In July 2013, the Journal of Emergency Medicine published an article titled, “Capnography for the Non-intubated Patient in the Emergency Setting.” In the article, Craig A. Manifold, D.O., et al., describe common use case scenarios for monitoring end-tidal CO$_2$ (etCO$_2$) in intubated patients. The authors also identify opportunities where capnography may be beneficial for detecting adverse patient conditions, measuring respiratory rates and adequacy of ventilation, and offering potential cost savings when providing non-invasive or non-intubated patient care. In 2010, the American Heart Association (AHA) published a Class 1 Recommendation for the use of capnography during cardiopulmonary resuscitation to monitor expired CO$_2$ (ventilation) on intubated patients. Capnography can also be an effective tool for monitoring ventilation with supraglottic airways. During a resuscitation event, etCO$_2$ monitoring provides real-time information about chest compression effectiveness and return of spontaneous circulation (ROSC). Use of capnography on intubated patients has been well documented; however, there is significant opportunity to enhance patient care and improve patient safety in the EMS environment with the utilization of etCO$_2$ in the non-intubated patient.

In EMS, potent narcotic analgesics and benzodiazepines are commonly used for pain management, seizure management and sedation. Respiratory depression is a known side effect of these drugs and supplemental oxygen administration is common practice. Undetected hypoxic events from the administration of narcotic analgesics and benzodiazepines can have lethal implications. Several studies referenced in the Manifold, et al. article demonstrated that abnormally high levels of CO$_2$ (hypercarbia) can exist in the presence of normal oxygenation. In one study cited, capnography gave advanced warning for low oxygenation (hypoxia) conditions in all 132 adult patients. Capnography was 100% sensitive for predicting hypoxia. In 2011, the American Society of Anesthesiologists (ASA) instituted a standard that requires the adequacy of ventilation be measured by exhaled carbon dioxide. This ASA standard, considered a minimum requirement for clinical practice, includes the use of capnography for moderate or deep sedation.

The Manifold, et al. article surmises there may be cost efficiencies in the EMS environment when capnography is used to monitor diabetic patients with ketoacidosis (DKA) and for patients with pulmonary embolism (PE). The authors suggest that using capnography to monitor etCO$_2$ on patients with DKA can result in fewer blood draws, resulting in economic savings. Additionally, the authors conclude that when used in conjunction with other diagnostic tests, capnography monitoring can offer cost savings by reducing unnecessary CT scans for patients with PE. According to the article, respiratory rates are inherently inaccurate and can affect emergency patient care. Patients actively seizing make evaluating respiratory rates and adequacy of ventilation difficult. CO$_2$ measurements via a nasal-oral sampling cannula can easily and rapidly provide an accurate assessment of respiratory rate and ventilation status in seizing and post-ictal patients.

A potentially helpful suggestion is to use the capnography waveform (capnogram) as a bio-feedback coaching tool to help lucid, but anxious and hyperventilating patients control their breathing. When patients are instructed to watch their breathing activity on the monitor, they can see their etCO$_2$ level rise and respiratory rate decrease.
Manifold, et al. conclude by stating that etCO$_2$ is safe, non-invasive, inexpensive, and rapidly performed. The authors further state that capnography is an essential tool for evaluating patients in the emergency setting.$^5$

**Summary**

Capnography has been clinically recommended for use in the EMS environment for monitoring an intubated patient. Moreover, etCO$_2$ has been shown to provide clinical utility and benefit beyond the intubated patient or simply as a “tube checker.” Non-invasive etCO$_2$ monitoring can be used for measuring respiratory rate and adequacy of ventilation in patients with DKA, PE, anxiety, or for patients actively seizing or post-ictal. Monitoring etCO$_2$ should be considered for use in all narcotic analgesia and benzodiazepine administration for pain management, seizure control or sedation in EMS.

By using Microstream*-enabled etCO$_2$ monitoring technology from Covidien, EMS care providers have access to more accurate respiratory rates, CO$_2$ values, and breath-by-breath waveforms in intubated (endotracheal tube and supraglottic airways) and in non-intubated patients. FilterLine® sampling lines, used with Microstream-enabled capnography monitors, are cost effective, simple to use, and typically well tolerated by the non-intubated patient.

Microstream capnography offers an effective tool for EMS clinicians to help recognize respiratory distress earlier and more quickly provide intervention.

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