I. **Policy:** It is the policy of Tuomey Healthcare System for the safe and timely etCO₂ with SpO₂ monitoring of certain high risk patients.

II. **Responsibility:** RN, LPN, Respiratory Care Practitioner, Cardiac Technicians

III. **Note:**

1. Observe Standard Precautions
2. A physician’s order is required to initiate and discontinue O₂ saturation or capnography/end tidal CO₂ (etCO₂) monitoring. This order is included in IV PCA, post-op Epidural, and Duramorph order sets.
3. etCO₂ monitoring is always used with pulse oximetry via telemetry.
4. The target patient population for oximetry and capnography monitoring:
   --Post-op patients with an IV PCA as per order set
   --Post-op patients with an Epidural infusion containing narcotics as per order set
   --Post-op Duramorph patients when criteria met as per order set
   --Post-op patients with known/suspected OSA receiving IV narcotics (recommended)
   --Post-op patients with morbid obesity or age >70 years receiving IV narcotics (consider)
   --Post-op patients with loud snoring or apnea episodes observed by nurse (recommended)
   --Exception - end of life and active labor
5. The high-risk target population above should receive continuous pulse oximetry by telemetry. If supplemental oxygen is used, add continuous etCO₂ monitoring (when available). **O₂ saturation assessment is most effective on room air. Pulse oximetry may suggest adequate oxygenation in patients who are actively experiencing respiratory depression when supplemental oxygen is used. Thus etCO₂ monitoring is added to monitor ventilation in these patients on supplemental oxygen.
6. Monitoring by CMU is available on all patient units except WCTR, CCTR, SSCP and ARU. WCTR has their own unit-specific monitoring system.

IV. **Procedure:**

A. When SpO₂ and/or etCO₂ monitoring is required the order is placed in order entry and the request will print on the central monitoring printer.
B. When the order is received, staff from the ordering unit will get the assigned monitor from the Central Monitoring Unit and take it to the patient care unit and apply it to the patient. A copy of the order request will be provided with the
monitor for the patient identification purposes. Name and date of birth are to be verified by comparing the order request with the arm band prior to application.

C. Once the monitor is applied, the nursing staff is to call the central monitoring unit to verify the signal is transmitting prior to leaving the patient’s room. A cardiac technician will contact the nursing unit if the patient’s waveform does not appear in a timely manner.

D. Staff is to instruct the patient on the purpose of the monitor. The patient will be instructed to notify the nurse if a lead comes off or if they take the monitor off for any reason.

E. Alarm notification will be made immediately to the appropriate patient care unit via telephone. A call from CMU cannot be ignored. A response to the alarm should be made within 5 minutes or a second call will be made. If a response is not received within the next 5 minutes, the Clinical Manager, Administrative Director or Nursing Supervisor is to be notified. An occurrence report is completed.

F. Pre-set alarm values for saturation and capnography monitoring in adult patients:
   1. Normal adult CO₂ values are 35-45 mm Hg.
   2. Default alarm limits for etCO₂ are set at 20 and 50 mmHg.
   3. Respiratory rate default limits are set at 30 and 8 breaths per minute.
   4. No breath (apnea) default at 25 seconds.
   5. Inspired CO₂ default high at 8 mmHg.
   6. SpO₂ default high off and low at 88%.
   7. Pulse rate default high at 130 and low at 45.
   8. Changes to the alarm limits are made only with a physician’s order.

G. etCO₂ is to be documented with vital signs and SpO₂.

H. The provider will be notified ASAP of any uncorrected breaches of alarm limits.

I. The patient may be off the capnography monitor only during activity, such as using bathroom privileges, ambulation, or while off the unit, and replaced as soon as finished. The monitor must be on if the patient is in the bed or chair. Notify CMU prior to removing the monitor.

J. Consider discontinuation of capnography monitoring after 24 hours if the patient is fully awake, is demonstrating a decreasing pain medication requirement, end-tidal CO₂ readings are within normal limits, and supplemental O₂ is no longer needed. SpO₂ monitoring would typically continue.

K. In the event no etCO₂ monitor is available, the charge nurse is to assess the acuity of the monitored patients and request a discontinuation order, if appropriate. Patients deemed at highest risk would get priority.

L. Notify physician to obtain order to discontinue monitoring (unless governed by standard order set, i.e. IV PCA, Epidural, and Duramorph). When obtained, notify CMU and place in order entry.

M. Capnography monitoring is done by evaluating trends of the respiratory rate and etCO₂ value, and should be assessed together. Therefore, if respiratory rate and etCO₂ value are both changing, the patient should be assessed and interventions done as needed. If the respiratory rate is stable while the etCO₂ is alarming, then the situation can be observed for a possible equipment malfunction or transient reading, before an intervention is warranted.

N. Any loss of CO₂ detection or waveform indicates a possible airway problem or respiratory depression and should be assessed immediately by the nurse, documented, and provider notified. (If patient is determined stable, assess
monitoring system, e.g., ensure proper placement of CO₂ sampling line, proper placement of pulse ox probe, etc.) Consider the following interventions for abnormal waveforms.

1. Hypoventilation:
   a. Signs include slow breathing and high etCO₂.
   b. Causes include over-medication/increased sedation, snoring, or possible obstruction.
   c. Ensure patient has open airway/assess ABCs.
   d. Assess sedation level. Discontinue or decrease drug delivery.
   e. Stimulate patient and instruct patient to take deep breaths.
   f. Consider reversing narcotics (or benzos if given).
   g. Notify provider and call Respiratory Care if necessary.
   h. Call Code White if appropriate.

2. Partial Airway Obstruction or Shallow Breathing with Hypoventilation:
   a. Signs include slow breathing, shallow/low etCO₂ breaths followed by deep/high etCO₂ breath, erratic etCO₂ waveform, etCO₂ decreasing, or snoring/OSA.
   b. Causes include over-medication/increased sedation, snoring, OSA.
   c. Ensure patient has an open airway/assess ABCs.
   d. Assess sedation level and consider discontinuing or decreasing drug delivery.
   e. Stimulate patient and instruct patient to take deep breaths.
   f. Reposition airway; consider reversing narcotics (or benzos if given).
   g. Notify provider and call Respiratory Care if necessary.
   h. Call Code White if appropriate.

3. Hyperventilation:
   a. Signs include fast breathing and low etCO₂.
   b. Causes include pain, anxiety, dyspnea, sepsis, bronchospasm, PE.
   c. Ensure patient has an open airway/assess ABCs.
   d. Assess patient.
   e. Consider analgesics if painful.
   f. Notify provider and call Respiratory Care if necessary.
   g. Call Code White if appropriate.

4. No Breath/Apnea:
   a. Causes include respiratory arrest or inadequate respirations or obstruction, over-sedation or displaced cannula.
   b. Assess ABCs.
   d. Stimulate patient and instruct patient to take deep breaths.
   e. Consider reversing narcotics (or benzos if given).
   f. Notify provider and call Respiratory Care if necessary.
   g. Call Code Blue and start BLS/ACLS if appropriate.

V. Cleaning:
   A. Clean the monitor and the external cables with the purple-top Sani cloth germicidal wipes prior to returning the monitor to CMU.
NORMAL WAVEFORM

- A-B: Baseline: End of inspiration, early expiration
- B-C: Rapid rise in CO$_2$, mixing of dead space and alveolar gas
- C-D: Alveolar Plateau: Alveolar gas exchange
- D: End of Exhalation: Point where EtCO$_2$ is measured
- D-E: Inspiration, rapid decrease of CO$_2$

COMMON ABNORMAL WAVEFORMS

- **Hypoventilation**
  - Increased CO$_2$ with decreased RR

- **Shallow Breathing**
  - Decreased CO$_2$ until deep breath

- **Partial Airway Obstruction**
  - Loss of alveolar plateau, waveform is erratic, patient may be snoring, CO$_2$ will decreasing (ie OSA)

- **No Breath Detected**
VI. References:
A. National Guidelines/National Standards/Regulatory
B. Literature
C. Manufacturer’s Guidelines