Evaluation and Management of Sleep-Disordered Breathing in Adult Nonsurgical Inpatients:

An American Academy of Sleep Medicine Clinical Practice Guideline

Introduction: The purpose of this guideline is to establish clinical practice recommendations for the management of sleep-disordered breathing in medically hospitalized adults.

Methods: The American Academy of Sleep Medicine (AASM) commissioned a task force of experts in sleep medicine to develop recommendations and assign strengths based on a systematic review of the literature and an assessment of the evidence using Grading of Recommendations, Assessment, Development and Evaluation methodology. The task force provided a summary of the relevant literature and the certainty of evidence, the balance of benefits and harms, patient values and preferences, and resource use considerations that support the recommendations. The AASM Board of Directors approved the final recommendations.

Good Practice Statement: The following good practice statement is based on expert consensus, and its implementation is necessary for the appropriate and effective management of hospitalized adults with sleep-disordered breathing: For medically hospitalized adults with an established diagnosis of sleep-disordered breathing and on active treatment, existing treatment should be continued rather than withholding treatment, unless contraindicated.

Recommendations: The following recommendations are intended as a guide for clinicians in managing medically hospitalized adults with sleep-disordered breathing. Each recommendations statement is assigned a strength ("Strong" or "Conditional"). A "Strong" recommendation (i.e., "We recommend…") is one that clinicians should follow under most circumstances. A "conditional" recommendation (i.e., "We suggest…") is one that requires that the clinician use clinical knowledge and experience and strongly consider the patient's values and preferences to determine the best course of action.

1. For medically hospitalized adults at increased risk for sleep-disordered breathing, the AASM suggests in-hospital screening for OSA as part of an evaluation and management pathway that incorporates diagnosis and treatment with positive airway pressure rather than no in-hospital screening. (Conditional recommendation, low certainty of evidence)
Remarks: Screening may include validated questionnaires and/or screening with overnight high-resolution pulse oximetry. When considering screening as part of a management pathway, patients who place a lower value on the potential reduction in clinically meaningful outcomes (e.g., cardiovascular events) or clinicians who may perceive that the diagnosis or management of OSA may interfere with medical care and a higher value on the possible downsides associated with the use of PAP (e.g., sleep disruption, discomfort) would reasonably decline OSA screening or PAP during the hospitalization.

2. For medically hospitalized adults with an established diagnosis of moderate-to-severe sleep-disordered breathing and not currently on treatment, the AASM suggests the use of inpatient treatment with positive airway pressure rather than no positive airway pressure. (Conditional recommendation, low certainty of evidence)
Remarks: Patients who place a lower value on the potential reduction in clinically meaningful outcomes (e.g., cardiovascular events, and a higher value on the possible downsides associated with the use of PAP (e.g., sleep disruption, discomfort) or clinicians who may perceive that the management of OSA may interfere with medical care would reasonably decline PAP during hospitalization.

3. For medically hospitalized adults at increased risk for or with an established diagnosis of sleep-disordered breathing, the AASM suggests that sleep medicine consultation be available as part of an evaluation and management pathway, rather than no sleep medicine consultation. (Conditional recommendation, very low certainty of evidence)
Remarks: It is recognized that there will be variability of the availability of hospital-based expertise and resources specific to sleep medicine consultation; therefore, we provide specific guidance as follows. Oversight by a board-certified sleep medicine clinician and/or an AASM-accredited sleep center is preferable. However, elements of this consultation including education and follow-up plan can be provided by those with requisite expertise including advanced practitioners, nurses, sleep technologists, respiratory therapists, care coordinators, case managers, health educators, or other available resources. Given the variability of expertise and resources available, creative consultation models of care such as teleconsult/telehealth, E-consult and/or nursing or respiratory therapist care can be considered. Consider availability of inpatient diagnostics and treatment as part of the consultation.

4. For medically hospitalized adults at increased risk for or with an established diagnosis of sleep-disordered breathing, the AASM suggests a discharge management plan to ensure timely diagnosis and effective management of sleep-disordered breathing, rather than no plan. (Conditional recommendation, very low certainty of evidence)
Remarks: Consider ordering post-discharge testing or sleep medicine evaluation prior to discharge. Inpatient sleep testing prior to discharge and/or telehealth medicine may be options to reduce barriers to care. Consider care coordination to ensure appropriate follow-up and post-discharge care.

Keywords: obstructive sleep apnea, OSA, sleep-disordered breathing, hospital, inpatient, positive airway pressure, PAP
Citation:

INTRODUCTION

This clinical practice guideline is the first of the American Academy of Sleep Medicine (AASM) to address the topic of inpatient sleep medicine with a focus on sleep-disordered breathing (SDB) in medically hospitalized adults. The guideline was developed with attention to alignment with previously published AASM guidelines on Diagnostic Testing for Obstructive Sleep Apnea[1] and Treatment of Adult Obstructive Sleep Apnea with Positive Airway Pressure[2]. Given that these prior guidelines were not created to address or focus attention on the evaluation and management of SDB in the hospitalized patient population, the AASM recognized the need for guidance in this area and convened a task force (TF) to address this existing gap in synthesized knowledge. The guideline is focused on the recognition and management of SDB in adult patients admitted to the hospital for medical inpatient care given that 1) this topic represents an area of growing concern, 2) it involves an inherently diverse and complex patient population, and 3) a systematic synthesis of the existing literature and knowledge to inform and guide clinical practice is lacking. This guideline, in conjunction with the accompanying systematic review, provides a comprehensive update of the available evidence and a synthesis of clinical practice recommendations for the screening, diagnosis and management of suspected or established inpatient SDB in medically hospitalized adults. SDB includes a range of breathing disorders during sleep including obstructive sleep apnea (OSA), central sleep apnea (CSA) and sleep-related hypoventilation. The term SDB is used throughout the text; however, it typically refers to OSA unless otherwise specified as the vast majority of evidence was focused on OSA. The recommendations of this guideline are not intended for hospitalized patients with acute or chronic respiratory failure requiring noninvasive ventilatory support, nor are the recommendations crafted to address SDB considerations in the perioperative surgical or procedural inpatient population. Patients with sleep-related hypoventilation (e.g., due to obesity, opiates, etc.) as a subgroup of SDB may be at high risk for poor clinical outcomes in the inpatient setting. Although an existing guideline provides recommendations for treatment of obesity hypoventilation syndrome in the inpatient settings based upon limited individual level patient data,[3] given the insufficient evidence regarding optimal inpatient management approaches for hypoventilation syndromes, the current guideline did not focus on this clinical entity. It is also important to recognize that sleep disorders other than SDB (e.g., parasomnias, restless legs syndrome) and hospital-specific environmental sleep disruption are also not the focus of this guideline. The recommendations are intended to provide guidance to optimize patient-centric inpatient clinical paradigms by broadly informing clinicians who care for the medically hospitalized patient population with suspected or an established diagnosis of SDB.

METHODS

The AASM commissioned a TF of sleep medicine clinicians with expertise in the management of hospitalized adults for acute medical illness (nonsurgical population) with SDB. The TF was required to disclose all potential

conflicts of interest (COI), per the AASM's COI policy, prior to being appointed to the TF and throughout the research and writing of these documents. In accordance with the AASM's COI policy, TF members with a Level 1 conflict were not allowed to participate. TF members with a Level 2 conflict were required to recuse themselves from any related discussion or writing responsibilities. All relevant conflicts of interest are listed in the Disclosures section.

The TF conducted a systematic review of the published scientific literature, focusing on patient-oriented, clinically relevant outcomes. The key terms, search limits, and inclusion/exclusion criteria specified by the TF are detailed in the supplemental material of the accompanying systematic review.[4] The purpose of the review was to determine whether the interventions of inpatient screening, diagnostics, treatment, sleep consultation, physiologic monitoring, and post-discharge management provided clinically meaningful improvements in relevant outcomes relative to no intervention on SDB. The TF set a clinical significance threshold (CST) for each outcome to determine whether the mean differences between intervention and control or before and after intervention in the outcomes assessed were clinically meaningful.[4] The TF then developed clinical practice recommendations according to the Grading of Recommendations Assessment, Development and Evaluation (GRADE) process.[5, 6] The TF assessed the following four components to determine the direction and strength of a recommendation: certainty of evidence, balance of beneficial and harmful effects, patient values and preferences, and resource use. Details of these assessments can be found in the accompanying systematic review.[4] Taking these major factors into consideration, each recommendation statement was assigned a strength ("Strong" or "Conditional"). Additional information is provided in the form of "Remarks" immediately following the recommendation statements, when deemed necessary by the TF. Remarks are based on the evidence evaluated during the systematic review and are intended to provide context for the recommendations and to guide clinicians in the implementation of the recommendations in daily practice.

This clinical practice guideline reflects the evidence and state of knowledge at the time of the last literature search, August 2023. Scoping literature searches are performed on all published AASM clinical practice guidelines on an annual basis to review new evidence. Based on this review, updates may be made if there are significant changes in areas such as the available interventions, outcomes of interest (or values placed on outcomes), or evidence of the existing benefits and harms.

Of note, when direct evidence was lacking, the panel relied on indirect evidence that included screening and diagnostic assessment together as part of a care management pathway.

GOOD PRACTICE STATEMENT

The following good practice statement is based on expert consensus, and its implementation is suggested for appropriate and effective management of hospitalized adults diagnosed with SDB.

For medically hospitalized adults with an established diagnosis of sleep-disordered breathing and on active treatment, existing treatment should be continued rather than withholding treatment, unless contraindicated. (Good Practice Statement)

Key Points

- Treatment of SDB should be continued regardless of modality (e.g., PAP, hypoglossal nerve stimulation therapy, oral appliance therapy, pharmacotherapies) if feasible given the clinical setting.
- Using the patient's own PAP device and mask interface is preferred, unless prohibited or not feasible.

- PAP use/mask type/pressure and device settings or use of other treatment modalities should be documented in the electronic medical record.
- Relative contraindications to providing PAP therapy include (but not limited to) facial trauma with concerns for pneumocephalus, aspiration concerns and/or facial burns precluding use of a mask interface.

The importance of the implementation of this good practice statement is supported by large population studies identifying estimates of continuation of in-hospital PAP therapy as low as 5.8%.[7, 8] Home PAP settings should be used (theoretically the optimal therapeutic setting) recognizing that given changes in physiology often attributable to the indication for hospitalization, e.g., exacerbation of cardiopulmonary disease and/or hypoventilation may necessitate reassessment of therapy and potential need for concomitant supplemental oxygen. PAP use may be contraindicated during the hospitalization due to aspiration risk and/or facial trauma among other reasons.[9] Measures to mitigate SDB severity which should be considered include lateral sleeping, elevating the head of the bed and judicious use of opiates and sedatives, particularly in patients with untreated SDB.[10] As medication dosage and frequency are documented as part of medication reconciliation with patient intake as a quality and safety measure, so should the PAP device type including pressure delivery type, i.e. fixed PAP settings versus auto-adjusting PAP, mode of delivery, mask type and size and manufacturer type.[10, 11]

Use of home PAP devices in the hospital can be associated with cost savings,[12] therapeutic benefits, as well as patient comfort and effective adherence due to use of home humidification settings and optimal mask type/fit. Clinical engineering approval of the PAP device prior to use in the hospital is often required. Hospitals often use waivers of liability specific to use of home PAP devices. If inpatient use of home PAP devices is not permitted, an adequate supply of hospital devices should be available that support different modalities (e.g., CPAP, auto-adjusting PAP, bilevel PAP, adaptive servoventilation (ASV), volume assured pressure support (VAPS)) and respiratory therapy resources to support device set-up and use. Recommendations to continue therapy apply not only to PAP therapy, but also to alternative PAP modalities including oral appliances and hypoglossal nerve stimulation (HNS).

RECOMMENDATIONS

The recommendations in this guideline were formulated to meet the needs of most patients in most situations. A "strong" recommendation is one that clinicians should follow for almost all patients (i.e., something that might qualify as a quality measure). A "conditional" recommendation reflects a lower degree of certainty in the appropriateness of the patient care strategy for all patients. It requires that the clinician uses clinical knowledge and experience and strongly considers the individual patient's values and preferences to determine the best course of action. The ultimate judgment regarding any specific care must be made by the treating clinician and the patient, taking into consideration the individual circumstances of the patient, available treatment options, and resources. The AASM expects this guideline to have an impact on professional behavior, patient outcomes, and -- possibly -- health care costs.

The following clinical practice recommendations are based on a systematic review and evaluation of evidence using the GRADE process. The implications of the strength of recommendations for guideline users are summarized in **Table 1**. Remarks are provided to guide clinicians in the implementation of these recommendations. **Table 2** summarizes the recommendations for interventions in adult populations. A flowchart for the implementation of the recommendations is presented in **Figure 1**.

172 **Table 1 – Implications of Strong and Conditional Recommendations for Users of AASM Clinical Practice**
173 **Guidelines**

User	Strong Recommendations *"We Recommend…"*	Conditional Recommendations *"We Suggest…"*
Clinicians	Almost all patients should be offered the recommended course of action. Adherence to this recommendation could be used as a quality criterion or performance indicator.	Most patients should be offered the suggested course of action; however, different choices may be appropriate for different patients. The clinician must help each patient determine if the suggested course of action is clinically appropriate and consistent with their values and preferences.
Patients	Almost all patients should be offered the recommended course of action, although a small proportion of patients would not choose it.	Most patients should be offered the suggested course of action, though some may not choose it. Different choices may be appropriate for different patients. The patient should work with their clinician to determine if the suggested course of action is clinically appropriate and consistent with their values and preferences.
Policy Makers	The recommended course of action can be adopted as policy for most situations. Adherence to the recommended course of action could be used as a quality criterion or performance indicator.	The ultimate judgment regarding the suitability of the suggested course of action must be made by the clinician and patient together, based on what is best for the patient. This decision-making flexibility should be accounted for when establishing policies.

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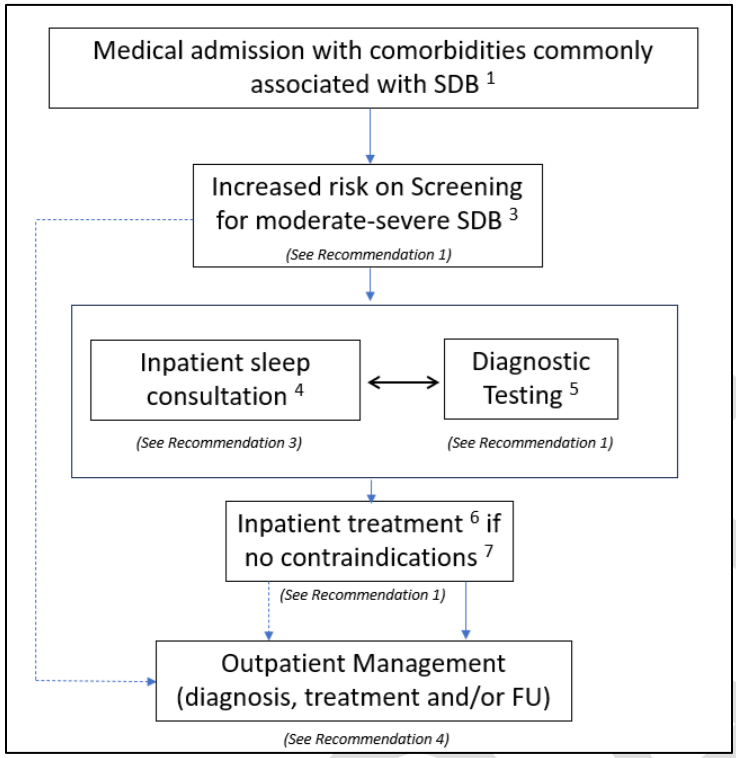
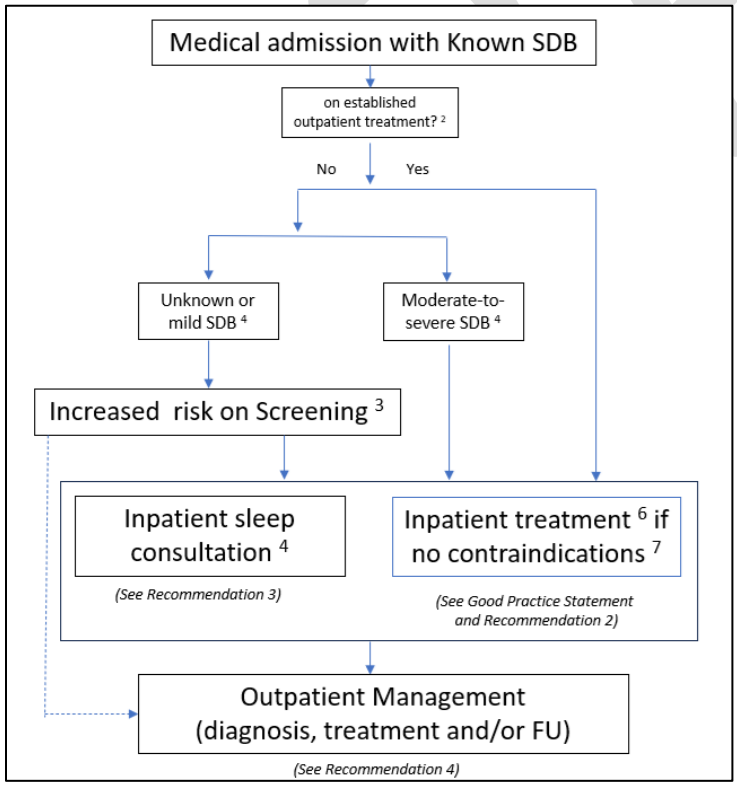
175 **Table 2 – Summary of recommended interventions in adult populations**

Intervention	Strength of recommendation	Presence of Improvements in Critical Outcomes Meeting CST*				
		Mortality	Incidence of SDB-related Comorbidities	Stroke Recovery	Readmission	# of Follow-up Diagnoses
Inpatient Screening, Diagnosis & Treatment (management pathway, no prior SDB diagnosis)	Conditional For	Y	Y	N	N	--
Inpatient Treatment (established SDB diagnosis)	Conditional For	Y	Y	N	N	--
Inpatient Sleep Consultation	Conditional For	--	--	--	--	Y
Peri-Discharge Management	Conditional For	Y	Y	N	Y	--

176 -- Outcome not reported.*CSTs can be found in the accompanying systematic review. CST = clinical significance threshold

Figure 1 – Inpatient Sleep-Disordered Breathing Management Pathways





1. With signs and symptoms that indicate moderate to severe SDB and/or high-risk comorbidities (e.g., Heart failure, Atrial fibrillation, Acute coronary syndrome, Chronic obstructive pulmonary disease, Pulmonary hypertension, Stroke, Severe obesity)

2. Using regularly and benefitting from treatment

3. STOP-BANG, STOP, High resolution pulse oximetry, or pulse oximetry

4. Shared decision making on whether to re-evaluate, continue treatment, or monitor

5. Portable sleep apnea testing or polysomnogram with need approved by sleep team and interpreted by sleep physician

6. Consider inpatient treatment in some scenarios like hypoxia/comorbidities; shared decision-making should consider SDB severity, patient values and access to resources

7. Relative contraindications (e.g., facial trauma/burns, aspiration risk, NG tube)

INPATIENT SCREENING, DIAGNOSIS, & TREATMENT OF MEDICALLY HOSPITALIZED ADULTS WITH NO PRIOR DIAGNOSIS OR TREATMENT OF SLEEP-DISORDERED BREATHING

Recommendation 1: For medically hospitalized adults at increased risk for sleep-disordered breathing, the AASM suggests in-hospital screening for OSA as part of an evaluation and management pathway that incorporates diagnosis and treatment with positive airway pressure rather than no in-hospital screening. (Conditional recommendation, low certainty of evidence)

Remarks:

- *Screening may include validated questionnaires and/or screening with overnight high-resolution pulse oximetry.*
- *When considering screening as part of a management pathway, patients who place a lower value on the potential reduction in clinically meaningful outcomes (e.g., cardiovascular events) or clinicians who may perceive that the diagnosis or management of OSA may interfere with medical care and a higher value on the possible downsides associated with the use of PAP (e.g., sleep disruption, discomfort) would reasonably decline OSA screening or PAP during the hospitalization.*
- *High risk for OSA is defined by signs and symptoms that suggest moderate to severe OSA and/or association of high-risk comorbidities, i.e., excessive daytime somnolence + 2 of the following: diagnosed hypertension; habitual loud snoring; witnessed apnea, gasping, or choking.*
- *Diagnostic testing for OSA should be ideally conducted when a patient has been medically optimized during their hospital stay.*

The TF identified 8 RCTs in which the pooled estimates demonstrated clinically meaningful improvements in mortality and incidence of SDB-related comorbidities (cardiovascular events), and non-clinically meaningful improvements in stroke recovery and readmission. In the setting of limited direct evidence, the recommendation was framed as screening in the context of a management pathway given the inherent inter-relationships between

inpatient OSA screening, diagnosis and treatment and the challenges of interpreting indirect evidence in each of these domains in isolation. Although screening of SDB occurs in the inpatient setting, we also note the variability in the studies in terms of inpatient versus outpatient diagnostic assessments and timing of treatment initiation. The diagnostic and management components of the pathway could occur either in the inpatient or outpatient setting depending upon the study.

The overall certainty of evidence was low due to risk of bias and imprecision. The cost for an evaluation and management pathway in the hospital was judged to vary, depending on the availability of staff and equipment. The intervention was feasible to implement.

INPATIENT TREATMENT OF MEDICALLY HOSPITALIZED ADULTS WITH AN ESTABLISHED DIAGNOSIS OF SLEEP-DISORDERED BREATHING AND NOT CURRENTLY ON TREATMENT

Recommendation 2: For medically hospitalized adults with an established diagnosis of moderate-to-severe sleep-disordered breathing and not currently on treatment, the AASM suggests the use of inpatient treatment with positive airway pressure rather than no positive airway pressure. (Conditional recommendation, low certainty of evidence)

Remarks:

- *Patients who place a lower value on the potential reduction in clinically meaningful outcomes (e.g., cardiovascular events, and a higher value on the possible downsides associated with the use of PAP (e.g., sleep disruption, discomfort) or clinicians who may perceive that the management of OSA may interfere with medical care would reasonably decline PAP during hospitalization.*

The TF identified 16 RCTs in which the pooled estimates demonstrated clinically meaningful improvements in mortality and incidence of SDB-related comorbidities (cardiovascular events), and non-clinically meaningful improvements in stroke recovery and readmission.

The overall certainty of evidence was low due to risk of bias and imprecision. The cost for the use of positive airway pressure in the hospital was judged to be moderate. The intervention was feasible to implement.

INPATIENT SLEEP CONSULTATION OF MEDICALLY HOSPITALIZED ADULTS AT INCREASED RISK OR WITH AN ESTABLISHED DIAGNOSIS OF SLEEP-DISORDERED BREATHING

Recommendation 3: For medically hospitalized adults at increased risk for or with an established diagnosis of sleep-disordered breathing, the AASM suggests that sleep medicine consultation be available as part of an

evaluation and management pathway, rather than no sleep medicine consultation. (Conditional recommendation, very low certainty of evidence)

Remarks:

- *It is recognized that there will be variability of the availability of hospital-based expertise and resources specific to sleep medicine consultation; therefore, we provide specific guidance as follows. Oversight by a board-certified sleep medicine clinician and/or an AASM-accredited sleep center is preferable. However, elements of this consultation including education and follow-up plan can be provided by those with requisite expertise including advanced practitioners, nurses, sleep technologists, respiratory therapists, care coordinators, case managers, health educators, or other available resources. Given the variability of expertise and resources available, creative consultation models of care such as teleconsult/telehealth, E-consult and/or nursing or respiratory therapist care can be considered.*
- *Consider availability of inpatient diagnostics and treatment as part of the consultation.*

The TF identified 1 observational study in which the pooled estimate demonstrated a clinically meaningful improvement in the number of follow-ups of patients with OSA diagnosed by polysomnography. The TF discussed that although the conditional recommendation is based on a single observational study, there is high value of the downstream benefits of inpatient consultation including outpatient outcomes of an established diagnosis. Indirect evidence supports that the diagnosis of OSA may also lead to improvement in clinical outcomes, particularly in high-risk populations such as those with cardiopulmonary or neurologic disease. The inpatient consultation also provides a platform for more systematic implementation of guideline recommendations of inpatient OSA evaluation and management. This conditional recommendation is aligned with data supporting the overall value of sleep medicine specialist expertise in the management of SDB.[13] The diagnostic and management components of the pathway could occur either in the inpatient or outpatient setting.

The overall certainty of evidence was very low due to risk of bias associated with observational studies. The cost for sleep medicine consultation in the hospital was judged to vary, depending on the availability of staff and equipment. The intervention was feasible to implement.

PERI-DISCHARGE MANAGEMENT OF MEDICALLY HOSPITALIZED ADULTS AT INCREASED RISK OR WITH AN ESTABLISHED DIAGNOSIS OF SLEEP-DISORDERED BREATHING

Recommendation 4: For medically hospitalized adults at increased risk for or with an established diagnosis of sleep-disordered breathing, the AASM suggests a discharge management plan to ensure timely diagnosis and effective management of sleep-disordered breathing, rather than no plan. (Conditional recommendation, very low certainty of evidence)

Remarks:

- *Timeliness: Consider an expedited evaluation and management plan to optimize post-discharge outcomes.*
- *Linkage to care: Consider ordering post-discharge testing or sleep medicine evaluation prior to discharge. Inpatient sleep testing prior to discharge and/or telehealth medicine may be options to reduce barriers to care.*
- *Population management: Consider care coordination to ensure appropriate follow-up and post-discharge care.*

The TF identified 1 RCT and 6 observational studies in which the pooled estimates demonstrated clinically meaningful improvements in mortality, incidence of SDB-related comorbidities (recurrent myocardial infarction, cardiovascular events), readmission, and PAP adherence.

The overall certainty of evidence was very low due to risk of bias associated with observational studies and imprecision. The cost for a peri-discharge management plan in the hospital was judged to vary, depending on the availability of staff and equipment. The intervention was feasible to implement.

INPATIENT PHYSIOLOGIC MONITORING OF MEDICALLY HOSPITALIZED ADULTS AT INCREASED RISK OR WITH AN ESTABLISHED DIAGNOSIS OF SLEEP-DISORDERED BREATHING

For non-surgical hospitalized adults at risk for or with a diagnosis of sleep-disordered breathing, the AASM makes no recommendation regarding inpatient physiologic monitoring (e.g., oximetry and/or capnography monitoring). There was insufficient evidence to make a recommendation, and further research and innovation are needed.

DISCUSSION

The merit and value of addressing SDB in the hospitalized adult resides in the confluence of the high prevalence of SDB of the inpatient population,[14-17] the association of unrecognized SDB with poor health outcomes, and decrements in quality of life, and the unique opportunity that the inpatient hospital setting presents to identify and manage SDB in those with high acuity. These individuals, most often with high morbidity, are at risk for consequences of underdiagnosis and undertreatment of SDB and most vulnerable to adverse outcomes, not only during their inpatient stay, but also for the long-term. The existing paradigm has focused thus far on the outpatient management of SDB; therefore, this clinical practice guideline was developed to focus on SDB evaluation and management in the inpatient setting. The recommendations culminate from the interpretation of the aggregated evidence from the systematic review of literature on SDB in the medically hospitalized adult. Four conditional recommendations are presented, including: 1) in-hospital screening for OSA as part of an evaluation and management pathway in at-risk patients that incorporates diagnosis and treatment with PAP therapy, 2) use of inpatient PAP therapy in those with an established diagnosis of moderate-to-severe SDB, 3) sleep medicine

consultation availability as part of an evaluation and management pathway in those with increased SDB risk or established SDB, and 4) a discharge management plan for timely diagnosis and effective management of SDB.

INPATIENT SDB SCREENING AS PART OF THE MANAGEMENT PATHWAY

Approach to SDB Screening

Several studies have shown an estimated prevalence of SDB in inpatients ranging from 25% to 77%.[14-17] Given the high burden of undiagnosed SDB, there is an opportunity to screen and identify patients in the hospitalized setting who are more likely to be susceptible to adverse clinical outcomes if they have moderate to severe untreated SDB. Some studies have used screening questionnaires such as the STOP-Bang questionnaire and others have utilized overnight continuous high resolution pulse oximetry or limited portable sleep apnea screening devices. While questionnaires can be used to assess for SDB likelihood in patients with high pre-test probability for SDB , limited objective testing offers the added benefit of assessing SDB severity.[18-21] A two-step screening protocol using both a questionnaire followed by objective testing (high resolution pulse oximetry, HRPO or home sleep apnea testing, HSAT) has shown feasibility and a high positive predictive value when validated against gold standard PSG in obese patients, with favorable resource utilization[22, 23]

High Risk Inpatient Subgroups and Timing of SDB Evaluation

Screening and diagnostics are recommended to be performed when patients are in a relatively stable condition after the resolution of an acute event, (e.g., decompensated HF, chronic obstructive pulmonary disease (COPD) exacerbation). Relative contraindications to objective screening and diagnostics may include supplemental oxygen requirements $\geq$ 3L/min, severe pain, impaired mental status, and sleep disruption due to conditions such pain, nebulizer treatments or blood draws.[23, 24] Many of the high-risk comorbidities (e.g., heart failure, atrial fibrillation, acute coronary syndrome, stroke, pulmonary hypertension) that warrant screening may merit eventual in-lab sleep testing for more detailed assessment of sleep-related hypoventilation, sleep-related hypoxia, and/or central sleep apnea. Therefore, while portable ("home") Type III sleep studies may not be the ideal diagnostic approach, they may still hold value to risk-stratify patients for clinical decision-making. Patients at high-risk for OSA are at increased risk for rapid response team (RRT) events.[25] Similarly, high-risk patients for SDB who are using narcotics may be at higher risk for escalation of care[26] and pre-emptive SDB detection may be beneficial. Screening for SDB in patients admitted for COPD exacerbation can help determine risk for both readmission and mortality in 6 months.[27] Patients with stroke may benefit from SDB screening, especially when admission to inpatient rehabilitation and long-term care facilities may otherwise delay outpatient follow-up. Patients with acute-on-chronic respiratory failure who are admitted to hospitals and require non-invasive positive pressure ventilation (NIPPV) at discharge are often required by some insurance providers to rule out OSA prior to NIPPV coverage. An inpatient sleep screening program utilizing objective testing may help with early approval of NIPPV at the time of discharge.[28]

SDB Inpatient Diagnostic Approaches

The decision to conduct inpatient screening alone versus diagnostic testing with either HSAT or PSG with or without titration is often a question of resources, costs, patient selection and ensuring coordination of sleep care post-hospitalization. Given resource and personnel limitations, full PSG in the inpatient setting is not available in most institutions, however, feasibility and benefit of PSG using a wireless system has shown feasibility in the

inpatient setting.[29] Some inpatient sleep programs may be able to conduct inpatient PSG with transcutaneous CO2 monitoring for both diagnosis and optimizing treatment[30] either with in-lab testing or utilizing wireless remote CO2 monitoring and technologist support[31] which has potential benefit of qualifying patients for less costly respiratory assist devices rather than non-invasive ventilation devices.

Given the complexity of titration with need for technologist monitoring combined with environmental challenges in the inpatient setting, split night sleep studies or PAP titration studies are likely beneficial in only select patient populations with high acuity. For example, in hospitalized patients with hypoventilation, those who are adherent with PAP therapy after in-hospital PAP titration have fewer readmissions than nonadherent patients or those that were never set up with PAP therapy.[30]

Sleep Health Disparities in the Inpatient Setting

Minority communities and communities in rural areas have a high prevalence of undiagnosed SDB.[17, 32-34] Additionally, the increasing reliance of low-socioeconomic status patients on hospital care given limited availability of preventative care[35, 36] and the low comfort level of rural primary care physicians in managing SDB,[17] make inpatient screening programs more likely to improve health care disparities. Well-structured inpatient sleep screening programs may help substantially mitigate bias in SDB and promote equity.[32, 33]

Impact of Inpatient SDB Screening and Healthcare Costs

Median hospitalization cost for patients with SDB is significantly higher than patients without SDB.[37] OSA diagnosis is associated with longer hospital stay, ICU transfer, increased intubations and 22% higher costs.[7] COVID-19 admissions with OSA had longer length of stay and greater number of ICU admissions.[38] The impact of screening and evaluating SDB in hospitalized patients results in cost savings in both hospital and ambulatory billing.[39, 40] Payer policies should allow for timely therapy in high-risk populations and flexibility for follow-up that takes into account patient disposition and local resources.

INPATIENT SDB TREATMENT IN THOSE WITH ESTABLISHED DIAGNOSIS OF SLEEP DISORDERED BREATHING NOT CURRENTLY ON TREATMENT

In adult patients with a known pre-admission diagnosis of SDB who are not already on treatment, we recommend initiation of PAP therapy, interventions to address any non-adherence prior to hospitalization, and a discussion of strategies to optimize post-discharge adherence as well as alternatives to PAP. Established diagnosis of SDB prior to hospitalization may be too proximate to the hospital admission, thereby providing insufficient time for the patient to be prescribed and initiate therapy. Of note, the inpatient setting may pose a challenge for introduction to PAP therapy for those with a pre-admission diagnosis of OSA not on treatment due to more of a focus on acuity of illness, in-hospital environmental factors and distractions such as noise and limited in-hospital support for education and PAP acclimation. That said, acuity of illness, such as that associated with cardiopulmonary and neurologic disease, may benefit from more immediate OSA treatment.

INPATIENT SDB SLEEP CONSULTATION

It is recommended that sleep medicine consultation be available to evaluate and manage medically hospitalized patients at risk for or with a known SDB diagnosis, particularly when the required clinical decision making is more complex. It is recommended that the sleep medicine consultation preferably be overseen by a board-certified sleep medicine clinician and/or an AASM-accredited sleep center. However, involvement of other core members, when

feasible, including advanced practitioners, nurses, sleep technologists, respiratory therapists, care coordinators, and case managers, could provide a beneficial multidimensional team approach.

INPATIENT PHYSIOLOGICAL MONITORING IN SDB

The TF did not develop specific recommendations regarding the use of physiologic monitoring in hospitalized patients with SDB due to the limited evidence. Clinicians can consider adopting oximetry and/or capnography monitoring as delineated in prior clinical practice guidelines for hypercapnic respiratory failure and obesity hypoventilation syndrome[3] and as detailed in prior multi-society statements.[41]

Observational studies[42] reveal that respiratory depression is common in those receiving opioids and associated with a longer length of stay and rapid response activation. Capnography may allow for early detection of respiratory depression prior to desaturation particularly in SDB, but studies[43] have not borne out any difference in rates of ICU transfer or re-intubation.

In the acute care setting, physiologic monitoring is less standard and highly variable, depending more on local practice patterns, staffing parameters, and resources. The potential is high for spurious or inaccurate values, and much like with cardiac monitoring, pulse oximetry and capnography are often faulty due to senor displacement or malfunction. This may lead to increased sleep disruption from frequent alarm signals, and alarm fatigue may delay staff evaluation for clinically significant issues which could be detrimental.

PERI-DISCHARGE MANAGEMENT OF SDB

There is improvement in mortality, cardiovascular events and readmissions once PAP therapy is implemented and adherence thresholds are met within 3 months of hospital discharge. Therefore, once the patient is screened and identified to be at increased risk for SDB or diagnosed with moderate to severe SDB during the inpatient hospital stay, implementation of peri-discharge management pathway should be considered to improve post discharge outcomes.

A focus on high-risk populations is recommended, e.g. those with resistant hypertension, heart failure, coronary artery disease, pulmonary hypertension, atrial fibrillation, and stroke,[44] to reduce healthcare utilization and length of stay, ER visits and hospital re-admissions.[39, 40, 45] Use of a peri-discharge management pathway has the potential to reduce sleep health disparities by facilitating early SDB detection and treatment in the Black and Latino populations.[32, 46]

Transition of care to the outpatient setting could be achieved by utilizing sleep navigators, discharge planners and/or case managers to expedite sleep study scheduling and/or sleep clinic appointments at the time of discharge. Telemedicine could be considered for post-discharge monitoring or establishing care in the outpatient setting, especially in resource-limited systems.[47] The peri-discharge management care pathway can lead to offering fast-track clinics, expediting prior authorization of sleep studies and involvement of sleep clinicians, nurses and/or medical assistants. Specific care paths with processes to ensure post-discharge follow up should be developed given the known high percentage of patients who are lost to follow-up despite identifying an inpatient diagnosis of SDB.[48]

FUTURE DIRECTIONS

For inpatient SDB, there is a need for rigorously conducted observational studies and randomized controlled clinical trials to examine the effectiveness of objective and subjective screening approaches, diagnostic testing approaches and SDB interventions. Characterizing efficient strategies for subjective and objective SDB screening with optimal performance characteristics in the inpatient setting is needed. Identifying the optimal timing for diagnostic testing, the most accurate approach to portable sleep apnea testing, and utility of triaging of patients with highly complex cardiopulmonary pathophysiology (e.g., hypoventilation syndromes and central SDB) to potentially undergo full PSG deserves further investigation. We particularly note a paucity of data specific to management of hypoventilation syndromes in the inpatient setting which anecdotally generate a high proportion of consultations to sleep medicine. For example, randomized clinical trials designed to ascertain whether patients with sleep related hypoventilation syndromes should be discharged on PAP therapy including non-invasive ventilation is a priority area of investigation specific to clinically relevant outcomes including patient-centered outcomes, hospital readmissions and mortality. Although sleep consultative care in the ambulatory setting may be beneficial and some evidence suggests benefit, more data about optimal inpatient consultative care delivery models are needed. The use of inpatient physiologic monitoring of key cardiopulmonary signals such as oximetry, capnography and/or telemetry may allow the ability to detect early warning signs of a deteriorating clinical state in those with known or suspected SDB; however, the effect on clinical outcomes remains unclear. Finally, aspects of the peri-discharge care of the hospitalized patient with established or suspected SDB also warrants further investigation to ensure post-discharge treatment and follow up with a sleep medicine or alternative clinician, and to elucidate the role and utility of post-discharge telemedicine. More research is also needed to determine the efficacy and costs of different screening and diagnostic algorithms specific to SDB in hospitalized patients including accounting for the downstream preventative costs. Clinical trials (with high consideration of pragmatic clinical trials) to assess the effect of screening and management of SDB including understudied areas of CSA and sleep-related hypoventilation are needed with a focus on clinical outcomes, patient reported outcomes and cost-effectiveness to optimally inform clinical management pathways.

SUMMARY

This clinical guideline provides four recommendations for the adult hospitalized medical patient: 1) inpatient screening of OSA in high risk patients as part of an integrated evaluation and management pathway, 2) use of PAP therapy in those with moderate to severe SDB, 3) sleep medicine consultation for those with increased SDB risk or established SDB, and 4) peri-discharge plans for management of SDB with a goal to minimize loss to follow up. All recommendations are conditional due to the low to very low certainty of evidence. The TF determined that there was insufficient evidence to provide recommendations specific to the utility of inpatient physiologic monitoring in SDB in the hospitalized medical patient.

The recommendations generated result from the interpretation of the evidence collected for the systematic review of the SDB literature in medically hospitalized adults. When implementing the recommendations, it is recognized that there will be marked variation in hospital and institutional resources to comprehensively screen, diagnose and treat SDB in the inpatient setting. The recommendations provided are intended to serve as a guide to move the field forward in prioritizing the need to develop systematic approaches to manage SDB in the inpatient setting as the nascent field of inpatient sleep medicine continues to evolve. We strongly encourage readers to refer to the companion systematic review for a more detailed presentation and assessment of the evidence. This clinical practice guideline reflects the state of knowledge at the time of publication and will be reviewed and updated as new information becomes available.

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