End Tidal Carbon Dioxide (EtCO₂) Monitoring (Capnography) for the Non-intubated Patient Receiving Pain and Sedation Therapies

PURPOSE
To provide guidelines for capnography monitoring of non-mechanically ventilated patients.

Capnography is an additional tool in the systematic assessment of sedation in a patient, resulting from the use of pain or sedation management therapies or having co-morbidities that increase their risk for respiratory depression. Capnography will supplement, but not replace, the use of the Pasero Opioid-Sedation Scale (POSS).

Capnography monitoring enables the practitioner to assess the quality of ventilation and allows early detection of possible respiratory compromise in patients who are at risk for respiratory depression.

To provide continuous assessment of patients’ physiologic responses to deep sedation for procedures outside of the operating room.

DEFINITIONS
American Society of Anesthesiologist (ASA) Physical Status
The ASA physical status is a classification system with the purpose of assessing the degree of a patient’s physical state prior to selecting the anesthetic or prior to performing surgery.

ASA Physical Status 1 - A normal healthy patient
ASA Physical Status 2 - A patient with mild systemic disease
ASA Physical Status 3 - A patient with severe systemic disease
ASA Physical Status 4 - A patient with severe systemic disease that is a constant threat to life
ASA Physical Status 5 - A moribund patient who is not expected to survive without the operation
ASA Physical Status 6 - A declared brain-dead patient whose organs are being removed for donor purposes

Capnography
Capnography is the measurement of inhaled and exhaled carbon dioxide concentrations. A photodetector measures CO₂ content and relays this information to a microprocessor in the monitor. The monitor converts this data to a CO₂ value and a corresponding waveform, or capnogram is displayed.

Capnogram
A capnogram is a real time waveform record of the concentration of carbon dioxide in respiratory gases.

CO₂ Detector
A CO₂ detector is used to verify proper endotracheal tube (ETT) placement by providing an immediate visual verification of exhaled CO₂ color change. Capnography differs in that it is quantitative and has a value and a waveform.
End-tidal Carbon Dioxide (EtCO₂)
End-tidal carbon dioxide (EtCO₂) is the carbon dioxide (CO₂) concentration in exhaled gas. EtCO₂ monitoring involves measuring the amount of infrared light absorbed by airway gas during inspiration and expiration, providing information about a patient’s pulmonary, cardiac, and metabolic status. Such information aids patient management and helps prevent clinical compromise. A normal value of exhaled CO₂ is in the range of 30-43mmHg.

EtCO₂ Modules
A EtCO₂ module enables continuous respiratory and end tidal CO₂ monitoring to reduce the risks of respiratory depression.

Opioid
An opioid is a synthetic compound that resembles the naturally occurring opiates or any substance that binds to or otherwise affects the opiate receptors on the surface of the cell. Opioid analgesics are used to relieve pain for a variety of conditions, and are listed by the DEA/FDA as a schedule II drug.

Opioid Naïve Patient
Opioid naïve are patients who do not meet the definition of opioid tolerant.

Opioid Tolerant Patient
A patient who is taking at least 60 mg of oral morphine/day, 25 mcg transdermal fentaNYL/hour, 30 mg oral oxyCODONE/day, 8 mg oral HYDROmorphine/day, 25 mg oral oxymorphone/day or an equianalgesic dose of another opioid for one week or longer.

Pasero Opioid-Sedation Scale (POSS)
The POSS is a scale that is used to assess sedation caused by opioids.

0 = Sleep, easily aroused
   Acceptable; must wake patient to assess; no action necessary; may increase opioid dose if needed

1 = Awake and Alert
   Acceptable; no action necessary; may increase opioid dose if needed

2 = Slightly drowsy, easy to arouse
   Acceptable; no action necessary; may increase opioid dose if needed

3 = Frequently drowsy, arousable, drifts off to sleep during conversation
   Unacceptable; monitor respiratory status and sedation level until within normal limits; notify prescriber to decrease opioid dose 25% to 50%; consider alternatives such as NASIDs

4 = Somnolent, minimal or no response to verbal and physical stimulation
   Unacceptable; stop opioid; call Rapid Response Team if indicated; stay with patient until respiratory status and sedation level are within normal limits
Respiratory Depression
A reduction in alveolar ventilation due to a decrease in respiratory rate or tidal volume resulting in an increase in the partial pressure of carbon dioxide (PaCO₂) in the arterial blood.

Minimal Sedation (anxiolysis)
Anxiolysis is a drug-induced state during which patients respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected.

Moderate Sedation/Analgesia (conscious sedation)
Moderate sedation is a drug-induced depression of consciousness during which patients respond purposefully to verbal commands, either alone or accompanied by light tactile stimulation. No interventions are required to maintain a patent airway, and spontaneous ventilation is adequate. Cardiovascular function is usually maintained.

POLICY
Capnography is the quantitative analysis of EtCO₂ and has a value and waveform and should not be confused with a colorimetric EtCO₂ detector which indicates proper endotracheal tube placement by the color change of exhaled CO₂.

Patient Selection
1. Exemptions from capnography monitoring:
   • Patients requiring end of life or comfort care only
   • Patient on mechanical ventilation
   • Patient refusal- A physician is to be notified of patient refusal and appropriate documentation must be made.

2. Capnography monitoring is required on the following patients:
   • Patients receiving deep sedation for invasive/diagnostic procedures outside of the operating room (by non-anesthesia personnel)

3. Capnography monitoring is strongly suggested for:
   • Patients receiving continuous (basal dosing) infusion PCA therapy
   • Patients diagnosed with sleep apnea and not receiving CPAP

4. Capnography is highly recommended for patients receiving continuous epidural therapy for pain (obstetrics excluded).

5. Capnography monitoring may be considered for the following patients:
   • Post-operative bariatric and spinal surgery patients
   • Pre-existing pulmonary/cardiac disease or dysfunction (COPD, asthma)
   • Large incisions that may interfere with adequate ventilation such as thoracic or abdominal surgeries
   • American Society of Anesthesiologist ASA status 3-5
• Patients currently receiving suboxone
• Recent naloxone administration
• Patients with an increased opioid dosing requirement, when the patient is:
  o Opioid naïve and requires high doses of opioids
  o Opioid tolerant and requires significant amounts of opioids in addition to their baseline dose
• Patients receiving continuous opioid infusions with any of the following characteristic:
  o Opioid naïve
  o BMI greater than 40
  o Greater than 64 years of age
• Consideration of patients with any of the characteristics potential for sleep apnea
  o History of snoring or witnessed apnea
  o Neck circumference greater than 17.5 inches

Ordering
1. Capnography monitoring can be ordered by the non-physician practitioner, anesthesia provider and physician for patients meeting the above outlined criteria.

   a. The provider may select capnography monitoring in eCare for the non-intubated, which will fire a task for nursing or for the intubated patient, which fires a task for respiratory therapy.

2. Exception to this: At SJHMC, pharmacists may order capnography monitoring for patient’s receiving PCA therapy.

3. Capnography should be discontinued by the ordering provider when the patient’s condition no longer warrants its use.

Monitoring
1. Assess monitoring parameters, CO₂ waveform and numeric measurement, to evaluate gas exchange:
   a. Waveform for each respiratory cycle
      • Height (amount of exhaled carbon dioxide)
      • Frequency
      • Rhythm
      • Baseline (no carbon dioxide in breath)
      • Shape
   
   b. Numeric value measurement
      • EtCO₂ level in mmHg
   
   c. Identify and document any abnormal numeric measurements or waveforms in the patient's medical record and notify provider.

2. Vital Signs
a. Baseline blood pressure, heart rate, respiratory rate, oxygen saturation (SpO₂), POSS, and EtCO₂ will be obtained prior to sedation or opioid infusion, then as ordered by provider during procedure or while on continuous opioid infusion.

3. Obtain ABG with any sudden increase or decrease of 10mmHg in EtCO₂ reading and when patient’s condition and EtCO₂ readings differ.

4. Monitor for changes in factors that may increase or decrease the EtCO₂:
   a. Decrease the EtCO₂
      • Decreased muscular activity (muscle relaxants)
      • Hypothermia
      • Decreased cardiac output and cardiac arrest
      • Pulmonary embolism
      • Mucus plug
      • Bronchospasm
      • Increased minute ventilation caused by either an increase in respiratory rate / tidal volume
      • Decreased metabolic rate
      • Equipment related factors
   b. Increase EtCO₂
      • Hyperthermia and increased muscular activity (shivering)
      • Malignant hyperthermia
      • Increased cardiac output (during resuscitation)
      • Bicarbonate infusion
      • Opioids and sedatives (including benzodiazepines, ketamine, and etomidate)
      • Alcohol
      • Tourniquet release
      • Effective drug therapy for bronchospasm (allowing patient to exchange CO₂ for oxygen)
      • Decreased minute ventilation caused by either a decrease in respiratory rate / tidal volume
      • Increased metabolic rate
      • COPD
      • Equipment related factors

5. Alarm limits should be set for each patient care area.
   a. Avoid nuisance alarms by reviewing trend data and adjusting alarm limits as needed.

   b. Notify provider if patient values go above or below the alarm limits.

6. Any compromise in the patient’s respiratory status, notify Respiratory Therapy and provider.

7. Continue monitoring for 30 minutes after sedation or opioid infusion is completed.
Documentation
Documentation will either be in eCare or on paper depending on a patient clinical care area
1. Nursing will document EtCO\textsubscript{2} values:
   • With each vital sign
   • Whenever there are significant changes in:
     o waveform
     o patient status occurs
     o clinical compromise
   • Ad hoc Respiratory End Tidal Carbon Dioxide Monitoring

Device Failure/Cleaning
1. Do not use any EtCO\textsubscript{2} module that fails the self-test. Tag and immediately send to Clinical Engineering.

2. Machine modules are cleaned between patient uses with hospital approved disinfectant wipes. Make sure the instrument is turned off and unplugged from power source. Wipe all surfaces taking care to not get excess liquids into the interface connections. Allow to fully dry.

EQUIPMENT
Various equipment is available for use at each campus and is department specific for both adult and pediatric patients.

RESPONSIBLE PERSONS
RNs, Respiratory Therapists, Non-Physician Practitioners (NPP), Pharmacists, Anesthesia Providers and Physicians

POLICY DATES:
ORIGINAL: November 2015
REVISED:

END OF POLICY
VERIFICATION AND APPROVAL

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<th>COMPiled BY</th>
<th>System Pain Advisory, System Clinical Pharmacist Group, System Respiratory Therapy Managers and Respiratory Therapists Clinical Experts September 2015</th>
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APPROVAL/SIGNATURES

Kevin Grady, MD CMO SJH&MC
Chair of Care Design Committee

Date: