a patient requiring less than or equal to 6 LPM).
3. Observe for a waveform and numerical values to appear during exhalation after a total of 6 breaths.
4. $ETCO_2$ numerical values and corresponding capnograph should be compared to normal values and morphology.

   NOTE: $ETCO_2$ monitoring should be discontinued while administering nebulized medications.
5. $ETCO_2$ numerical values and capnographs should be monitored following medication administration to determine the patient's response to the intervention and the need for additional intervention.

Considerations

1. Capnography is only an adjunct to careful patient assessment.
2. Do not use capnography as the sole method of assessing correct tube placement, especially in a pulseless patient.
3. Capnography may not indicate right mainstem bronchus intubation or pyriform placement.

The diagram below shows the shape of a normal capnogram.
Normal $ETCO_2$ Values
35 – 45 mmHg

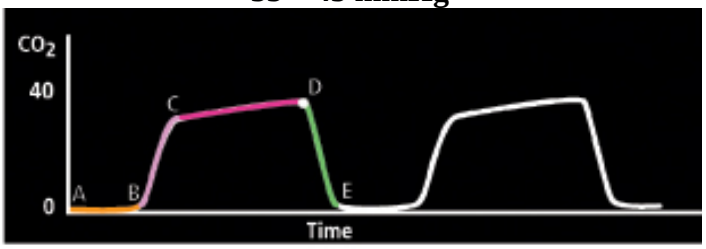
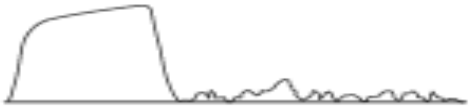


Figure 1: A normal capnography waveform

Sudden loss of $ETCO_2$ to zero, or near zero:

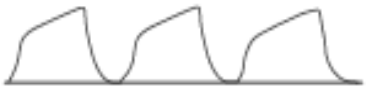


Possible causes:
Airway disconnection
Dislodged ET tube/esophageal intubation
Totally obstructed/kinked ET tube
Complete ventilator malfunction

Sustained low $ETCO_2$ with good alveolar plateau:

Possible causes:
Hyperventilation
Hypothermia
Sedation, anesthesia
Dead space ventilation

Elevated $ETCO_2$ with good alveolar plateau:



Possible causes:
Inadequate minute ventilation/hypoventilation
Respiratory-depressant drugs
Hyperthermia, pain, shivering

Gradually increasing $ETCO_2$:

Possible causes:
Hypoventilation
Rising body temperature/malignant hyperthermia
Increased metabolism
Partial airway obstruction
Absorption of CO_2 from exogenous source

Exponential decrease in $ETCO_2$:

Possible causes:
Cardiopulmonary arrest
Pulmonary embolism
Sudden hypotension or massive blood loss
Cardiopulmonary bypass

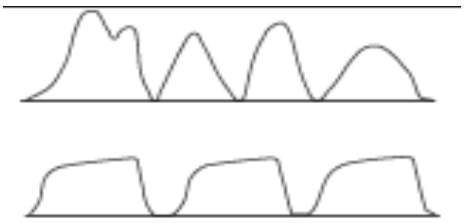
Sudden decrease in $ETCO_2$ to a low, non-zero, value:

Possible Causes:
Leak in the airway system
ET tube in hypopharynx
Poorly fitting anesthetic mask
Partial airway obstruction
Partial disconnect from ventilator circuit

Rise in baseline and $ETCO_2$:

Possible causes:
Defective exhalation valve
Rebreathing of previously exhaled CO_2
Exhausted CO_2 absorber

Spontaneous breathing during mechanical ventilation:



Spontaneous breathing efforts may be evident on the CO_2 waveform display. The patient on the top demonstrates poorer quality spontaneous breathing effort than the patient on the bottom.