

# IMPLEMENTATION OF CAPNOGRAPHY IN THE PACU AND POSTOPERATIVE UNIT

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DATE APRIL 9, 2022      SESSION # 403

ASPAN'S 41<sup>ST</sup> NATIONAL CONFERENCE 2022

PHILADELPHIA, PA

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## PACU RN

"Registered nurses monitor the cardiopulmonary status of pediatric and adult patients after a procedure or surgery sedation, opioids or anesthesia have been administered."

(McNeil & Hardy Tabet, 2021)

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Adverse respiratory events in non intubated postoperative patients are thought to frequently related to hypoventilation followed by hypoxemia.

(McNeil & Hardy Tabet, 2021)

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## HISTORY OF OXYGEN

Discovered in 1771

Important gas for human

Purpose



(<https://www.ncbi.nlm.nih.gov/books/NBK539754/?=printable>)

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## OXYGENATION

Essential to monitor oxygen levels

Measured by the amount of hemoglobin saturation by pulse oximetry

Measured by oxygen partial pressures

(<https://www.ncbi.nlm.nih.gov/books/NBK539754/?=printable>)

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## DEFINITION

Capnography by monitoring the partial pressure of end-tidal carbon dioxide is an evaluation of ventilation

(McNeil & Hardy Tabet, 2021)

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## METABOLISM

Products of metabolism- water and carbon dioxide  
Accumulation of carbon dioxide effect

(<https://www.ncbi.nlm.nih.gov/books/NBK539754/?=printable>)

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## GOLD STANDARD OF VENTILATION

ABGs measure partial pressure of oxygen =oxygenation and  
partial pressure of carbon dioxide=ventilation

(McNeill & Hardy Tabet , 2021)

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## VENTILATION

“Ventilation is physiologically controlled by respiratory rate and tidal volume. Increase or decrease in either of the two changes ventilation. In cases of hypoxia, the body tends to hyperventilate, and thus the partial pressure of CO<sub>2</sub> reduces as more gets expelled from the body.”

(<https://www.ncbi.nlm.nih.gov/books/NBK539754/?=printable>)

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## CAPNOGRAPHY

Can assess ventilation by measuring end-tidal carbon dioxide (ETCO<sub>2</sub>)

Does not measure oxygenation

Diagnose hypoventilation before hypoxia

(<https://www.ncbi.nlm.nih.gov/books/NBK539754/?=printable>)

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## CAPNOGRAPHY

Capnography/ETCO<sub>2</sub> is the measured at the end of expiration  
Detects hypercarbia and hypoxemia 2-3 min before pulse ox  
Provides real time information  
Reveals twice as many apnea events than a standard visual

(Scully, 2019)

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## CAPNOGRAPHY CURRENT STANDARD

Standard for surgeries requiring anesthesia worldwide  
1978 Holland was the first country to adopt capnography as standard  
Now patients receiving MAC and procedural sedation have capnography

(McNeil & Hardy Tabet, 2021)

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2022

Currently, the ASPAN Standards Practice Recommendation 2 B: Postanesthesia Phases of Care Initial and Ongoing Assessment: Phase 1 under airway assessment state, "End-tidal CO2 (capnography) monitoring if available and indicated"

(ASPAN Standards 2021-2022)

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2015

2015 Association of Anesthetists of Great Britain and Ireland included capnography as the standard for monitoring in the PACU for patients with an artificial airway and if deeply sedated.

(McNeil & Hardy Tabet, 2021)

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#### ASPAN PRACTICE RECOMMENDATION 10 OSA IN THE ADULT PATIENT

"5. Initiate postanesthesia management of the patient with diagnosed or suspected OSA, Phase 1 and II management includes: A. ... Routine monitoring and the addition of capnography when available."

(ASPAN Standards 2021-2022)

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#### EFFECTS OF POST OP OPIOID RELATED EVENTS

55% have longer hospital stays

47% higher costs associated with care

36% increased risk of 30-day readmission

3.4% higher risk of inpatient mortality compared ...

(McNeil & Hardy Tabet, 2021)

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#### CAPNOGRAPHY/OSA/OPIOIDS/DATA

55% longer hospital stays

47% higher costs associated with care

36% increased of 30 readmission

3.4 times high risk of inpatient mortality compared to those without opioid related events

(McNeil & Hardy Tabet, 2021)

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#### EVIDENCE TO SUPPORT

McNeil/ Hardy Tabet Narrative Review

Purpose

Findings

Conclusions

(McNeil & Hardy Tabet, 2021)

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## RCT EVIDENCE

### Findings

Intervention / control group

“Capnography detected apnea in 29% of patients in the study.”

“...there were no statistically differences between the groups in the rates of oxygen desaturations.”

(McNeil & Hardy Tabet ,2021)

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## CROSS-SECTIONAL OBSERVATIONAL STUDY # 1

Designed to compare 3 types of monitoring

Sample/Data Collection

Findings Summary: 26/48 patients “ exhibited signs of opioid-induced respiratory depression. The SpO2 measures did not change, but the PETCO2 increased and minute ventilation decreased, indicating hypoventilation. ”

(McNeil & Hardy Tabet, 2021)

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## CROSS-SECTIONAL OBSERVATIONAL STUDY # 2

“Patients who received opioid medications were more likely to experience hypoventilation and apnea.”

“... pulse oximetry alone may fail to identify respiratory depression.”

(McNeil & Hardy Tabet, 2021)

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## FURTHER EVIDENCE

“Capnography and the Integrated Pulmonary Index™ algorithm (IPI) detected respiratory adverse events earlier than standard monitoring in 75% and 88% of cases, respectively, with an average early warning time of  $8 \pm 11$  min.”

(Chung, 2020)

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## PREDICTING ORID ON INPATIENT WARDS

Opioid –induced respiratory depression events are serious problems

1 or more episodes of respiratory depression were detected in 46% of 1335 patients on general floor care

Mean hospital length of stay was 3 days longer for these patients

(Khanna, 2020)

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## CONTINUOUS ELECTRONIC MONITORING

Typical patient monitoring every 4-8 hours

Sun found 90% of serious hypoxemic episodes SpO2 for  $\geq 1$  full hour were missed by nurses with routine 4-hour vital signs

Reviewing opioid-related events (deaths and injuries) found 97% on the general care floor were deemed preventable with better monitoring and response (Khanna, 2018)

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## POINTS TO CONSIDER

Opioid-induced respiratory depression (OIRD) is common on the nursing unit

Which patients are most likely to experience OIRD?

How do we monitor for OIRD?

(Khanna, 2018)

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## OIRD ON THE GENERAL NURSING FLOOR

Mortality within 30 days after surgery

4<sup>th</sup> most common patient safety event

41% of in hospital cardiac arrests occur on the general unit with a adjusted survival rate of 0.106 (Khanna, 2018)

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## WHO AND WHAT TO MONITOR

Problem acknowledged both in PACU and the general unit

"Who to monitor?"

"What to monitor?"

(Khanna, 2018)

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## RECOMMENDED TO

Calculate risk

Monitor ETCO<sub>2</sub>, SpO<sub>2</sub>, respiratory rate ...

(Khanna, 2020)

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## PREDICTION MODEL USING 5 VARIABLES

age  $\geq$  60 (in decades)

sex

opioid naivety

sleep disorders

chronic heart failure

(Khanna, 2020)

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## RESULTS/CONCLUSION

PRODIGY risk assessment showed significant separation between patients with and without respiratory depression

The conclusion of the study accurately predicts respiratory depression episodes in patients receiving opioids on the general care floor

(Khanna, 2020)

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ASPAN PRACTICE RECOMMENDATION 10 OSA IN THE ADULT PATIENT

“Initiate postanesthesia management of the patient with diagnosed or suspected OSA, Phase 1 and II management includes: A. ... Routine monitoring and the addition of capnography when available.”

(ASPAN Standards 2021-2022)

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ASPAN COMPETENCIES

Core Competencies for all phases of perianesthesia care ...

“Pulse oximetry/ capnography and interpretation”

(ASPAN Standards, 2021-2022)

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BACKGROUND

How did this project come about?

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STORY

How many of you know your units could do better?

What area(s) comes to mind?

Who is going to change it ?

How are you going to change this situation?

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SITUATION

Discussed with anesthesia for the need for monitoring OSA patients

Patient Events

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PAIN MANAGEMENT POLICY

“Patients on IV opioids receiving supplemental oxygen therapy are to have continuous ETCO2 monitoring while unattended by staff.”

“Patients on PCA therapy receiving supplemental oxygen therapy must have continuous ETCO2 monitoring. “

(Phillips, retrieved 2021)

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## ACCORDING TO POLICY

Presented multiple challenges

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## SHARE OUR JOURNEY



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### CONTINUOUS POSTOPERATIVE MONITORING CRITERIA

| Criteria  | Criteria details  | Check box if criteria met |
|---|---|---------------------------|
| Recurrent PACU respiratory events and postoperative parenteral opioid | Respiratory Events<br>• <b>Episodes of apnea</b> for greater than 10 seconds<br>• <b>Bradypnea</b> (less than 8 breaths/ minute)<br>• <b>Repeated oxygen desaturation</b> less than 90%<br>• <b>Pain-sedation mismatch</b> (high pain score on the visual analog scale with a high level of sedation) |                           |
|   | (Khan, 2021)  |                           |

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### CONTINUOUS POSTOPERATIVE MONITORING CRITERIA

|   |   |
|---|---|
| Moderate/Severe OSA and postoperative parenteral opioid | <b>AHI</b> (apnea-hypopnea index obtained from sleep study) $\geq 15$<br><b>or</b><br><b>STOP-BANG</b> $\geq 5$<br>(Khan, 2021) |
|---|---|

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### CONTINUOUS POSTOPERATIVE MONITORING

|   |   |  |
|---|---|--|
| Patient to be admitted with significant comorbidities and postoperative parenteral opioid | Examples include, but not limited to:<br>•Recent (< 3 months) MI, CVA, or CAD/stents<br>•Ongoing cardiac ischemia or severe valve dysfunction<br>•Severe reduction EF<br>•Sepsis, DIC, ARD<br>•ESRD not undergoing regularly scheduled dialysis |  |
|   | (Khan, 2021)  |  |

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### INP CAPNOGRAPHY ORDER SET

VS q 30 minutes...

Stop-BANG Score of 5 or more add potential OSA to problem list

Use capnography whenever the patient has CPAP or BiPAP

If pulse oximeter is less than 90 % or resp rate is less than 8 per min or apneic for 10 seconds-open the ...

(Capnography order set, 2021)

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## AUDITS

Found gaps in documentation  
Sent Health Care Heroes

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## BARRIERS - HURDLES

Lack of awareness of policy  
COVID weary  
Staff turnover / travelers  
Order set does not fire to tasks.  
Different equipment  
(image retrieved from unsplash)



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## SIMILAR IMPLEMENTATION BARRIERS

Lack of education  
Lack of resources  
Attitudes

(Scully, 2019)

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## IMPLEMENTATION

Pain policy  
Needed something to address OSA  
Floor capnography order set

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## IMPLEMENTATION AND SCIENCE

Transition of research to practice  
Only 50% of EBP becomes standard practice

(Scully, 2019)

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## GAPS

Insert some of graphs without fin numbers

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## INTERVENTIONS

Nursing Grand Rounds 2020 with a scenario  
Nursing Grand Rounds Nov. 2021  
INSPAN Chapter Meeting OSA  
Presented data at Educator huddles, Anesthesia QA and Shared Governance  
Competency Fair- mx days all day  
Reeducation  
Traveled to units to provide in person education

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## IMPLEMENTATION POSTOPERATIVE UNITS

April 2021 meet with administration  
July meet with the Chief of Surgery  
Started

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## ASSESSMENT

From a PACU perspective, the outlook was disappointing  
Rather than stop, I went to the staff

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## RECOMMENDATION/ ACTION PLAN

Anesthesia  
Surgical Committee  
Chief of Surgery  
Hospital Leadership

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## EDUCATION ON THE CRITERIA

PACU  
Post op units-  
Criteria reeducation  
Equipment education

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## AUDITS

Gaps noted  
Orders sets not initiated  
Capnography not charted  
Capnography charted in wrong place  
Recognition to those who documented properly

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## CAPNOGRAPHY AT NW HEALTH

Meet with leadership and capnography approved  
Meanwhile mx leadership changes  
Meet with the Interim CNO who approved PACU Capnography  
Biomed adjusted PACU Monitors to display the capnography waveform and value

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## CURRENT STATUS

Audits continue  
Education continues  
We have capnography tubing  
We have one unit, while our other two have been loaded to ICU  
Special ordered capnography for our vented patients

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## LET'S EXAM PATIENT SITUATION

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## MOTIVATION

Research to practice  
Dissemination and Implementation Science (DIS) is "defined as the scientific study of methods to promote the systematic uptake of research findings and other EBPs into routine practice, and hence, to improve the quality and effectiveness of health services."  
(Scully, 2019)

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## REVIEW PATIENT EXAMPLE # 1

44-year-old female with no past medical history  
High STOP-Bang  
Pt data: weight 164 kg, ASA 3  
High STOP-Bang  
PACU Arrival of O2 sat 69%  
Left PACU with O2 Sat of 90%

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## QUESTION #1

Please choose all data to indicate this patient may have been appropriate for post op capnography?

- A. High Stop Bang score preoperatively
- B. Respiratory Status on admission to PACU
- C. Oxygen saturation at discharge
- D. All the above

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### REVIEW PATIENT EXAMPLE #2

56-year-old male with history of HTN, sleep apnea with Bipap use, COPD, asthma, diabetes, hepatitis C, and reflux. Pt weight was 113 kg and ASA 3. Procedure: open anterior repair of recurrent ventral incisional hernia General Anesthesia with spinal with Duramorph. Procedure uneventful, pt extubated and taken to PACU.

Nov. 1 at 1320 Pt discharged from PACU BP 103/55, pulse 84, resp. 18 and oxy sat 94 % on 3 L NC.

O2 sat 80 on 3 L, RAT call pt obtunded, snoring, respirations.

- rate elevated.

Narcan given, minimally responsive.

Respirations improved with bipap.

Transferred to ICU. Note states acute respiratory failure with hypercapnia.

Pt discharged home one week from day of surgery

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### QUESTION # 2

Based on the scenario which risk factor(s) indicate this patient may benefit from capnography monitoring?

- A. History of OSA with bipap use
- B. Discharged from PACU with oxygen
- C. Received Duramorph intraoperatively
- D. All the above

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### REVIEW PATIENT EXAMPLE # 3

72-year-old male past medical history of diabetes, HTN, hyperlipidemia, TIA, left shoulder osteoarthritis and rotator cuff tear. Cardiac Clearance reads moderate risk for surgery. Procedure was left reverse total shoulder arthroplasty under general anesthesia with interscalene block

Pt arrived in the PACU with ETT and oxygen sat of 72%. Pt placed on ventilator and oxygen sat increased to 94%. 1500 Pt was extubated and placed on 4 L NC. 1900 Pt transferred to ortho unit with orders for continuous pulse oximetry.

Pt in no acute distress BP 147/70, pulse 63, respiratory rate 20, and oxy sat 97% on 4 L NC. 2319 Found unresponsive. Code called.

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### QUESTION # 3

Why would this patient have benefited from continuous capnography in addition to continuous pulse oximetry?

- A. Capnography readily detects periods of apnea
- B. Capnography readily detects hypoventilation
- C. Capnography readily detects decreased respiratory rate
- D. All the above

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