

## **Society of Anesthesia and Sleep Medicine Educational Document: Abbreviated Guidelines and Recommendations for the Management of Obstructive Sleep Apnea (OSA) in the Perioperative Period For Healthcare Professionals**

This document and the original, Long Guidelines and Recommendations Document, are located at the Educational Resources link, found at: <http://sasmhq.org/educational-resources/>

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## COMMON TERMINOLOGY AND ABBREVIATIONS IN THIS GUIDELINE<sup>1,2,28</sup>

- Apneas: 0% airflow for ~10 seconds
- AHI: Apnea Hypopnea Index (a measure of the severity of Obstructive Sleep Apnea (OSA):
  - < 5/hour (no OSA)
  - ≥ 5 - <15/hour (mild OSA)
  - ≥ 15 - ≤30/hour (moderate OSA)
  - >30/hour (severe OSA)
- BPAP or BiPAP<sup>TM</sup>: Bilevel Positive Airway Pressure (pressure support)
- BMI: Body Mass Index, body tissue mass, weight divided by the square of the body height expressed in kg/m<sup>2</sup>
- CPAP: Continuous Positive Airway Pressure
- cm H<sub>2</sub>O: centimeters of water pressure (prescribed setting for PAP)
- HSAT: Home Sleep Apnea Testing, a limited channel home sleep test to diagnose OSA
- Hypopneas: <30% of airflow/a reduction of oxyhemoglobin saturation by ~3-4%
- ICU: Intensive Care Unit
- O<sub>2</sub>: Oxygen
- OSA: Obstructive Sleep Apnea
- ODI: Oxygen Desaturation Index, number of oxyhemoglobin desaturations, typically 3 - 4%, per hour
- PACU: Post Anesthesia Care Unit
- PCA: Patient Controlled Analgesia
- PAP: Positive Airway Pressure, first-line treatment for OSA
- PSG: Polysomnography, gold standard test to diagnose OSA

# 1. INTRODUCTION

Obstructive Sleep Apnea (OSA), a disorder characterized by recurring partial or total airway collapse during sleep, is a risk factor for adverse perioperative complications including pulmonary,<sup>3-9</sup> cardiovascular<sup>3,4,6-9</sup> and neurologic morbidities,<sup>9</sup> longer hospital stays,<sup>4,7,8</sup> increased health care utilization,<sup>7,10-12, 3,4,8,9</sup> medical litigation,<sup>13,14</sup> and death.<sup>13-15</sup>

However:

- Greater than 75% of patients with OSA, mostly undiagnosed, are not routinely identified with OSA before surgery<sup>16,17</sup>
- Screening tools in the preoperative period can help to identify at-risk patients<sup>1,18</sup>
- For patients with known diagnosed OSA who are non-compliant with positive airway pressure (PAP), or do not use it perioperatively, the risk for complications is increased<sup>1,8,19-21</sup>

The Society of Anesthesia and Sleep Medicine (SASM) has produced this abbreviated guideline<sup>1</sup> as an educational tool to increase awareness and to help health care providers develop institutional protocols for patients with known or suspected OSA. Case descriptions of actual circumstances that resulted in patients' death or suffering serious adverse events are included with each section.

*This paper is intended as a resource; it cannot be considered definitive nor will it apply to all patients and all situations. SASM is not responsible for outcomes based on care suggested in this document. SASM intends to regularly revise these recommendations as further knowledge accumulates in this rapidly developing field.*

## RISK REDUCTION STRATEGIES

In the following sections, we present risk reduction strategies for preoperative evaluation, perioperative, postoperative, post-discharge care and protocol example for the perioperative care of patients with known or suspected OSA.

## 2. PREOPERATIVE



### A. CASE

A 49-year-old female with osteoarthritis and morbid obesity [Body Mass Index (BMI) 50 kg/m<sup>2</sup>] scored as high risk for OSA on the STOP-Bang screening tool (Figure 1) in the presurgical evaluation clinic, placing her at high risk for OSA. She then underwent bilateral total knee replacements under general anesthesia. Her risk for OSA was not addressed in the medical record by the anesthesiologists or the surgeon. There was no arrangement for the patient to go to a monitored bed postoperatively. The patient was sent to the surgical floor with an intravenous (IV) hydromorphone Patient Controlled Analgesia (PCA) pump. Later the patient became lethargic with oxygen saturations found to be in the 60% range. Naloxone was administered and the patient was transferred to the Intensive Care Unit (ICU). The remaining postoperative course was uneventful. Polysomnography (PSG) performed 2 weeks after surgery revealed an Apnea Hypopnea Index (AHI) of 94 events per hour associated with severe hypoxia (lowest saturation of 55%).

**Issue:** The patient was identified as being at risk for OSA preoperatively. However, there was failure to act on this information and a failure to monitor this high-risk patient while she was receiving opioids.

**Outcome:** Urgent intervention and ICU transfer. Discharged without sequelae.

### B. PREOPERATIVE OSA SCREENING QUESTIONNAIRES

**1) Questionnaires** validated for ease of use during pre-operative evaluation include:

- STOP- Bang, [www.stopbang.ca](http://www.stopbang.ca) (Figure 1)<sup>18</sup>
- American Society of Anesthesiologists' Checklist<sup>22</sup>
- Berlin Questionnaire<sup>18,23</sup>
- Sleep Apnea Clinical Score<sup>24</sup>
- Perioperative Sleep Apnea Prediction Score<sup>25</sup>

Figure 1. STOP-BANG QUESTIONNAIRE<sup>18</sup>

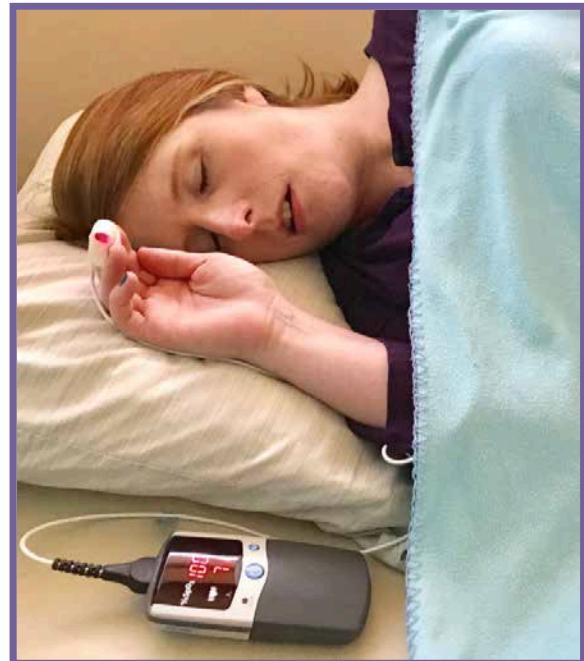
1. Snoring: Do you snore loudly (loud enough to be heard through closed doors)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
2. Tired: Do you often feel tired, fatigued, or sleepy during daytime?	<input type="checkbox"/> Yes <input type="checkbox"/> No
3. Observed: Has anyone observed you stop breathing during your sleep?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4. Blood Pressure: Do you have or are you being treated for high blood pressure?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. BMI: BMI more than 35 kg/m <sup>2</sup> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6. Age: Age over 50 yr old?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7. Neck circumference: Neck circumference >41 cm (Females) or 43 cm (Males)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
8. Gender: Male?	<input type="checkbox"/> Yes <input type="checkbox"/> No

High risk of OSA: Yes to 5-8 questions, Intermediate risk of OSA: Yes to 3-4 questions. Low risk of OSA: Yes to 0-2 questions. Questionnaire reproduced with permission from Dr. Frances Chung.

## C. PREOPERATIVE TEST OPTIONS

### 1) Overnight Oximetry

Overnight Oximetry (Picture A) with recording, reports an Oxygen Desaturation Index (ODI) however it has variable sensitivity and specificity depending upon the definitions used for respiratory events and how it is interpreted.<sup>2,26,27</sup>



*Picture A. Overnight Oximetry. Picture courtesy of Jessica Schweller, APRN-CNP, RRT, Sleep Disorder Specialist. The Ohio State University Sleep Disorders Center, Columbus, OH.*

### 2) Limited Channel Home Sleep Apnea Testing (HSAT)

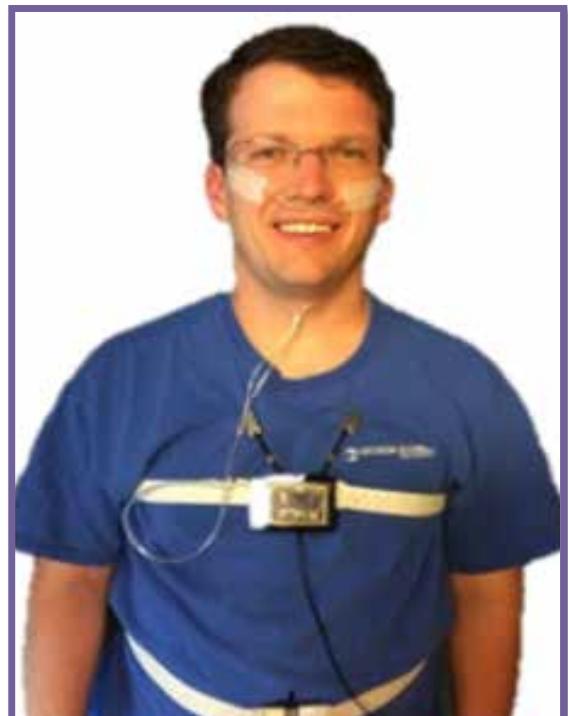
HSAT (Picture B) can identify OSA preoperatively in a substantial portion of the adult population at risk for OSA. A negative HSAT in a patient highly suspected of having OSA should warrant further testing, usually in-lab polysomnography (PSG). Airflow, oximetry and chest wall motion are typically monitored.<sup>16</sup> Further:

- Easy to use, completed in patients' home and costs less than a PSG. Adds diagnostic accuracy to questionnaire findings. Provides data regarding respiratory events [Apnea Hypopnea Index (AHI) and ODI] and allows assessment of their duration and associated hypoxemia
- Use should be limited to patients without significant cardiac, pulmonary or neurologic disease (i.e. those at risk for central sleep apnea and/or significant hypoventilation) as these require more rigorous evaluation, possibly PSG

### 3) Laboratory Polysomnography (PSG)

Overnight stay in-sleep laboratory PSG (Picture C) is the gold standard for diagnosing and categorizing OSA severity.<sup>28</sup> Further:

- It is expensive and access to testing may be limited
- Surgical patients may be reluctant to undergo such labor intensive testing preoperatively
- In some cases, therapy may be implemented (a "split night" study with CPAP titration in the second portion of the study on the same night)



*Picture B. Limited Channel Home Sleep Apnea Study (HSAT). Picture courtesy of William Healy, MD. The Ohio State University Sleep Disorders Center, Columbus, OH.*

- CPAP titration in the sleep lab allows for precise determination of CPAP settings



*Picture C. In-Sleep Laboratory Overnight Polysomnography. Picture courtesy of Zachary Coleman, RPSGT & Crystal McClary, RPSGT, The Ohio State University Sleep Disorders Center, Columbus, OH.*

## D. ADDITIONAL SASM BEST PREOPERATIVE PRACTICE RECOMMENDATIONS<sup>1</sup>

- 1) The healthcare team and patient should be aware that diagnosed OSA (whether treated, partially treated or untreated) as well as suspected OSA may be associated with increased perioperative morbidity
- 2) The healthcare team should attempt to obtain results of the sleep study and the recommended PAP therapy setting before surgery, if able
- 3) PAP equipment should be available for perioperative use (patients may bring their own PAP equipment or utilize hospital supplied equipment)
- 4) Additional evaluation for preoperative cardiopulmonary optimization should be considered in patients with known and suspected OSA who have uncontrolled systemic conditions (e.g. i) hypoventilation syndromes, ii) severe pulmonary hypertension, and iii) resting hypoxemia in the absence of other cardiopulmonary disease)
- 5) Patients with known or suspected OSA with optimized co-morbid conditions may proceed to surgery provided strategies for mitigation of postoperative complications are implemented
- 6) The use of PAP therapy in previously undiagnosed but suspected OSA patients should be considered case by case

### 3. PERIOPERATIVE



#### A. CASE

A 55-year-old male with osteoarthritis, benign prostate hypertrophy, a history of gastric bypass surgery with residual obesity ( $BMI 31.4 \text{ kg/m}^2$ ) and OSA (PSG showed an AHI of 38.0 events per hour, compliant with PAP therapy) underwent a transurethral resection of the prostate (TURP) under general anesthesia. He was extubated in the OR but 30 minutes after arrival in the PACU, obstructive apneic episodes were noted with desaturations into the 60%-70% range. The patient was reintubated and transferred to the ICU. His sodium level at the time was 143 mmol/L, making TURP syndrome an unlikely reason for his clinical decompensation. Upon regaining alertness, he was extubated, and the remainder of his hospital course was uncomplicated.

**Issues:** Premature extubation after surgery under general anesthesia. Faulty assumption that patients with a history of OSA who have significant weight loss may no longer have OSA.

**Outcome:** Reintubation and ICU transfer. The patient was discharged without further sequelae.

#### B. INTRAOPERATIVE AND IMMEDIATE POSTOPERATIVE MANAGEMENT (CONSENSUS RECOMMENDATIONS)

##### 1) Airway management and Anesthesia

The following risk factors in the OSA patient contribute to airway narrowing/obstruction<sup>28</sup> (Figure 3A):

- Tonsillar hypertrophy
- Enlarged uvula
- High arched/narrow hard palate
- Macroglossia (enlarged tongue)
- Retrognathia (recessed lower jaw/mandible); overbite
- Other classic OSA features include a  $BMI \geq 30 \text{ kg/m}^2$ , and enlarged neck circumference of  $> 43 \text{ cm (17")}$  in men and  $> 41 \text{ cm (16")}$  in women

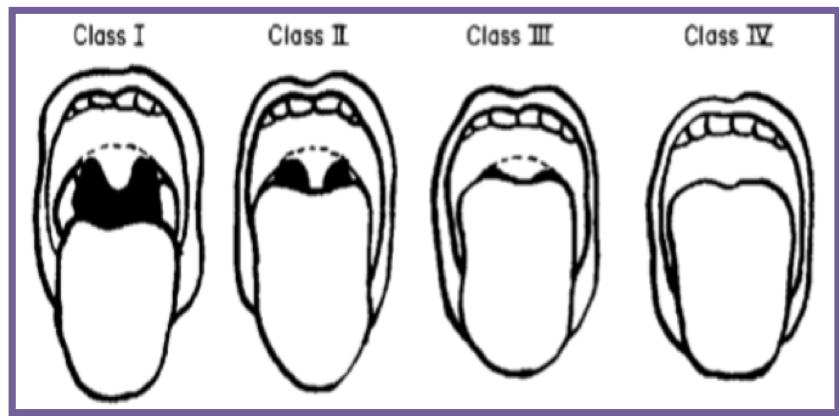
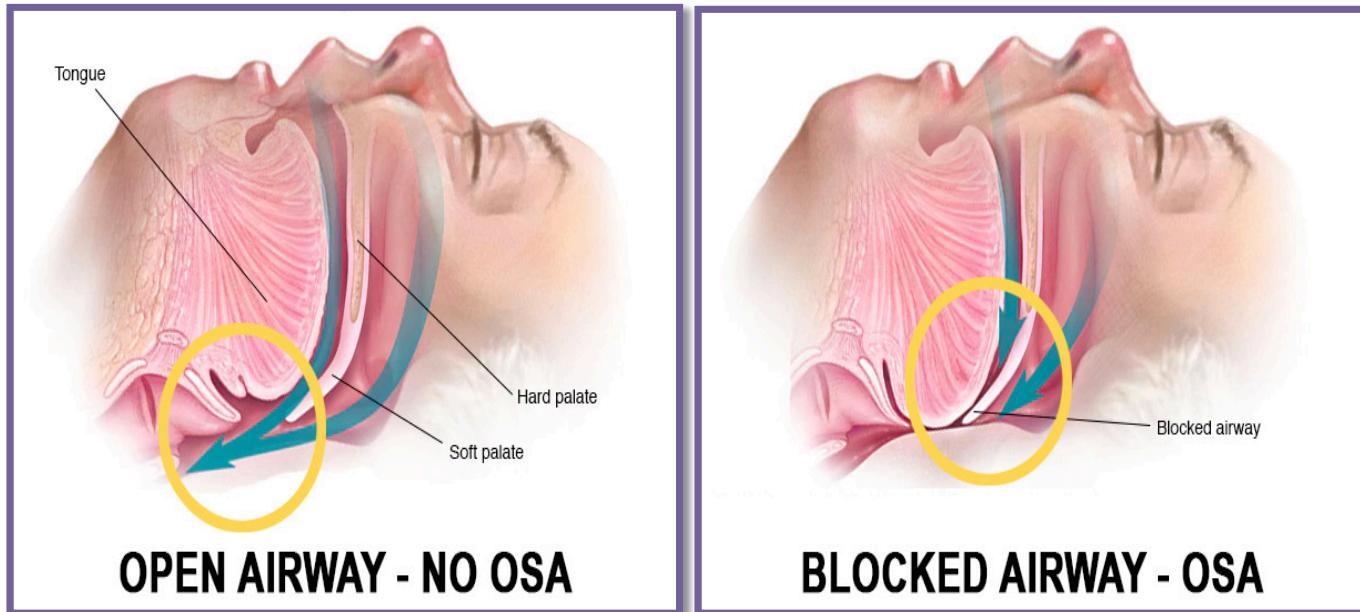


Figure 2. Modified Mallampati classification of pharyngeal structures.<sup>29</sup>

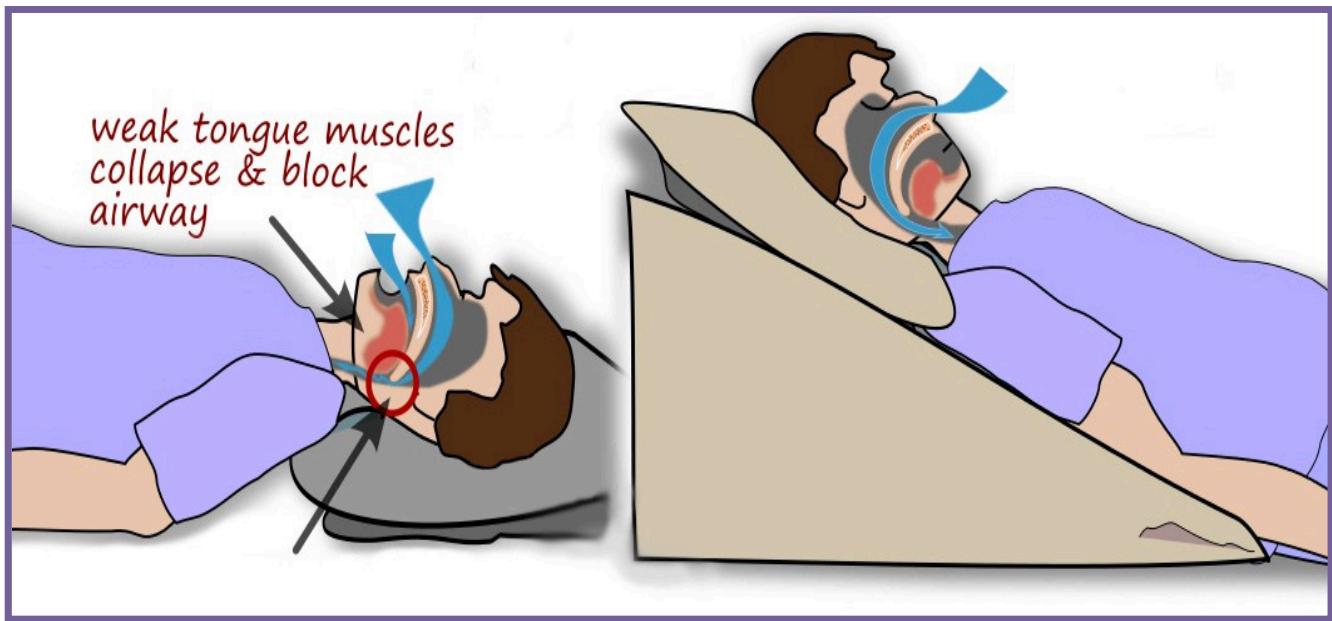
Airway is assessed using the Modified Mallampati score. A score  $\geq 3$  is predictive for OSA (Figure 2).



*Figure 3A. Retrieved from: <https://www.mayoclinic.org/diseases-conditions/obstructive-sleep-apnea/symptoms-causes/syc-20352090>, May 2018.*

Recommendations for patients with known or suspected OSA:

- Local or regional anesthesia should be considered when possible<sup>30</sup>
- If moderate sedation is required, continuous capnography is warranted during the procedure
- If general anesthesia is planned, pre-oxygenation should be considered and early emergence techniques (i.e. short acting agents with adequate reversal of muscle relaxants) should be considered
- Difficult airway equipment should be readily available
- Extubation in a position other than supine is desirable<sup>31</sup>
- Ready availability of CPAP is important during sedation and post-extubation<sup>22</sup>
- Whenever possible, the use of sedatives and opioids should be minimized
  - Extra caution should be used for patients with known or suspected OSA who are opioid naïve
  - Consideration should be given to a non-opioid multimodal analgesia approach (e.g., local/regional analgesia, non-steroidal anti-inflammatory drugs, acetaminophen, and steroids)
  - If opioids are required, use short acting ones, where possible



*Figure 3B. Airway compromise & importance of positioning in OSA. A semi upright position is encouraged when possible to minimize pharyngeal collapse and maximize airflow. The lateral or semi upright positions can decrease upper airway collapsibility.* Retrieved from: <http://www.equanimo.com/de.html#pagetopDE.>, January, 2018.

### **Recovery [operating room and post- anesthesia care unit (PACU)]**

- Identify high risk patients for OSA to all members of the care team, including bedside staff and pharmacy personnel
- Consider extubation only once awake
- Place patients in a semi-upright position prior to extubation<sup>31</sup>
- Consider placing patients in a lateral decubitus position post-extubation and during PACU recovery, if the surgery allows, to minimize obstruction secondary to supine positioning
- Consider use of a sedation scale (e.g., Richmond Agitation Sedation Scale) to guide management. Avoid systemic opioids, if possible. If necessary, titrate long acting opioids (e.g., morphine) to the lowest effective dose<sup>32</sup>
- Observe patients for apneic episodes, increased FiO<sub>2</sub> requirements, pain-sedation mismatch, or episodes of desaturation. These patients should receive extra vigilance that may include enhanced monitoring (i.e. capnography, continuous pulse oximetry and/ or placement in a step-down unit) or interventions (i.e. head of the bed elevation, use of nasal trumpets or the implementation of airway pressure)<sup>33</sup>
- Patients with known OSA on therapy should be placed on PAP therapy (Picture D1), either their home machine, a hospital machine adjusted to home settings, or auto-adjusting CPAP upon arrival to the PACU (Picture D2)

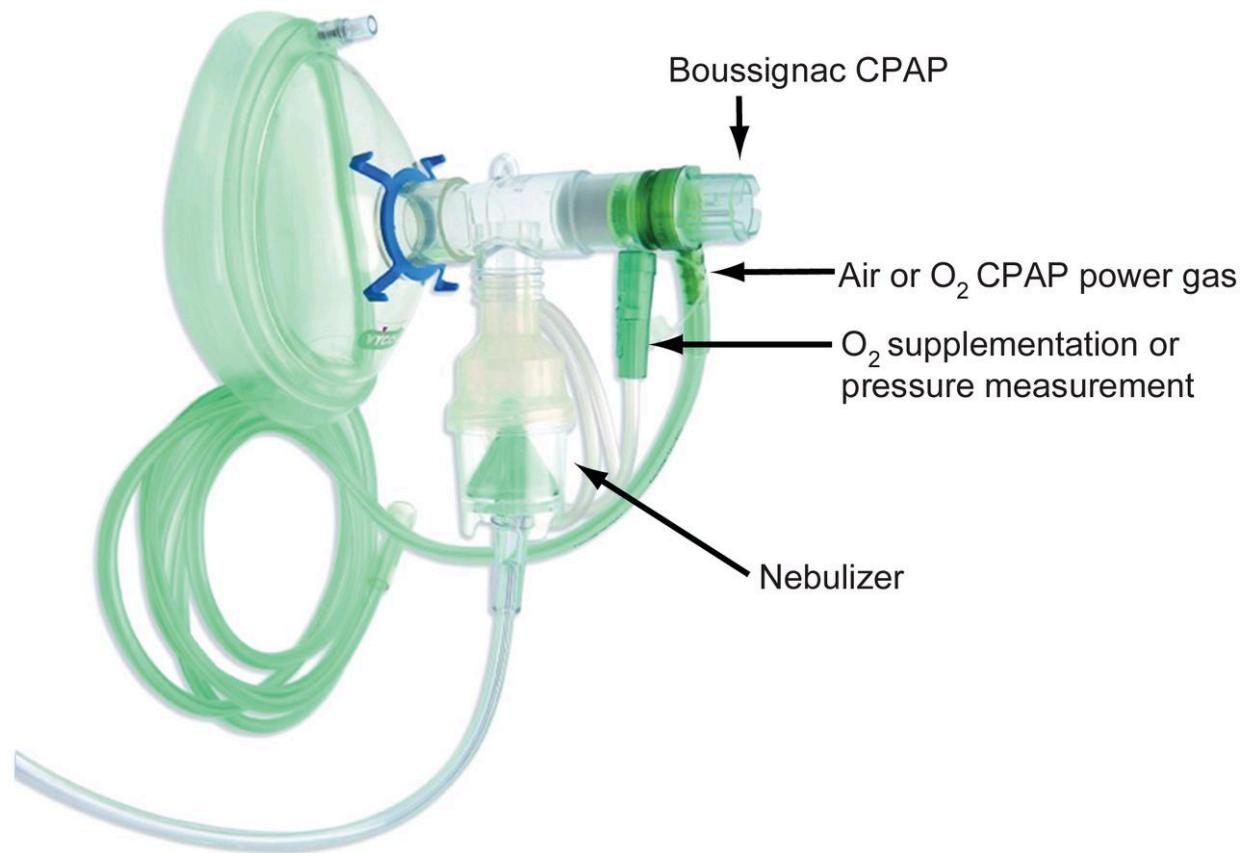


*Picture D1: Application of PAP full face mask (left) and with home CPAP device (right). Pictures courtesy of Carrie Miller Downs, MSN, ACNP and Edwin Downs, MBA.*

- One may need to consider adjusting the settings if obstructive events are observed on therapy. Table 1 depicts the common types of adult PAP therapy utilized
- If oxygen desaturation occurs while on oxygen therapy, use of PAP therapy should be considered before discharge from the PACU (i.e. CPAP, auto-adjusting CPAP or BPAP/BiPAP)
- Outpatient facilities should be prepared for respiratory care interventions as noted above and have transfer agreements with inpatient facilities



*Picture D2: Adjusting nasal CPAP mask (left) and discussing CPAP settings with RRT using hospital PAP device (right). Pictures courtesy of: J. Yoon, MSN, ACNP, Anthony Jackominic, RRT, Nilda Prena, Cardiovascular Technician, and Kirstan Clay-Weinfed, MSN, ACNP, University of Pennsylvania Health Systems, Philadelphia, PA.*



*Picture E: Boussignac CPAP mask. Retrieved from<sup>34</sup> <http://rc.rcjournal.com/content/56/10/1526>, January 2018.*

**Table 1. Common types of adult Positive Airway Pressure (PAP) therapy to be documented:**

PAP: a fan driven air pump that uses external air to deliver pressurized air (pneumatic splint to prevent airway collapse), typically via nasal or oral mask, to keep the airway open. Pressure is measured in centimeters of H<sub>2</sub>O (cm H<sub>2</sub>O) and tubing resistance.

1. Continuous positive airway pressure (CPAP):	<ul style="list-style-type: none"><li>• Delivers a fixed continuous level of pressure</li><li>• Pressure levels are set at one pressure settings, typically between 4 to 20 cm H<sub>2</sub>O</li><li>• All breathing effort is from the patient</li></ul>
2. Auto- adjusting PAP (Auto-CPAP; Auto-BPAP, Auto-BiPAP):	<ul style="list-style-type: none"><li>• A range of prescribed pressure (e.g., 5-20 cm H<sub>2</sub>O) is automatically adjusted by the device based on device flow sensing algorithm</li><li>• All breathing effort is from the patient</li></ul>
3. Bilevel Positive Airway Pressure (BPAP-S or BiPAP-S; BPAP-ST or BiPAP-ST)	<ul style="list-style-type: none"><li>• Delivers a set Inspiratory PAP (IPAP, ranges from 8-30 cm H<sub>2</sub>O) and Expiratory PAP (EPAP, range starts at 4)</li><li>• Provides additional pressure support (IPAP-EPAP) to generate a tidal volume</li><li>• In general, for patients:<ul style="list-style-type: none"><li>- with restrictive and obstructive lung disease</li><li>- OSA patients intolerant to CPAP</li><li>- can be with/without a back-up respiratory rate</li><li>“S” depicts spontaneous breathing</li><li>“ST” depicts spontaneous with a timed back up respiratory rate</li></ul></li></ul>
4. Boussignac CPAP mask <sup>34</sup> (Picture E)	<ul style="list-style-type: none"><li>• Provides a pressure level range from 3.5 to 10 cm H<sub>2</sub>O that is based on the Oxygen flow rate</li><li>• Flow rate can be used to adjust Positive End Expiratory Pressure (PEEP)</li><li>• Requires an Oxygen source and flowmeter</li><li>• Benefits:<ul style="list-style-type: none"><li>- disposable/for acute use (set-up in 2 minutes)</li><li>- eliminates a fan pump</li><li>- can deliver nebulizer bronchodilator treatment in- line without disruption during CPAP use</li><li>- allows for in-line suctioning without disruption to CPAP utility</li></ul></li></ul>

## 4. POSTOPERATIVE



### A. CASE

A 45-year-old male with a recent diagnosis of OSA (PSG results were not available) presented to the emergency room (ER) after a motor vehicle accident with resultant leg trauma. Oxygen desaturation was noted in the ER after IV morphine was given for pain, and the patient required mask ventilation. The patient then underwent general anesthesia for an open reduction and internal fixation (ORIF) of a tibial fracture. The patient was extubated in the OR, but apneic episodes were noted with desaturations in

the 80% range documented in the PACU. The patient was sent to the floor with a request for continuous pulse oximetry. Continuous pulse oximetry was not applied, and further apneic episodes were documented by the nurses. After 30 minutes, the patient was found in cardiopulmonary arrest. The patient was intubated and CPR was performed until spontaneous respirations returned. Severe anoxic brain injury resulted and the patient subsequently died.

**Issue:** Premature release from the PACU after general anesthesia in a patient with known OSA. Failure to monitor a patient with known OSA given IV opioids postoperatively despite documented apneas and desaturation while receiving opioids.

**Outcome:** Severe anoxic brain injury and death.

Optimal strategies for postoperative management of known or suspected OSA patients have yet to be defined. However, it is likely that judicious use of opioids (monitored by pharmacy alerts), avoidance of sedatives, increased levels of monitoring and perhaps the use of positive airway pressure therapy (CPAP or BPAP) are all important in minimizing risk for postoperative complications.

### B. POSTOPERATIVE CONSIDERATIONS (CONSENSUS RECOMMENDATIONS)

#### 1) After release from PACU

- Patients with known OSA who are on therapy should be placed on PAP therapy (either home machine, hospital machine adjusted to home settings, or auto- adjusting CPAP) during periods of sleep while hospitalized
- Consider adjusting the PAP settings if obstructive events are observed on therapy. This can be initiated in PACU. Patients requiring supplemental oxygen in the immediate postoperative period to offset hypoxemia secondary to atelectasis or other pulmonary problems may still require oxygen when on PAP therapy
- Exercise caution in OSA patients who develop prolonged and/or frequent severe respiratory events (e.g., sedation analgesic mismatch with opioids and/or select anti- emetics,

desaturation, and apneic episodes) in the postoperative period<sup>33</sup>

- Consider minimizing postoperative nausea/vomiting with use of non-sedating anti-emetics
- Monitoring oximetry alone can fail to detect significant hypercapnia in some patients. Continuous capnography (carbon dioxide monitoring) (Picture F) may be appropriate in some cases, though many facilities do not have capnography resources outside of the operating room / PACU setting



*Picture F: Continuous capnography (carbon dioxide monitoring). Picture courtesy of Rolayne Taylor, BSN (simulating patient), Nancy Huston, BS, RN, and Renee Crim, RN, Post Anesthesia Care Unit, Lutheran Hospital, Fort Wayne, IN.*

### **Clinical judgement should be used to determine if additional respiratory monitoring is needed.**

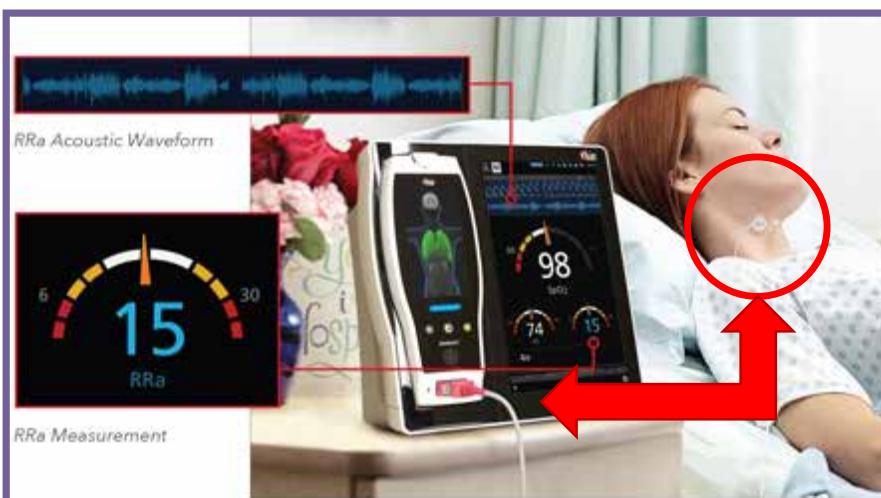
This may include:

- i. Continuous pulse oximetry, which can be monitored remotely
  - ii. Continuous capnography/end-tidal CO<sub>2</sub> and/or acoustic monitoring
  - iii. Placement in a step-down unit
  - iv. Telemetry
- Oxygen therapy may be needed to prevent hypoxemia in some patients. However, oxygen therapy should be used with caution and a search for potential underlying causes is recommended: one should not assume that hypoxia is due only to untreated OSA
  - Additional caveats include:
    - i. Oxygen may prolong apneas in some individuals<sup>35</sup>
  - Use of supplemental oxygen therapy may mask the development of hypercapnia if on supplemental O<sub>2</sub>. For example, patients can be apneic for significant periods of time before desaturation is noted on continuous pulse oximetry, all the while their CO<sub>2</sub> level may be climbing. Patients with obesity hypoventilation syndrome or overlap syndrome (OSA and chronic obstructive lung disease) are at higher risk of hypercapnia with oxygen therapy. The ideal locations for monitoring, and the parameters to be monitored, have not been clearly established.
    - i. Monitoring locations may include intensive care units, stepdown units and general ward beds with additional monitoring capability. In some patients, no additional monitoring may be warranted. Numerous factors (i.e. type of surgery, type of anesthesia, postoperative analgesic requirements, co-morbidities, OSA severity and treatment)

- should play a role in decision making
- ii. Continuous pulse oximetry is often recommended for monitoring known or suspected OSA patients postoperatively (see protocol examples later in the document).<sup>36</sup> Guidelines for how best to utilize pulse oximetry have not been established. Continuous respiratory rate monitoring may be considered as a surrogate in some cases
  - iii. Continuous capnography (carbon dioxide) monitoring or transcutaneous (carbon dioxide) CO<sub>2</sub> monitoring (Picture G) technology is evolving and may be a useful tool, as may other measures such as acoustic monitoring (monitoring of respiratory vibrations associated with breathing) (Picture H), to continuously monitor airflow
- Naloxone should be readily available for any patients receiving opioids



*Picture G: Transcutaneous (carbon dioxide) CO<sub>2</sub> monitoring. Retrieved from: <https://www.sentec.com/intl> January 15, 2018*



*Picture H: Acoustic monitoring. Note the corresponding skin transducer placed/located on the patient neck. Retrieved from: <http://masimo.com/technology/oxygenation/rra> January 15, 2018*

## 2) Significant Respiratory Depression

- Appropriate resuscitation should be initiated—this may include noninvasive positive-pressure ventilation or tracheal intubation as well as appropriate use of naloxone and/or other drug reversal agents
- Consider transfer of ambulatory patients to an inpatient facility for additional monitoring
- Hospitalized patients should be placed on a floor or care unit with experience in treating OSA patients, complete with a system capable of providing appropriate monitoring

## 5. FOLLOW UP CARE AFTER DISCHARGE



### A. CASE

52-year-old male with hypertension, osteoarthritis, obesity (BMI 34.6 kg/m<sup>2</sup>) and mild OSA (PSG with an AHI of 6.5 events per hour, not on therapy) underwent general anesthesia for a lumbar laminectomy. The patient was extubated and monitored overnight in a surgical ward with continuous oximetry monitoring. The patient was discharged home the following day with acetaminophen/oxycodone and cyclobenzaprine. While in his family room, the patient took his prescriptions and fell asleep. He became apneic and cyanotic and his wife could not awaken him. She administered a precordial thump and called 911. The patient regained consciousness and was not postictal. The patient was transported to the ER where intermittent polymorphic ventricular tachycardia (VT) was documented. He required defibrillation/cardioversion X 3 and an amiodarone infusion. He

had no history of cardiac disease, arrhythmias or seizures. A cardiac workup was negative (normal echocardiogram, negative cardiac catheterization and electrophysiology study). No electrolyte abnormalities were noted. No clear cause for the VT was found except for possible hypoxemia related to OSA, likely worsened by the combination of his prescription medications with resulting arrhythmia. An implantable cardioverter-defibrillator (ICD) was placed. No subsequent episodes of arrhythmia were documented.

**Issue:** Excessive narcotic and sedative medications prescribed postoperatively in a patient with known OSA.

**Outcome:** Admission to the ICU, extensive cardiac workup, and ICD placement.

Respiratory events noted in the PACU may predict ongoing events that impact the disposition of the patient. This can help with determining if the patient is able to be discharged to home. Factors including post-operative sleep disruption resulting in subsequent nights of REM rebound, the lingering effects of anesthesia, and the concomitant use of opioids will play a role in discharge home or in hospital management.

- OSA can be greatest on postoperative night 3 and may not return to baseline for several more nights. It is therefore imperative that patients with known and suspected sleep apnea are provided with appropriate follow-up care
- Cautious use of opioids and sedatives in the home setting

- If a patient was determined to be at high risk for OSA but not yet diagnosed, follow-up with a primary care provider or a sleep specialist for further evaluation is recommended. OSA is a chronic medical condition associated with significant long-term health consequences when left untreated
- Identifying patients at risk for OSA in the preoperative setting should serve as an impetus for patients to undergo additional evaluation

## B. HOME TREATMENT AND FOLLOW-UP (CONSENSUS RECOMMENDATIONS)

### 1) Known OSA

- Patients on PAP, and their families, should be educated at discharge to use their PAP therapy whenever sleeping, and to avoid opiates as much as possible due to adverse effects on breathing
- If the patient has brought their equipment to the hospital, it's reasonable to have a respiratory therapist inspect the patient's home CPAP equipment (in order to verify proper working condition, mask fit, etc.)
- If a patient with known OSA is non-compliant with therapy, make efforts to provide education regarding risks of untreated OSA, identify barriers that have resulted in non-compliance, and ensure that follow up with an appropriate provider is arranged
- Depending on resources and clinical circumstances, such patients may be candidates to be seen before discharge by a sleep specialist, a respiratory therapist, or a CPAP educator

### 2) Suspected OSA

- Patients who are suspected of having OSA should be urged to follow up with their primary care or a sleep medicine provider to consider further sleep evaluation
- Triage tools that might trigger a more urgent follow-up include a:
  - i. STOP-Bang score > 6
  - ii. Abnormal screening oximetry, or prolonged need for O<sub>2</sub> during recovery or
  - iii. Hospitalization
  - iv. Requirement for opioids

In general, most insurance providers will not reimburse outpatient PAP therapy for patients initiated on PAP in the postoperative period until a formal diagnosis of OSA has been established (with HSAT or PSG). For this reason, formal testing needs to be strongly considered in most patients.

Additionally:

- i. In some regions, local vendors may provide PAP therapy on a short-term basis until sleep study results become available
  - ii. Emerging data suggest that limited channel testing (such as HSAT) in hospitalized patients may be feasible.<sup>37,38</sup> However, careful patient selection and, in some cases, outpatient confirmation of inpatient testing may be indicated
  - iii. Patients with significant hypoventilation syndromes requiring BPAP therapy may need to meet separate criteria for therapy and the reader is referred to regulatory agency (i.e. CMS) guidelines for these requirements
- Home O<sub>2</sub> as a bridge before definitive treatment with CPAP or BPAP can be considered, but is

not universally recommended. Further:

- i. There are concerns that supplemental O<sub>2</sub> may blunt hypoxic respiratory drive or cause V/Q mismatching that may result in significant hypercapnia in certain individuals (e.g. those with COPD)
- ii. O<sub>2</sub> may be beneficial in preventing adverse consequences related to hypoxemia in certain individuals. Clinical judgment should be used
- iii. Patients who are on home O<sub>2</sub> may be more motivated to follow up with a specialist, in order to determine when O<sub>2</sub> may be appropriately discontinued. This results in an opportunity to provide education and optimize care

## 6. PROTOCOLS

These original protocols are located at the Educational Resources link, Long Guidelines and Recommendations Document, found at: <http://sasmhq.org/educational-resources>.

Many institutions have initiated screening and monitoring protocols for patients with known or suspected OSA. Below are four examples, each developed and utilized at different institutions. Note that these are examples of what are considered best clinical practices, though the impact these protocols might have on patient outcomes has not yet been established.

### **Protocol 1:**

This protocol comes from Intermountain Health Care (IHC), a large non-profit HMO based in Salt Lake City and affiliated with the University of Utah. The program has a joint Sleep Medicine Fellowship Program shared by IHC and the University of Utah.

We screened nearly 500 orthopedic patients considering joint replacement surgery with the STOP-Bang questionnaire (SBQ). We found that a positive SBQ ( $> 3$ ) resulted in a PSG-confirmed diagnosis of sleep apnea in over 90% of subjects. Of subjects with a positive SBQ, 68% agreed to consultation with Sleep Medicine and 81% of these underwent a PSG.

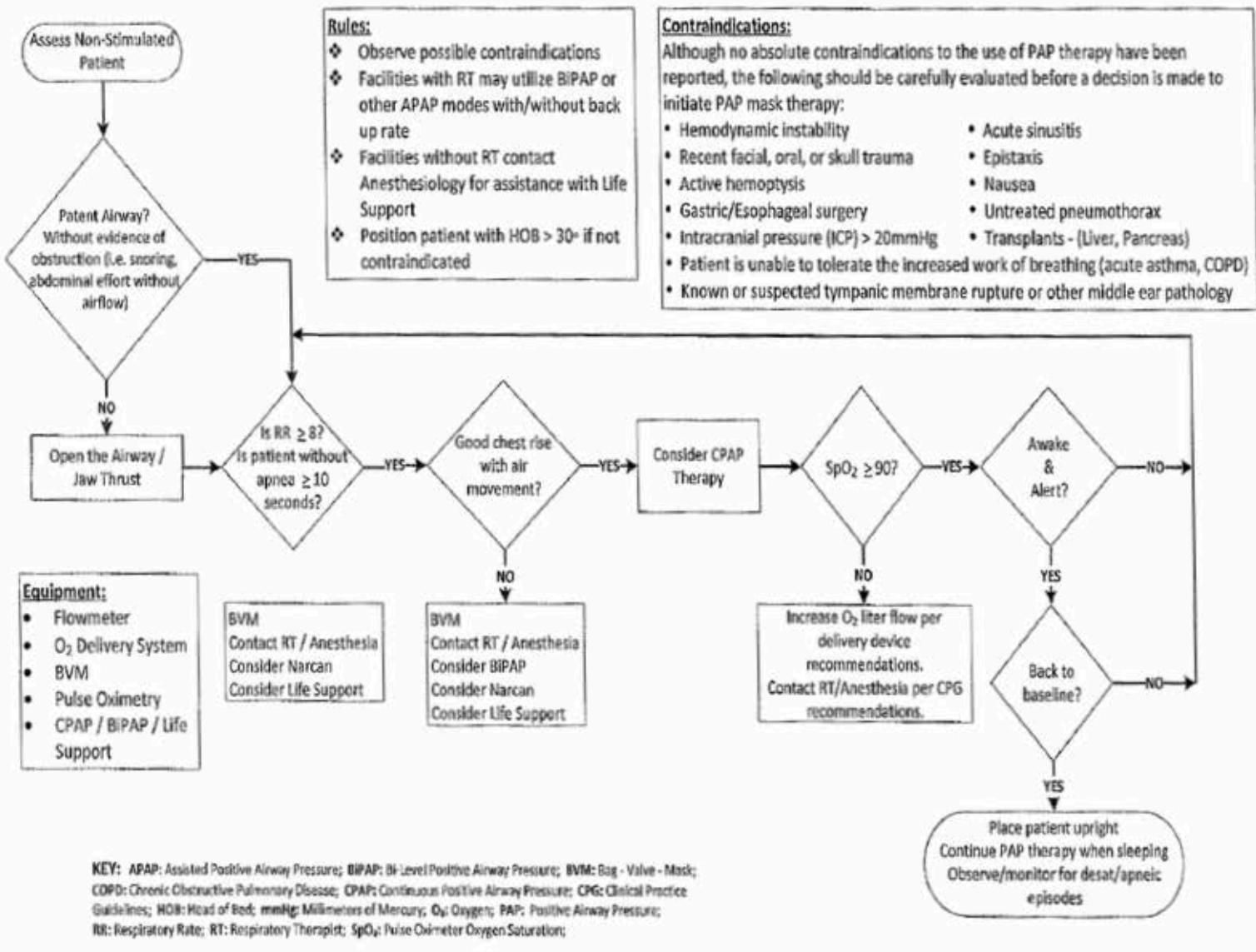
The challenges to address sleep apnea on a large scale in the perioperative setting are as follows: a) administering an easy and effective screening tool (such as the SBQ); b) establishing a diagnosis quickly to avoid delay in surgery; c) establishing a formal diagnosis by PSG or other modality so that CMS and other insurance pays for CPAP or other therapy, and d) coordinating care with surgeons, anesthesiologists, PACU and hospital staff, discharge planners, and durable medical equipment suppliers. The attached protocol is our endeavor to screen for OSA in patients referred from 3 new orthopedic offices based in an orthopedic specialty hospital.

The orthopedic staff administers the SBQ to patients being considered for surgery. Those with a negative SBQ ( $SBQ < 3$ ) proceed to surgery. Those with a positive SBQ are stratified into 1 of 3 groups. The first group is composed of those who live out of town or refuse further work-up. They are given oxygen postoperatively with aggressive monitoring and outpatient sleep evaluation recommended. All others will undergo a home sleep study, and those with an AHI  $> 5$  events per hour are divided into one of two groups based on the timing of their surgery. Those with surgery  $> 2$  weeks away will have a sleep medicine consultation and a PSG/CPAP titration with a CPAP prescription arranged thereafter. These patients will use home CPAP settings perioperatively. Those with surgery  $< 2$  weeks away will be given APAP perioperatively and discharged with APAP/O<sub>2</sub>, with follow-up with a sleep practitioner. Patients with a positive SBQ, but a negative home sleep study, will be given oxygen postoperatively as needed and plan for outpatient follow-up. A negative home sleep study does not rule out sleep apnea.

## Protocol 1:



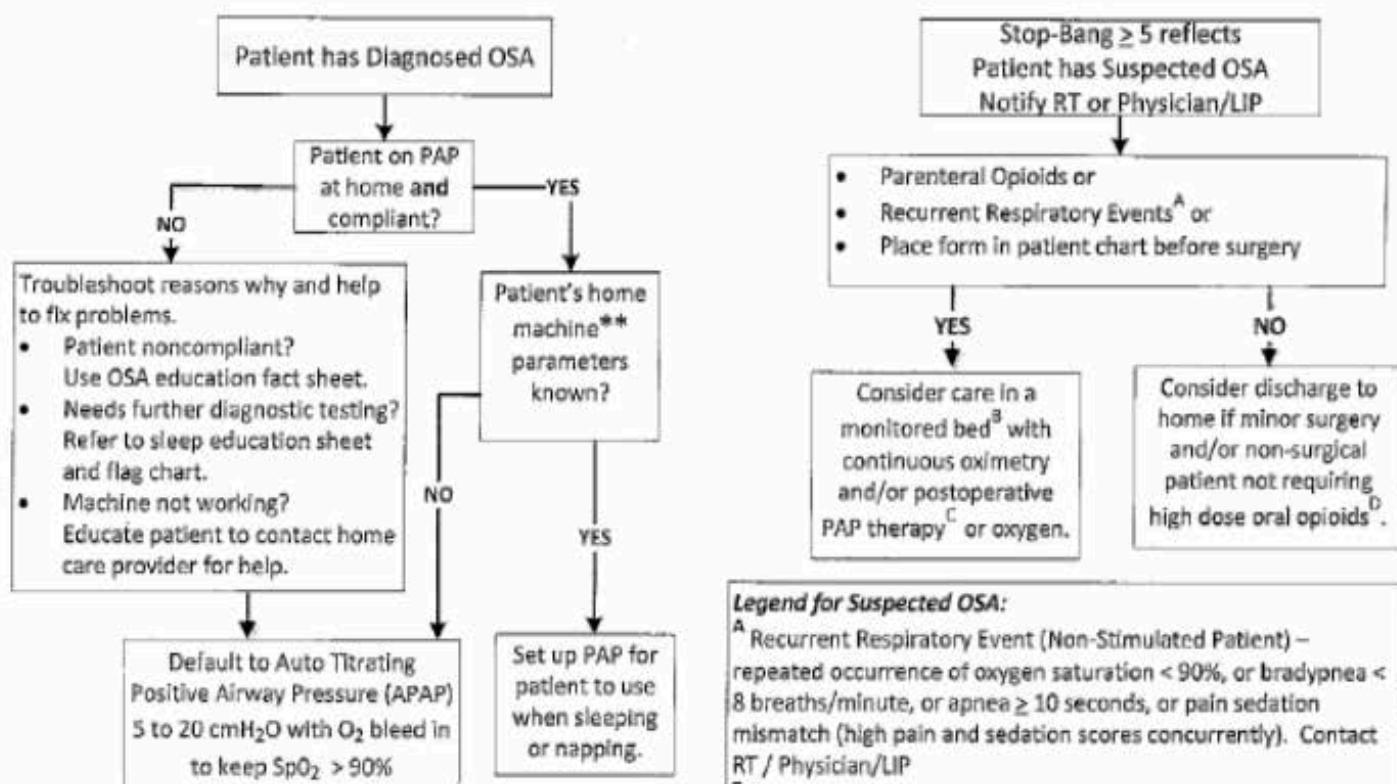
### OSA / Suspected OSA Respiratory Assessment for Post Surgical & Patients on Opioids



## Protocol 1:



### Positive Pressure for Diagnosed Obstructive Sleep Apnea Patients & Suspected Obstructive Sleep Apnea Patients



\*\* For Patients with *Central Sleep Apnea and Heart Failure*: On ASV – Contact Sleep Physician or Telehealth and place patient in monitored bed.

#### RULES:

- High risk surgical patients must be monitored in post anesthesia care unit (PACU) for longer duration.
- Patient education provided to patient and caregiver responsible for post-op care/discharge care; including Home O<sub>2</sub>, CPAP, and Sleep Study education by the RT (RN if RT unavailable), and Opioid information given by the RN or Pharmacy.
- At any time if patient requires more than 5 L/min bleed in or if there has been an increase in O<sub>2</sub> need greater than 3 L/min from the starting baseline, contact the Physician/LIP.

#### Legend for Suspected OSA:

<sup>A</sup> Recurrent Respiratory Event (Non-Stimulated Patient) – repeated occurrence of oxygen saturation < 90%, or bradypnea < 8 breaths/minute, or apnea ≥ 10 seconds, or pain sedation mismatch (high pain and sedation scores concurrently). Contact RT / Physician/LIP

<sup>B</sup> Monitored Bed - environment with continuous oximetry and the possibility of early medical intervention (e.g. intensive care unit, step-down unit, or remote pulse oximetry with telemetry in surgical ward).

<sup>C</sup> Positive Airway Pressure (PAP) Therapy – automatically adjusting PAP for surgical patients 5 to 20 cmH<sub>2</sub>O with O<sub>2</sub> bleed in to keep SpO<sub>2</sub> > 90%, or per physician order. Contact Physician/LIP for non-surgical patients.

<sup>D</sup> Consult with RN or Pharmacist caring for patient to determine if opioid use is high dose. See Common Definitions for Opioid Dosing in table below and also an approved Intermountain opioid conversion chart from the Pharmacy in the provided hyperlink as well.

Term	Morphine Equivalents
Low Dose	< 40 mg per day
Medium Dose	41-90 mg per day
High Dose	> 91 mg per day

[opioid conversion chart](#)

**KEY:** ASV: Adaptive Support Ventilation; cmH<sub>2</sub>O: Centimeters of Water Pressure; CPAP: Continuous Positive Airway Pressure; LIP: Licensed Independent Practitioner; L/min: Liters per minute; O<sub>2</sub>: Oxygen; OSA: Obstructive Sleep Apnea; PAP: Positive Airway Pressure; RN: Registered Nurse; RT: Respiratory Therapist; SpO<sub>2</sub>: Pulse Oximeter Oxygen Saturation

## **Protocol 2:**

\*Update 10/2018: Mayo Clinic has now transitioned to using STOP-BANG as the preoperative screening tool, with  $\geq 5$  considered high risk.

This protocol was developed at the Mayo Clinic in Rochester, MN via a clinical practice initiative to identify and manage patients at risk for undiagnosed OSA. We developed a protocol whereby we use the sleep apnea clinical score (SACS) preoperatively (*Figure 1*) combined with a PACU assessment (*Figure 2*) for specific respiratory events (at 3 time periods) to risk stratify patients. We then performed a prospective cohort study to identify patients at high risk for postoperative respiratory complications. This two- phase screening process is currently utilized for all patients undergoing inpatient surgical procedures at our institution.

Patients who are identified as high risk by either the SACS or PACU events that otherwise meet criteria for floor level care are monitored on the floor remotely with pulse oximetry for 24-48 hours after discharge from the PACU. PACU staff can order monitoring independently (*Figure 3*). Floor nurses are made aware of high-risk status at time of transfer to the floor by PACU nursing. Events that are noted by remote oximetry (monitored by respiratory therapy) are reported to the nurse caring for the patient.

## Protocol 2:

\*Update 10/2018: Mayo Clinic has now transitioned to using STOP-BANG as the preoperative screening tool, with ≥5 considered high risk



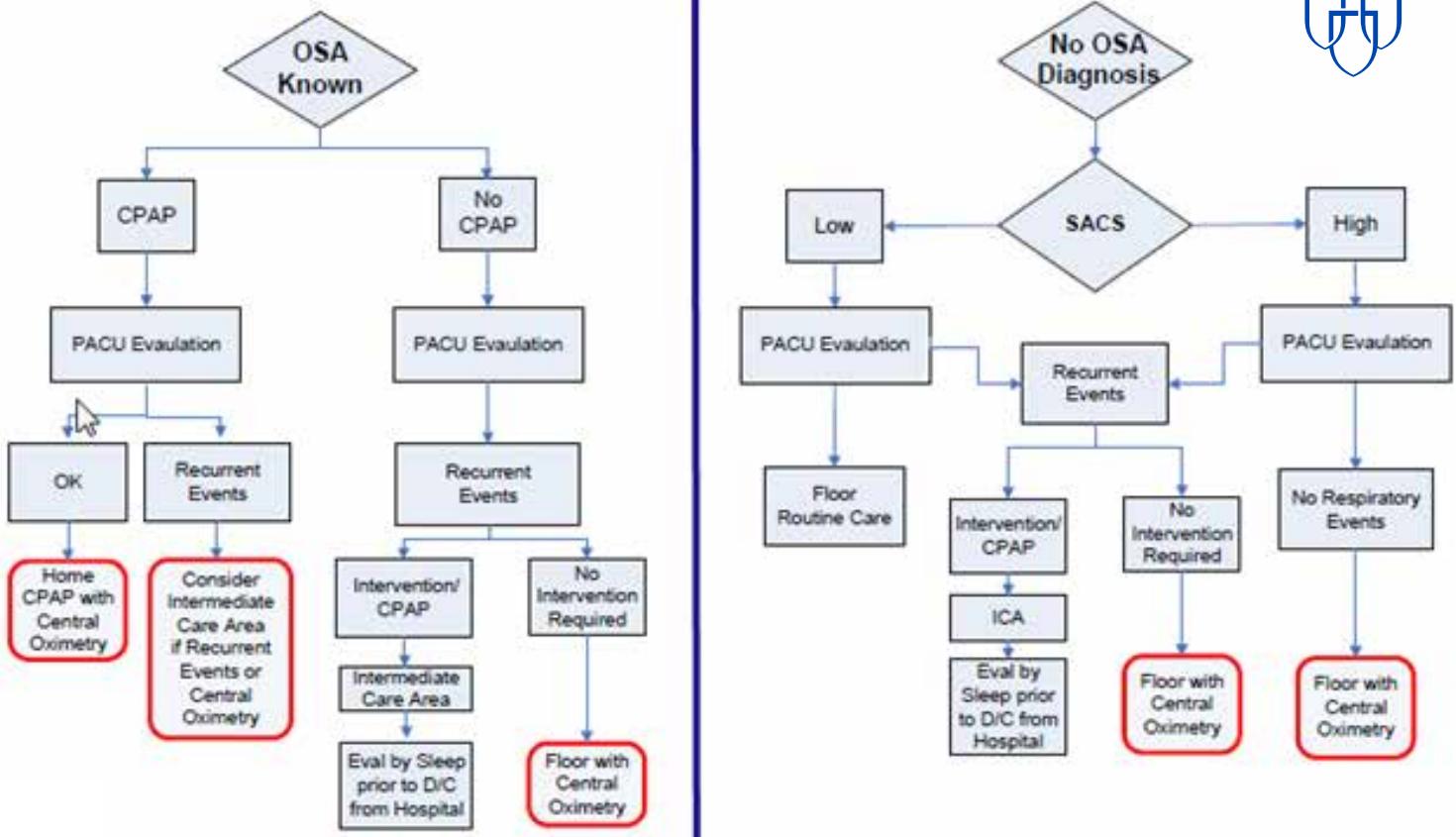
**Figure 1**

PACU Evaluation			
	Evaluation Period		
	<u>Initial</u> 30 min. after extubation or PACU admit (whichever occurs later)	<u>2nd</u> 30 min. after <b>Initial eval.</b> (60 min after extubation or PACU admit)	<u>3rd</u> 30 min. after <b>2nd eval.</b> (90 min after extubation or PACU admit)
<b>Bradypnea:</b> < 8 respirations/minute (3 episodes needed for yes)			
<b>Apnea:</b> ≥ 10 seconds (only 1 episode needed for yes)			
<b>Desaturations:</b> Pulse Ox <90% with nasal cannula (3 episodes needed for yes)			
<b>Pain/Sedation mismatch:</b> RASS score -3 thru -5 <u>and</u> Pain scale score > 5 (only 1 episode needed for yes)			

RASS = Richmond Agitation-Sedation Scale Pain Score = Visual Analog Score  
Recurrent events: if any event occurs at more than one eval period (not necessary to be same event)

\*Update 10/2018: Mayo Clinic has now transitioned to using STOP-BANG as the preoperative screening tool, with ≥5 considered high risk

**Figure 2**



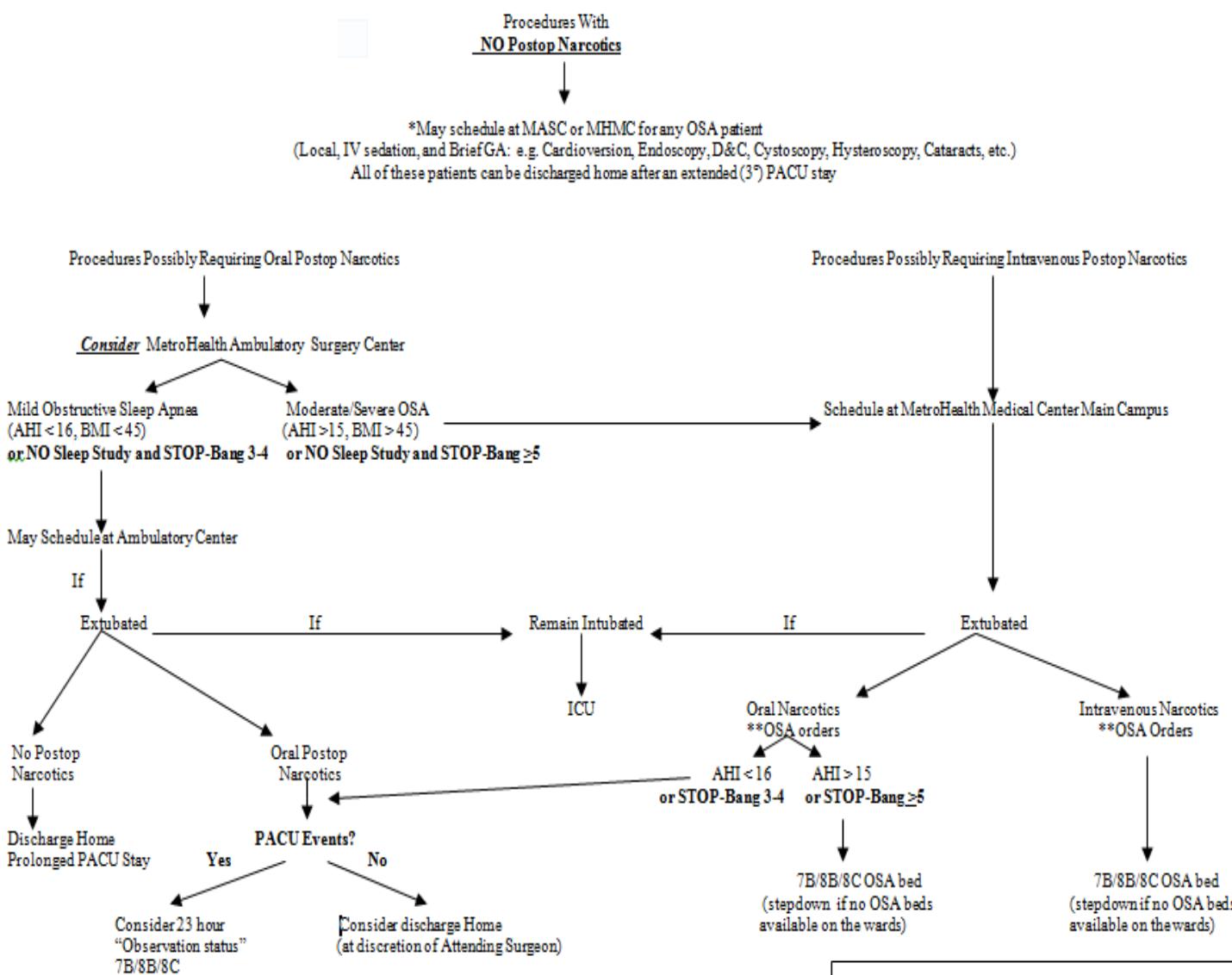
### **Protocol 3:**

This protocol was developed at MetroHealth Medical Center, affiliated with Case Western Reserve University and located in Cleveland, OH. Following the case of an OSA patient undergoing surgery who experienced an adverse outcome directly attributable to OSA, our institution convened a quality committee to determine how best to identify and manage patients with known or suspected OSA preoperatively. The committee included representation from pulmonary / sleep medicine, anesthesiology, surgery, ambulatory surgery, nursing (PACU and floor nursing), hospital administration and the legal department. The goal of the committee was to optimize safety without causing significant disruption to the OR schedule or patient throughput. An algorithm was developed, implemented, and monitored. Quality data was collected and reviewed and the protocol was revised with the current algorithm shown below.

The important decision points of the algorithm take into consideration the presence of known versus suspected OSA (suspected are considered to have at least moderate to severe OSA) and the anticipated or actual use of narcotics postoperatively. In the algorithm, patients are screened in the preoperative screening clinic with the STOP- Bang questionnaire to determine risk for OSA. Recommendations (i.e. minimizing sedatives, avoid supine positioning if possible) are included in the protocol.

## Protocol 3:

### MetroHealth Medical Center Obstructive Sleep Apnea Algorithm



- AHI = Apnea Hypopnea Index
- OSA = Obstructive Sleep Apnea
- Avoid Narcotics whenever possible
- Consider PCA without basal rate
- Regional Anesthesia and Neuraxial Opioids whenever possible
- All sedatives, hypnotics, and medications with sedation as side effect should be avoided whenever possible (e.g. benadryl, flexeril, benzodiazepines, halcion, antidepressants with sedation etc.)

\*All OSA patients require prolonged recovery period

\*\*See preprinted OSA physician order form

OSA beds = floor beds with continuous pulse oximetry monitoring capability (alarms at nursing station)

MASC = ambulatory surgery site

MHMC = main campus surgery site

## **Protocol 4:**

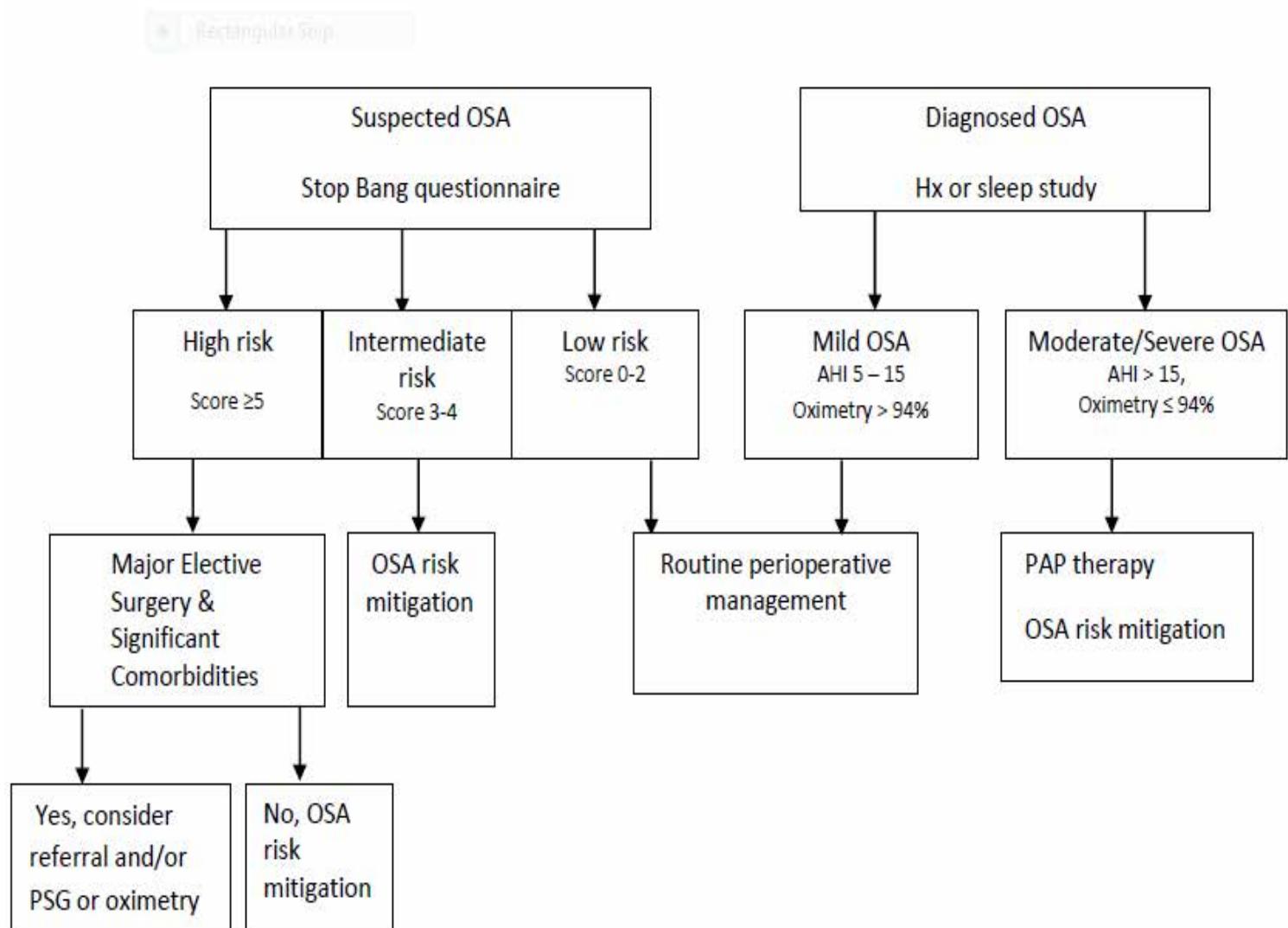
This protocol comes from Toronto Western Hospital, part of the University Health Network at the University of Toronto (Canada) as well as Khoo Teck Puat Hospital, part of Alexandra Health System (Singapore). The perioperative functional algorithms were formulated with input from various academic medical centers including San Diego Health Care System, Kingston General Hospital, Beth Israel Deaconess Medical Center, MetroHealth Medical Center, University of California, and the Ottawa Hospital.

1. The algorithms have been published and address the following issues:
2. Evaluation of a known / diagnosed OSA patient preoperatively (*Figure 1*).
3. Evaluation of a suspected OSA preoperatively (*Figure 1*).
4. Minimize/mitigate the risk posed by OSA intraoperatively (*Table 1*).
5. Determination of postoperative disposition of a known diagnosed OSA patient after general anesthesia (*Figure 2*).
6. Determination of the postoperative disposition of a suspected OSA patient after general anesthesia (*Figure 2*).

## Protocol 4:

**Figure 1: Preoperative Evaluation of Suspected or Diagnosed OSA Patient**

Figure 1: Preoperative Evaluation of Suspected or Diagnosed OSA Patient in the Anesthesia Clinic



Adapted from Seet E, Chung F Can J Anesth 2010; 57: 849-64

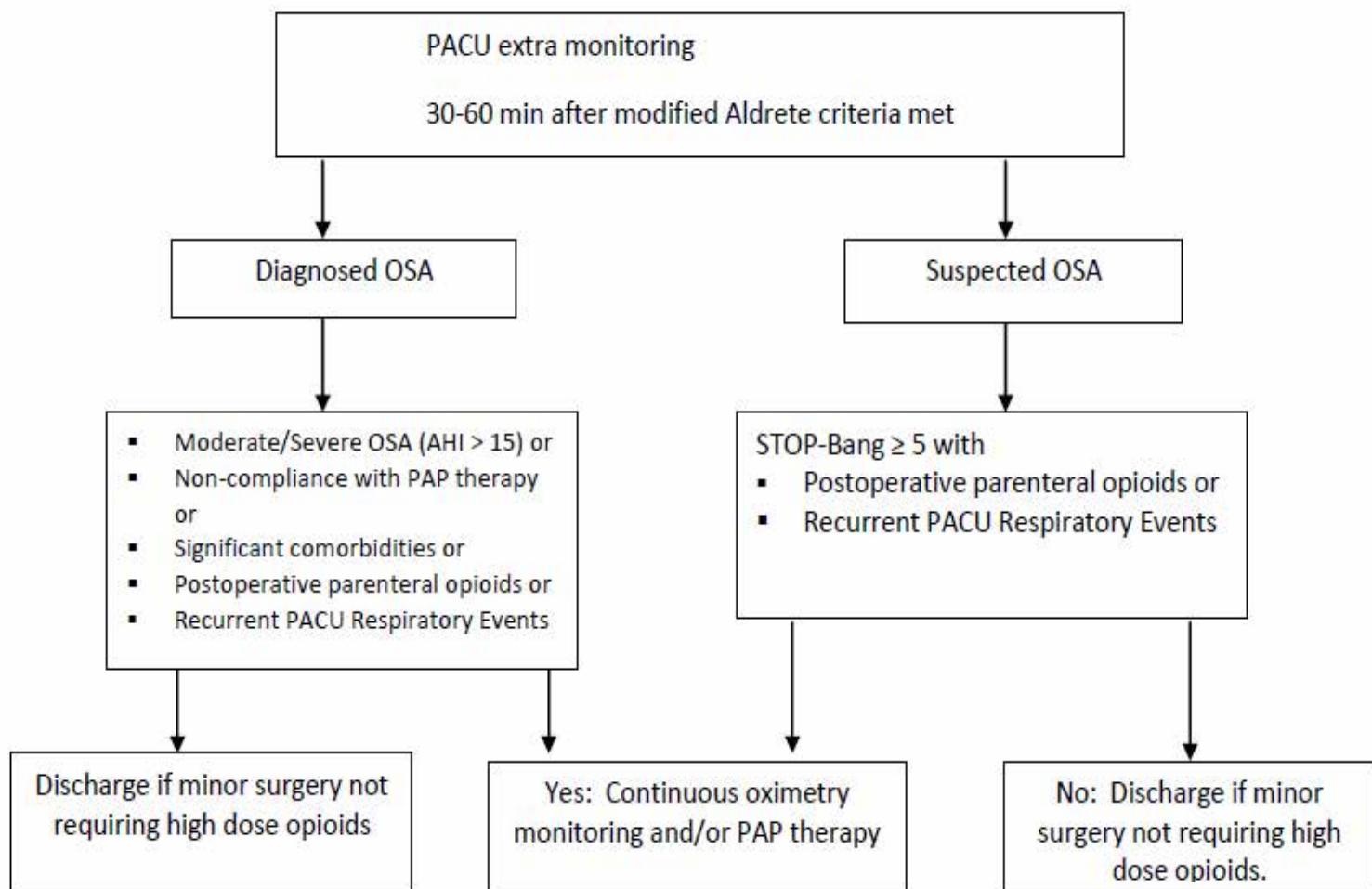
**Protocol 4:****Table 1: Intraoperative Precautions and Strategies**

Anesthetic Concern	Principles of Management
Premedication	Avoid sedating premedication Consider Alpha-2 adrenergic agonists (clonidine, dexmedetomidine)
Potential difficult airway (difficult mask ventilation and tracheal intubation)	Optimal positioning (Head Elevated Laryngoscopy Position) if patient obese Adequate preoxygenation Consider CPAP preoxygenation Two-handed triple airway maneuvers Anticipate difficult airway. Personnel familiar with a specific difficult airway algorithm
Gastroesophageal reflux disease	Consider proton pump inhibitors, antacids, rapid sequence induction with cricoid pressure
Opioid-related respiratory depression	Minimize opioid use Use of short-acting agents (remifentanil) Multimodal approach to analgesia (NSAIDs, acetaminophen, tramadol, ketamine, gabapentin, pregabalin, dexmedetomidine, clonidine, Dexamethasone, melatonin) Consider local and regional anesthesia where appropriate
Carry-over sedation effects from longer-acting intravenous and volatile anesthetic agents	Use of propofol / remifentanil for maintenance of anesthesia Use of insoluble potent anesthetic agents (desflurane) Use of regional blocks as a sole anesthetic technique
Excessive sedation in monitored anesthetic care	Use of intraoperative capnography for monitoring of ventilation
Post-extubation airway obstruction	Verify full reversal of neuromuscular blockade Extubate only when fully conscious and cooperative Non-supine posture for extubation and recovery Resume use of positive airway pressure device after surgery

## Protocol 4:

**Figure 2: Postoperative Disposition of Known and Suspected OSA Patient**

Figure 2 - Postoperative Management of the Diagnosed or Suspected OSA Patient after General Anesthesia



Adapted from Seet E, Chung F Can J Anesth 2010; 57: 849-64

### Legend

<sup>a</sup> Positive Airway Pressure (PAP) therapy - including continuous PAP, bilevel PAP, or automatically adjusting PAP.

<sup>b</sup> Significant comorbidities – heart failure, arrhythmias, uncontrolled hypertension, cerebrovascular disease, metabolic syndrome, obesity BMI > 35kg/m<sup>2</sup>

<sup>c</sup> Recurrent Postanesthesia Care Unit (PACU) Respiratory Event – repeated occurrence of oxygen saturation < 90%, or bradypnea < 8 breaths / min, or apnea ≥ 10 s, or pain sedation mismatch (high pain and sedation scores concurrently).<sup>21</sup>

<sup>d</sup> Monitored bed - environment with continuous oximetry and the possibility of early medical intervention (e.g. intensive care unit, step-down unit, or remote pulse oximetry with telemetry in surgical ward).

<sup>e</sup> Equianalgesic doses of oral opioids – Codeine 60mg Q4H, Oxycodone 5mg Q4H, Hydromorphone 2mg Q4H

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**Abbreviations:**

ACNP	Acute Care Nurse Practitioner
APRN	Advanced Practice Registered Nurse
BS	Bachelor of Science
BSN	Bachelor of Science in Nursing
CHSE	Certified Healthcare Simulation Educator
CNP	Certified Nurse Practitioner
CCNS	Certified Clinical Nurse Specialist
DNP	Doctor of Nursing Practice
FAAN	Fellows of the American Academy of Nursing
FAANP	Fellows of the American Association of Nurse Practitioners
NE-BC	Nurse Executive-Board Certification
MBA	Master of Business Administration
MD	Medical Doctor
MSN	Master of Science Nursing
PA	Physician Assistant
PhD	Doctor of Philosophy
RN	Registered Nurse
RPSGT	Registered Polysomnographic Technologist
RRT	Registered Respiratory Therapist

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