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REVIEW ARTICLES

# Evaluation and management of obstructive sleep apnea in adults hospitalized for medical care: an American Academy of Sleep Medicine systematic review, meta-analysis, and GRADE assessment

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**Introduction:** The purpose of this systematic review is to provide supporting evidence for a clinical practice guideline on management of obstructive sleep apnea in medically hospitalized adults.

**Methods:** The American Academy of Sleep Medicine commissioned a task force of experts in sleep medicine. A systematic review was conducted to identify randomized controlled trials and observational studies that addressed interventions for the management of obstructive sleep apnea in medically hospitalized adults. Statistical analyses were performed to determine the clinical meaningfulness of critical and important outcomes. Finally, the Grading of Recommendations Assessment, Development, and Evaluation process was used to assess the evidence for making recommendations.

**Results:** The literature search resulted in 5,159 studies, out of which 27 studies provided data suitable for statistical analyses. The task force provided a detailed summary of the evidence along with the certainty of evidence, the balance of benefits and harms, patient values and preferences, and resource use considerations.

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

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## INTRODUCTION

Obstructive sleep apnea (OSA) is highly prevalent[1] but remains underdiagnosed.[2,3] There is a consistent association of OSA with adverse cardiopulmonary and neurologic outcomes,[4] and the recognition and treatment of OSA has the potential to favorably affect these outcomes.[5,6] The evaluation and management of OSA has traditionally been carried out in ambulatory settings, but there is a growing concern that OSA, both diagnosed and undiagnosed, may affect critical outcomes during hospitalization, in the immediate postdischarge period, and during subsequent care.[7,8] Although current American Academy of Sleep Medicine (AASM) guidelines provide recommendations specific to the diagnosis of OSA via the use of home sleep apnea tests or limited-channel sleep studies and in-lab polysomnography (PSG),[9] and the use of positive airway pressure (PAP) therapies,[10] these guidelines are for an outpatient population. Implementation in the inpatient setting is problematic for a variety of reasons. For instance, hospitalized patients tend to have more complex and greater acuity of comorbidities that may require different, multidisciplinary approaches to the evaluation and management of OSA than in the ambulatory setting. There are unique logistical in-hospital aspects to the evaluation and management of OSA related to risk management, insurance coverage, staffing, and equipment availability. In addition, this complex patient population has special considerations that need to be addressed (eg, validating screening tools in inpatient populations; inpatient sleep testing; criteria for PAP therapy initiation in the hospital; the role of inpatient sleep medicine consultation; and understanding which patients could be safely scheduled postdischarge in the outpatient clinic for further workup and management). Finally, consideration for which, if

any, untreated patients might require additional monitoring via oximetry, noninvasive $CO_2$ monitoring (capnography, transcutaneous $CO_2$ monitoring), and arterial blood gas measures.

To date, the AASM has not provided guidance on how to address OSA in this diverse and complicated patient population. Therefore, a task force (TF) of content experts was commissioned by the AASM to conduct this review of OSA in hospitalized patients. This systematic review is intended to provide supporting evidence, where available, for the screening, diagnosis, and management of inpatient sleep-disordered breathing (SDB), though it is focused primarily on OSA in adult patients, including screening, timing of and type of diagnostic evaluation, timing of initiation of treatment, role of inpatient monitoring, the role of sleep medicine consultation in the evaluation and management process, and postdischarge care. The systematic review does not apply to hospitalized patients with acute or chronic respiratory failure requiring noninvasive ventilation support. Recognizing that patients with SDB in the form of sleep-related hypoventilation are at risk for worse outcomes during hospitalization, and that recent guidelines have offered conditional recommendations on how to manage these individuals,[11] the TF felt there was insufficient evidence to make recommendations beyond these guidelines and did not focus on this condition. Likewise, it was felt that the evaluation and management of patients with known or suspected OSA in the perioperative setting, a distinctly different environment when compared to hospitalization for medical care, was beyond the scope of this guideline.

## BACKGROUND

SDB is defined by breathing disturbances during sleep that are quantified by objective testing.[12] The most common form of SDB is OSA, and the majority of the literature regarding inpatient SDB involves OSA. As such, the TF decided to focus on OSA, though recognizing that other forms of SDB exist. There is a paucity of data regarding central sleep apnea (CSA) in the inpatient setting, and this will be highlighted in the guideline when applicable.

Respiratory events are used as the criteria to diagnose OSA, and these events are defined by the apnea-hypopnea index or respiratory event index with threshold cutoffs of 15 events or more/h, or 5 events or more/h in conjunction with symptoms.[12] OSA, when defined by an apnea-hypopnea index of 15 or more events/h, is estimated to affect 425 million adults worldwide,[13] and the prevalence is expected to grow over time as rates of obesity, a primary risk factor for OSA, increase.[3] However, despite increasing awareness, more simplified testing technology, and better access to testing, OSA continues to be underdiagnosed,[13] particularly in populations at risk for health disparities.[3,14]

Demographic risk factors for OSA include obesity, older age, male sex, postmenopausal status in women, and race.[1,15–20] OSA is also associated with a number of important comorbidities, particularly cardiovascular and metabolic diseases, which often lead to hospitalization or are commonly seen in inpatient populations. The prevalence rates of OSA in many cardiovascular diseases is often more than 50%, and thus the presence of these conditions places an individual in a high-risk category for having OSA.[20] **Table 1** lists medical comorbidities that should be considered when risk stratifying an individual's OSA risk.

A number of studies have found OSA to be extremely common in certain inpatient populations.[8,21–26] Using various screening and diagnostic methodologies, studies have reported the following prevalence rates in inpatient populations: obese (defined by body mass index > 30 kg/m$^2$) 84%,[25] obese African Americans 60%,[24] cardiac disease 48%,[8] poststroke 72%,[21] and chronic obstructive pulmonary disease 46%.[27] As expected, the majority of these patients present with undiagnosed OSA.[8,21,22,25,26] Due to the added stress of acute illness and/or the effects of certain medications used during hospitalization, undiagnosed or unrecognized OSA may place patients at risk for a variety of adverse cardiopulmonary outcomes during admission or in the near-term postdischarge.[28,29] Literature has suggested that inpatients with OSA may experience higher rates of escalation of care and rapid response activations,[28,29] cardiac arrhythmias,[30] major adverse cardiac events,[31] need for ventilatory support,[23] and longer length of stay.[23] However, the data are not all consistent,[32–34] and thus a critical analysis of the data is warranted. Acute illness and/or medications used during hospitalization may adversely affect postdischarge outcomes in patients with diagnosed or undiagnosed OSA, particularly readmission rates.[27,35–37] And finally, unrecognized and/or untreated OSA may potentially influence longer-term health consequences and mortality.[38,39]

In order to favorably affect outcomes in hospitalized patients, OSA needs to not only be diagnosed but also treated. Existing data suggest PAP therapy is frequently underused in inpatients,

**Table 1**—Defining patients at increased risk for obstructive sleep apnea.

| Comorbidities/Medical Conditions |
|---|
| Cardiovascular disease (CAD, MI, CHF, atrial fibrillation) |
| Nocturnal dysrhythmias |
| Cerebrovascular disease (stroke, TIA) |
| Pulmonary hypertension |
| Chronic obstructive pulmonary disease |
| Asthma |
| Obesity/metabolic syndrome (HTN, treatment-resistant HTN, DM type 2) |
| BMI ≥ 30 kg/m$^2$ |
| Hypothyroidism[44] |
| Preeclampsia |
| Treatment-resistant mood disorders[45] |

The following demographics and signs/symptoms should also be considered when risk-stratifying individuals for obstructive sleep apnea: racial or ethnic groups, females after menopause, middle-aged/older populations, lower socioeconomic group; daytime sleepiness/fatigue, morning headaches, loud, habitual snoring, choking/gasping, fragmented sleep, insomnia. BMI = body mass index, CAD = coronary artery disease, CHF = congestive heart failure, DM = diabetes mellitus, HTN = hypertension, MI = myocardial infarction, TIA = transient ischemic attack.

even in those with a known preexisting diagnosis of OSA.[23,30] Emerging data suggest that the initiation of treatment of newly diagnosed OSA during hospital admissions may be feasible and could potentially improve short-term outcomes.[29,40,41] However randomized controlled trials (RCTs) reporting on clinically relevant outcomes are limited to studies performed in specific patient populations (ie, acute coronary syndrome and poststroke)[22,42] and generally involved small sample sizes.[42]

Evidence supports the benefit of sleep consultative care in the ambulatory setting, and it would seem to follow that hospitalized patients would benefit from the same expertise. And indeed, some data suggest that inpatient sleep consultation may improve diagnostic rates of OSA. However, a formal analysis of the existing literature is warranted in order to assess the impact of inpatient sleep consultation on clinically meaningful outcomes. Similarly, whereas the use of enhanced inpatient physiologic monitoring of key cardiopulmonary signals such as oximetry, carbon dioxide and/or electrocardiography may enable the ability to detect clinical deterioration in patients hospitalized with established or suspected OSA, a review of existing data is indicated to determine how enhanced monitoring may influence outcomes. Finally, issues related to the peri-discharge care of the hospitalized patient with established or suspected OSA, such as ensuring postdischarge evaluation (if indicated) and treatment of OSA, need additional guidance.

Given the above data, one might conclude that the evaluation and management of OSA in hospitalized patients should be broadly adopted. Prior guidelines have addressed OSA in the perioperative setting and in hospitalized patients with obesity hypoventilation[11,43]; however, a synthesis and review of the available data in medically hospitalized (including neurologic, psychiatric, and obstetric) patients has not been performed. Thus, this systematic review provides the current state of the evidence regarding the evaluation and management of OSA in medically hospitalized adults.

## METHODS

### Expert TF

The AASM commissioned a TF of sleep medicine clinicians with expertise in the management of medically hospitalized adults with OSA. The TF was required to disclose all potential conflicts of interest, per the AASM's conflicts of interest policy, prior to being appointed to the TF and throughout the research and writing of these documents. In accordance with the AASM's conflicts of interest 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.

### PICO questions

PICO (Patient, Intervention, Comparison, and Outcomes) questions were developed by the TF based on an examination of systematic reviews, meta-analyses, and guidelines published for adult populations. The AASM Board of Directors approved the final list of questions presented in **Table 2** before the literature searches were performed.

Through consensus, the TF then developed a list of patient-oriented, clinically relevant outcomes to determine the efficacy of the interventions. Input on interventions, outcomes, and adverse events from stakeholders (patients, caregivers, and health care providers) was collected using electronic surveys. The TF rated the relative importance of each outcome to determine which outcomes were critical vs important for decision-making. A summary of these outcomes by PICO is presented in **Table 3**.

The TF set a clinically meaningful threshold (CMT) for each outcome to determine whether the mean differences between treatment and control or before and after treatment in the outcomes assessed were clinically meaningful. The CMT was defined as the minimum level of improvement in the outcome of interest that would be considered clinically important to clinicians and patients. CMTs were determined based on a TF literature review of commonly used thresholds. When no clearly established threshold values could be determined, the TF used their clinical judgment and experience to establish a CMT based on consensus. If there was a range, the TF used the lower side of the range. This was done given the known low risk of PAP therapy, as well as due to concerns that the benefits of PAP therapy might not be as robust as in the outpatient setting due to other acute standard inpatient therapies potentially having a larger immediate impact on recovery (eg, thrombolytics given for an acute stroke). A summary of the CMTs for the clinical outcome measures is presented in **Table 4**.

### Literature searches, evidence review, and data extraction

The TF performed an extensive review of the scientific literature to retrieve articles that addressed the PICO questions. Literature searches were performed by the TF to address each PICO question using the PubMed and Embase databases (see **Figure 1**). Articles that met inclusion criteria but did not report outcomes of interest were rejected from the final evidence base. Articles that included the process of evaluation, testing, and/or treatment of OSA that was initiated during admission but completed within 3 months of discharge were included because these were felt to represent an extension of the inpatient admission. The key terms, search limits, and inclusion/exclusion criteria specified by the TF are detailed in the supplemental material.

The initial literature search was performed in October 2021. Subsequent literature searches were performed in August 2023 and December 2024 to identify studies that were published since the first literature search to update the body of evidence for the review. These searches identified a total of 5,159 articles. Finally, the TF reviewed previously published guidelines, systematic reviews, and meta-analyses to spot-check for references that may have been missed during the prior searches. The TF identified 55 additional articles that were screened for inclusion/exclusion in the guideline.

The TF set inclusion and exclusion criteria, which are presented in the supplemental material. All studies were reviewed based on inclusion/exclusion criteria by 2 TF members. Any

**Table 2**—PICO questions.

| | |
|---|---|
| 1 | **Population:** Medically hospitalized adult patients at increased risk[a] for obstructive sleep apnea[b]<br>**Intervention:** Inpatient screening[c]<br>**Comparison:** No inpatient screening<br>**Outcomes[d]:** Critical – Obstructive sleep apnea diagnosis, prevention of escalation in level of care (eg, intubation, RRT support), readmission, mortality, incidence of sleep-disordered breathing–related comorbidities (eg, hypertension, cardiovascular events); Important – Length of hospitalization, daytime sleepiness, quality of life, PAP adherence, time to treatment, time to postdischarge follow-up |
| 2 | **Population:** Medically hospitalized adult patients at increased risk[a] for obstructive sleep apnea[b,e]<br>**Intervention:** Inpatient sleep diagnostics<br>**Comparison:** No inpatient sleep diagnostics<br>**Outcomes:** Critical – Prevention of escalation in level of care (eg, intubation, RRT support), readmission, mortality, incidence of obstructive sleep apnea–related comorbidities (eg, hypertension, cardiovascular events), stroke recovery; Important – Length of hospitalization, daytime sleepiness, quality of life, positive airway pressure adherence, time to treatment, time to postdischarge follow-up |
| 3 | **Population:** Medically hospitalized adult patients with newly diagnosed obstructive sleep apnea, or with a prior established diagnosis of moderate-to-severe obstructive sleep apnea but not currently on treatment[b,f,g,h]<br>**Intervention:** Inpatient treatment with positive airway pressure, supplemental oxygen or alternative therapies<br>**Comparison:** No inpatient treatment<br>**Outcomes[d]:** Critical – Prevention of escalation in level of care (eg, intubation, RRT support), readmission, mortality, incidence of obstructive sleep apnea–related comorbidities (eg, hypertension, cardiovascular events), stroke recovery; Important – Length of hospitalization, daytime sleepiness, quality of life, PAP adherence, time to treatment, time to postdischarge follow-up |
| 4 | **Population:** Medically hospitalized adult patients diagnosed with obstructive sleep apnea and on preadmission treatment[b,h]<br>**Intervention:** Inpatient treatment with PAP, alternative therapies, or supplemental oxygen<br>**Comparison:** No inpatient treatment<br>**Outcomes[d]:** Critical – Prevention of escalation in level of care (eg, intubation, RRT support), readmission, mortality, incidence of obstructive sleep apnea–related comorbidities (eg, hypertension, cardiovascular events), stroke recovery; Important – Length of hospitalization, daytime sleepiness, quality of life, PAP adherence, time to treatment, time to postdischarge follow-up |
| 5 | **Population:** Medically hospitalized adult patients at increased risk[a] for or with an established diagnosis of obstructive sleep apnea (with or without therapy at home)[b,f,h]<br>**Intervention:** Inpatient sleep consultation[i]<br>**Comparison:** No inpatient sleep consultation<br>**Outcomes:** Critical – Obstructive sleep apnea diagnosis, prevention of escalation in level of care (eg, intubation, RRT support), readmission, mortality, incidence of obstructive sleep apnea–related comorbidities (eg, hypertension, cardiovascular events), stroke recovery; Important – Length of hospitalization, daytime sleepiness, quality of life, PAP adherence, time to diagnosis, time to treatment, time to postdischarge follow-up, number of follow-up polysomnograms |
| 6 | **Population:** Medically hospitalized adult patients at increased risk[a] for or with an established diagnosis of obstructive sleep apnea[b,f,g]<br>**Intervention:** Inpatient physiologic monitoring[j]<br>**Comparison:** No inpatient physiologic monitoring<br>**Outcomes:** Critical – Prevention of escalation in level of care (eg, intubation, RRT support), mortality, incidence of obstructive sleep apnea–related comorbidities (eg, hypertension, cardiovascular events), Important – Length of hospitalization, readmission, stroke recovery, PAP adherence, time to treatment, time to postdischarge follow-up |
| 7 | **Population:** Medically hospitalized adult patients at increased risk[a] for or with an established diagnosis of obstructive sleep apnea[b,f,h]<br>**Intervention:** Peri-discharge management with sleep medicine[k]<br>**Comparison:** No peri-discharge management with sleep medicine<br>**Outcomes:** Critical – Readmission, mortality, incidence of obstructive sleep apnea–related comorbidities (eg, hypertension, cardiovascular events), stroke recovery; Important – Daytime sleepiness, sleep quality, dyspnea, time to treatment, time to postdischarge follow-up |

[a]Patients at risk for obstructive sleep apnea are defined in Table 1. [b]Special consideration of sleep-disordered breathing subtypes, severity and comorbidities and their related outcomes (eg, heart failure, atrial fibrillation, acute coronary syndrome, chronic obstructive pulmonary disease, pulmonary hypertension, stroke). [c]Mode of screening such as questionnaire versus high-resolution pulse oximetry. [d]Special consideration of sex- and race-specific differences. [e]Special consideration of home sleep apnea tests or limited-channel sleep studies versus polysomnogram. [f]Special consideration of those with inpatient diagnosis versus no inpatient diagnosis. [g]Special consideration of positive airway pressure type (continuous PAP, auto-PAP, bilevel PAP, bilevel PAP ST mode, auto-bilevel PAP, average volume-assured pressure support, or adaptive servo-ventilation). [h]Special consideration of the poststroke rehabilitation population. [i]Special consideration of provider type (ie, physician, physician assistant, nurse practitioner, respiratory therapist). [j]Inclusive of continuous oximetry, carbon dioxide monitoring (end tidal or transcutaneous), cardiac telemetry and arterial blood gas. [k]Includes patients with a prior diagnosis but were untreated. Adult patients admitted to the hospital found to be at risk for obstructive sleep apnea, newly diagnosed with obstructive sleep apnea, or newly initiated on PAP therapy. PAP = positive airway pressure, PICO = Patient, Intervention, Comparison, and Outcomes, RRT = rapid response team.

discrepancies between the reviewers were discussed and resolved by the 2 reviewers or a third TF member. A total of 27 studies were determined to be suitable for meta-analysis and/or grading.

## Statistical and meta-analysis and interpretation of clinical meaningfulness

Meta-analysis was performed on outcomes of interest, when possible, for each PICO question. These are presented in a table

**Table 3**—Outcomes by PICO question.

| Outcomes | PICO Question | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| OSA diagnosis | √[a] | | | | √[a] | | |
| Prevention of escalation in level of care (eg, intubation, RRT support) | √[a] | √[a] | √[a] | √[a] | √[a] | √[a] | |
| Readmission[b] | √[a] | √[a] | √[a] | √[a] | √[a] | √ | √[a] |
| Mortality[b] | √[a] | √[a] | √[a] | √[a] | √[a] | √[a] | √[a] |
| Incidence of OSA-related comorbidities (eg, hypertension, CV events)[b] | √[a] | √[a] | √[a] | √[a] | √[a] | √[a] | √[a] |
| Stroke recovery | | √[a] | √[a] | √[a] | √[a] | √ | √[a] |
| Length of hospitalization | √ | √ | √ | √ | √ | √ | |
| Daytime sleepiness | √ | √ | √ | √ | √ | | √ |
| Quality of life | √ | √ | √ | √ | √ | | |
| PAP adherence | √ | √ | √ | √ | √ | √ | √ |
| Time to diagnosis | | | | | √ | | √ |
| Time to treatment | √ | √ | √ | √ | √ | √ | √ |
| Time to postdischarge follow-up | √ | √ | √ | √ | √ | √ | √ |
| Sleep quality | | | | | | | √ |
| Dyspnea | | | | | | | √ |
| Number of follow-up PSGs | | | | | √[a] | | |

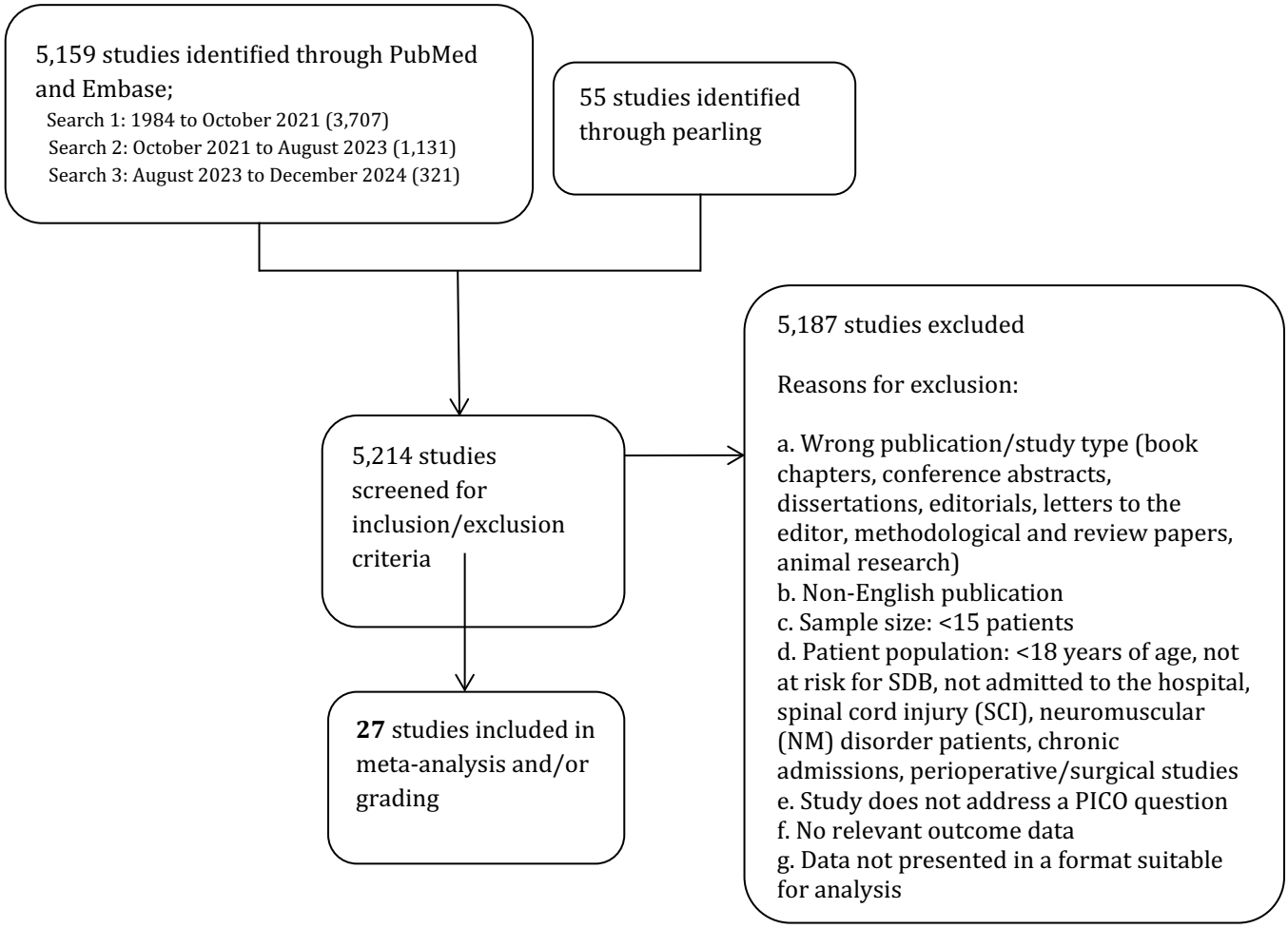
[a]Outcomes considered critical for decision-making. [b]Readmission data ranged from 6 months to 3 years. Mortality data ranged from 3 months to 5 years. Cardiovascular events data ranged from 1 month to 5 years. CV = cardiovascular, OSA = obstructive sleep apnea, PAP = positive airway pressure, PICO = Patient, Intervention, Comparison, and Outcomes, PSG = polysomnogram, RRT = rapid response team.

**Table 4**—Summary of clinically meaningful thresholds for outcome measures.

| Outcome Measure | Clinically Meaningful Threshold[a,b] |
|---|---|
| Mortality | −10 per 1,000 absolute risk difference |
| Incidence of OSA-related comorbidities (eg, hypertension, cardiovascular events) | −10 per 1,000 absolute risk difference |
| Readmission | −30 per 1,000 absolute risk difference |
| Number of follow-up PSGs | Not established |
| OSA diagnosis | Not established |
| Stroke recovery | |
| mRS score | −1 point[46] |
| BI score | +1.45 points (20-point scale); +7.25 points (100-point scale)[47] |
| Length of hospitalization | −1 day |
| PAP adherence | +0.5 hours/night[10] |
| Daytime sleepiness | |
| ESS score | −2 points[48] |
| Quality of life | |
| EQ-5D score | +0.08 points[10] |
| PHQ-9 score | −3 points[49] |
| SF-36 score | +3 points[10] |
| Sleep quality | |
| PSQI score | −3 points[50] |

[a]References used to inform task force consensus. [b]The clinically meaningful thresholds are for comparison of pre- vs posttreatment effects as well as between intervention and control. BI = Barthel index, ESS = Epworth Sleepiness Scale, EQ-5D = European Quality of Life-5D, mRS = Modified Rankin scale, PAP = positive airway pressure, PHQ-9 = Patient Health Questionnaire-9, PSQI = Pittsburgh Sleep Quality Index, SF-36 = 36-item Short Form Health Status Survey.

**Figure 1—**Evidence base flow diagram.




SDB = sleep-disordered breathing.

format in the supplemental material (**Tables S1–S27** and **Figures S1–S22**). Comparisons of interventions to controls and/or assessment of efficacy before and after each intervention were performed. The analyses were performed using Review Manager 5.3 software (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) by pooling data across studies for each outcome measure. Some studies had data presented in the form of median and interquartile range. These were converted into data expressed as means and standard deviation.[51,52] Posttreatment data from each arm were used for meta-analysis of RCTs when change values were not reported and baseline values between the 2 study groups were statistically similar. Pre- and posttreatment data were used for meta-analyses of observational studies. The pooled results for each continuous outcome measure were expressed as the mean difference between the intervention and control for RCTs or pretreatment vs posttreatment for observational studies. The pooled results for dichotomous outcome measures were expressed as the risk ratio between the intervention and comparator or pre- vs posttreatment. The relative risk data were converted to an absolute risk estimate expressed as the number of events/1,000 patients treated. Analyses of 3 or more studies were performed using a random-effects model with results displayed as a forest plot. Analyses of fewer than 3 studies were performed using a fixed-effects model. Interpretation of clinical meaningfulness for the outcomes of interest was conducted by comparing the mean difference in effect size, or the risk difference for dichotomous outcomes, of each treatment approach to the CMT (see **Table 4**).

### GRADE assessment for developing recommendations

The evidence was assessed according to the GRADE process for the purposes of making clinical practice recommendations. The TF considered the following 4 GRADE domains: certainty of evidence, balance of beneficial and harmful effects, patient values and preferences, and resource use, as described below.[53,54]

1. Certainty of evidence: Based on an assessment of the overall risk of bias (randomization, blinding, allocation concealment, selective reporting), imprecision (95% confidence interval crosses the CMT and/or sample size < 400 participants), inconsistency ($I^2 \geq 50\%$), indirectness (study population vs target patient population), and risk of

publication bias, the TF determined their overall confidence that the estimated effect found in the body of evidence was representative of the true treatment effect that typical hospitalized patients with OSA would see. The certainty of the evidence was based on outcomes that the TF deemed critical for decision-making; important outcomes are not considered when determining the overall certainty of evidence.

2. Benefits vs harms: Based on the meta-analysis of adverse effects reported within the accepted literature and on the clinical expertise of the TF, the TF determined whether the beneficial outcomes of using each intervention outweighed any harms.
3. Patient values and preferences: Based on the clinical expertise of the TF members and any data published on the topic relevant to patient preferences, the TF determined whether patient values and preferences would be generally consistent across most patients, and whether patients would use the intervention based on the relative harms and benefits identified.
4. Resource use: Based on the clinical expertise of the TF members and any data published on the topic relevant to resource use, the TF determined whether the accessibility and costs associated with each intervention compared favorably to those associated with alternative interventions. Information on costs to both patients and the health care system, impact on health equity, acceptability, and feasibility to implement the interventions were considered.

TF members voted on the strength and direction of each recommendation using the GRADE framework. A threshold of ≥70% agreement was required to achieve consensus. Where consensus was not initially achieved, further discussion and re-voting were conducted until a decision was reached. A summary of each GRADE domain is provided after the detailed evidence review for each PICO question.

### Public comment and final approval

Drafts of the systematic review and accompanying guideline were made available for public comment for a 4-week period on the AASM website. AASM members, the general public, and other relevant stakeholders were invited to provide feedback on the drafts. The TF also invited three subject matter experts as external reviewers to provide additional feedback on the drafts. The TF took into consideration all the comments received and made decisions about whether to revise the draft based on the scope and feasibility of comments. The public comments and revised documents were submitted to the AASM Board of Directors, who subsequently approved the final documents for publication. The AGREE II tool was used to assess the quality and rigor of the methodology used to develop the guideline and ensure the methodology is transparently described.

The AASM expects this systematic review to have an impact on professional behavior, patient outcomes, and, possibly, health care costs. This review reflects the state of knowledge at the time of publication and will be reviewed and updated as new information becomes available. The AASM reviews existing guidelines at least every 5 years. Updates to existing guidelines are based on advancements in the field of sleep medicine and the availability of scientific literature.

## RESULTS

The aims of the current systematic reviews and data analyses were to address PICO questions pertaining to OSA in adult patients undergoing hospitalization for medical, including neurological, indications. This review does not apply to patients admitted with acute or chronic respiratory failure requiring noninvasive ventilation support or for OSA considerations in perioperative surgical or procedural inpatient populations.

Below are detailed summaries of the evidence identified in the literature searches and the statistical analyses performed by the TF. Each evidence summary is accompanied by a discussion of the certainty of evidence, balance of benefits and harms, patient values and preferences, and resource use considerations that contributed to the development of the clinical practice recommendations, which are provided in the accompanying clinical practice guideline.

### Inpatient screening, diagnosis, and treatment of medically hospitalized adults with no prior diagnosis or treatment of OSA

The literature search did not yield any studies that examined the impact on outcomes of only screening (PICO 1) or diagnosing (PICO 2) OSA in the absence of a treatment intervention (PAP therapy, PICO 3) (see **Table 5**). As such, the TF opted to combine

**Table 5**—Randomized controlled trials that investigated the use of a screening, diagnosis, and treatment program for hospitalized adults with no prior diagnosis of obstructive sleep apnea.

| Study | Screening | Diagnosis | PAP Treatment | PAP Initiation |
|---|---|---|---|---|
| Bravata et al, 2018[55] | | X | X | < 3 months |
| Sánchez-de-la-Torre et al, 2020[56] | | X | X | Inpatient |
| Ryan et al, 2011[57] | | X | X | < 3 months |
| Parra et al, 2015[58] | X | X | X | Inpatient |
| Parra et al, 2011[59] | X | X | X | Inpatient |
| Bravata et al, 2011[60] | | X | X | Inpatient |
| Bravata et al, 2010[61] | | X | X | Inpatient |
| Aaronson et al, 2016[62] | | X | X | Inpatient |

PICOs 1–3 for analysis as part of an overarching screening, diagnosis and treatment approach to OSA in inpatients.

A total of 8 RCTs[55–62] investigated the use of an evaluation and management program for hospitalized adults with no prior diagnosis of OSA to improve 1 or more of the following outcomes: mortality, incidence of OSA-related comorbidities (cardiovascular events), stroke recovery, readmission, length of hospitalization, daytime sleepiness, and quality of life. Participants in the RCTs had a mean age of 61 years (18% female). Meta-analyses were performed to assess the efficacy of PAP as a treatment for hospitalized adults with OSA. One of the 8 RCTs reported secondary stroke recovery outcomes and was not included in the final meta-analysis for the critical outcome of stroke recovery. The meta-analyses are provided in **Tables S1–S7** and **Figures S1–S7**. A summary of the findings in a table format is provided in **Table S8**. A summary of the evidence for each outcome is provided below.

### *Critical outcomes*

The following outcomes were determined by the TF to be critical for evaluating the efficacy of a screening, diagnosis, and treatment program for hospitalized adults at risk for OSA: mortality, incidence of OSA-related comorbidities (cardiovascular events), stroke recovery, and readmission. None of the studies identified in our literature review reported data for the following critical outcomes: OSA diagnosis or prevention of escalation in level of care (eg, intubation, rapid response team support).

**Mortality:** The efficacy of a screening, diagnosis, and treatment program to reduce mortality was evaluated using a meta-analysis of 2 RCTs[56,58] including a total of 1,381 participants. The duration of patient follow-up after treatment ranged from 3–5 years. The meta-analysis demonstrated a clinically meaningful reduction in mortality with a risk ratio of 0.83 (95% confidence interval [CI]: 0.53 to 1.30) and an absolute risk difference of 10 fewer deaths/1,000 patients (95% CI: −28 to 18 events/1,000) (**Table S1** and **Figure S1**). The certainty of evidence was low due to imprecision.

**Incidence of OSA-related comorbidities—cardiovascular events:** The efficacy of a screening, diagnosis, and treatment program to reduce the incidence of cardiovascular events was evaluated using a meta-analysis of 4 RCTs[56,58,60,61] including a total of 1,452 participants. The duration of patient follow-up after treatment ranged from 1 month to 5 years. The meta-analysis demonstrated a clinically meaningful reduction in cardiovascular events with a risk ratio of 0.67 (95% CI: 0.38 to 1.20) and an absolute risk difference of 67 fewer events/1,000 patients (95% CI: −127 to 41 events/1,000) (**Table S2** and **Figure S2**). The certainty of evidence was low due to imprecision.

**Stroke recovery:** The efficacy of a screening, diagnosis, and treatment program to improve stroke recovery, as measured by the modified Rankin scale score, was evaluated using an analysis of 1 RCT[55] including a total of 150 participants. The duration of patient follow-up after treatment was 12 months. The analysis demonstrated a nonclinically meaningful improvement in change in modified Rankin scale score, reporting a mean difference of −0.70 points (95% CI: −1.14 to −0.26) (**Table S3** and **Figure S3**). The certainty of evidence was low due to risk of bias and imprecision.

**Readmission:** The efficacy of a screening, diagnosis, and treatment program to reduce readmission was evaluated using an analysis of 1 RCT[56] including a total of 1,255 participants. The duration of patient follow-up after treatment was 3 years. The analysis demonstrated a nonclinically meaningful reduction in readmission with a risk ratio of 0.82 (95% CI: 0.59 to 1.13) and an absolute risk difference of 21 fewer readmissions/1,000 patients (95% CI: −48 to 15 events/1,000) (**Table S4** and **Figure S4**). The certainty of evidence was low due to imprecision.

### *Important outcomes*

The following outcomes were determined by the TF to be important outcomes but not critical for evaluating the efficacy of a screening, diagnosis, and treatment program for hospitalized adults at risk for OSA: length of hospitalization, daytime sleepiness, quality of life, and sleep quality. None of the studies identified in our literature review reported data for the following important outcomes: PAP adherence, time to diagnosis, time to treatment, or time to postdischarge follow-up.

**Length of hospitalization:** The efficacy of a screening, diagnosis, and treatment program to reduce length of hospitalization was evaluated using an analysis of 1 RCT[59] including a total of 126 participants. The analysis demonstrated a nonclinically meaningful reduction in length of hospitalization, reporting a mean difference of −0.60 days (95% CI: −2.16 to 0.96) (**Table S5** and **Figure S5**). The certainty of evidence was low due to risk of bias and imprecision.

**Daytime sleepiness:** The efficacy of a screening, diagnosis, and treatment program to reduce daytime sleepiness was evaluated using an analysis of 1 RCT[57] including a total of 44 participants. The duration of patient follow-up after treatment was 1 month. The analysis demonstrated a clinically meaningful improvement in posttreatment Epworth Sleepiness Score, reporting a mean difference of −2.70 points (95% CI: −3.71 to −1.69) (**Table S6** and **Figure S6**). The certainty of evidence was low due to risk of bias and imprecision.

**Quality of life:** The efficacy of a screening, diagnosis, and treatment program to improve quality of life as measured by mental 36-item Short Form Health Status Survey score was evaluated using an analysis of 1 RCT[59] including a total of 126 participants. The duration of patient follow-up after treatment was 3 months. The analysis demonstrated a nonclinically meaningful improvement in posttreatment mental 36-item Short Form Health Status Survey score, reporting a mean difference of 0.60 points (95% CI: −3.82 to 5.02) (**Table S7** and **Figure S7**). The certainty of evidence for quality of life was very low due to risk of bias and imprecision.

**Overall certainty of evidence:** The TF determined that the overall certainty of evidence for the use of a screening, diagnosis, and treatment program for hospitalized adults not previously diagnosed with OSA was low based on the critical outcomes and downgrading of the evidence due to risk of bias and imprecision (**Table S8**).

**Benefits vs harms:** The potential benefits of a screening, diagnosis, and treatment program for hospitalized adults not previously

diagnosed with OSA include clinically meaningful improvements in the critical outcomes of mortality and cardiovascular events. In addition, clinically meaningful improvements in the important outcome of daytime sleepiness were found, and nonclinically meaningful improvements in the critical outcomes of stroke recovery and readmission and in the important outcomes of length of hospitalization and quality of life were also found. No specific harms from screening, diagnosis, or initiation of OSA treatment were reported in any of the studies. Based on these findings and the TF's combined clinical experience, the TF judged that the potential benefits of a screening, diagnosis, and treatment program in hospitalized adults diagnosed with OSA outweigh the potential harms.

**Resource use:** The TF judged the costs for the use of a screening, diagnosis, and treatment program for hospitalized patients not previously diagnosed with OSA to vary, depending on the availability of staff and equipment. For example, for some institutions there may exist a wide range of resources that might include personnel (nurses, respiratory therapy) with the capability to easily embed systematic screening tools at little cost to time or workflow and/or readily available home sleep apnea testing devices/PSG equipment that can be implemented by nursing, respiratory therapy, or sleep technologists in a protocolized manner, and/or clinicians with dedicated time to interpret and provide guidance on test results. However, contrary to this, some institutions may lack any of these resources and need to determine what is feasible to implement from a personnel and equipment standpoint, which could carry substantial cost.

**Patients' values and preferences:** The TF concluded that there is probably no important uncertainty or variability in how much patients value the critical outcomes. The TF judged that most hospitalized adults not previously diagnosed with OSA would generally be accepting of a screening, diagnosis, and treatment program.

## Inpatient treatment of medically hospitalized adults with newly diagnosed OSA, or with a prior established diagnosis of OSA but not currently on treatment

In addition to the 8 RCTs listed in the above recommendations, 8 more RCTs that did not explicitly exclude patients with a prior known diagnosis of OSA were found. When combined, a total of 16 RCTs[55–70] investigated the PAP treatment of hospitalized adults with a newly diagnosed OSA and/or an established diagnosis of OSA and/or SDB (note that 1 study included patients with predominantly CSA[65] and was included in the meta-analysis, and thus the term SDB will be used for this section) to improve 1 or more of the following outcomes: mortality, incidence of OSA-related comorbidities (cardiovascular events), stroke recovery, readmission, length of hospitalization, daytime sleepiness, quality of life, and sleep quality. Participants in the RCTs had a mean age of 61 years (19% female). Meta-analyses were performed to assess the efficacy of PAP as a treatment for hospitalized adults with SDB. Six of the 16 RCTs reported secondary stroke recovery outcomes and were not included in the final meta-analysis for the critical outcome of stroke recovery. The meta-analyses are provided in **Tables S9–S17** and **Figures S8–S16**. A summary of the findings in table format is provided in **Table S18**. A summary of the evidence for each outcome is provided below.

### *Critical outcomes*

The following outcomes were determined by the TF to be critical for evaluating the efficacy of PAP to treat hospitalized adults with SDB: mortality, incidence of OSA-related comorbidities (cardiovascular events), stroke recovery, and readmission. None of the studies identified in our literature review reported data for the following critical outcome: prevention of escalation in level of care (eg, intubation, rapid response team support).

**Mortality:** The efficacy of PAP to reduce mortality was evaluated using a meta-analysis of 4 RCTs[56,58,65,70] including a total of 1,531 participants. The duration of patient follow-up after treatment ranged from 3 months to 5 years. The meta-analysis demonstrated a clinically meaningful reduction in mortality with a risk ratio of 0.78 (95% CI: 0.52 to 1.18) and an absolute risk difference of 14 fewer deaths/1,000 patients (95% CI: −31 to 12 events/1,000) (**Table S9** and **Figure S8**). The certainty of evidence was low due to imprecision.

**Incidence of OSA-related comorbidities—cardiovascular events:** The efficacy of PAP to reduce the incidence of cardiovascular events was evaluated using a meta-analysis of 4 RCTs[56,58,60,61] including a total of 1,452 participants. The duration of patient follow-up after treatment ranged from 1 month to 5 years. The meta-analysis demonstrated a clinically meaningful reduction in cardiovascular events with a risk ratio of 0.67 (95% CI: 0.38 to 1.20) and an absolute risk difference of 67 fewer events/1,000 patients (95% CI: −127 to 41 events/1,000) (**Table S10** and **Figure S9**). The certainty of evidence was low due to imprecision.

**Stroke recovery:** The efficacy of PAP to improve stroke recovery, as measured by the modified Rankin scale score, was evaluated using a meta-analysis of 2 RCTs[55,67] including a total of 190 participants. The duration of patient follow-up after treatment ranged from 3 weeks to 12 months. The meta-analysis demonstrated a nonclinically meaningful improvement in change in modified Rankin scale score, reporting a mean difference of −0.55 points (95% CI: −0.86 to −0.24) (**Table S11** and **Figure S10**). The certainty of evidence was low due to risk of bias and imprecision.

**Readmission:** The efficacy of PAP to reduce readmission was evaluated using a meta-analysis of 2 RCTs[56,65] including a total of 1,381 participants. The duration of patient follow-up after treatment ranged from 6 months to 3 years. The meta-analysis demonstrated a nonclinically meaningful reduction in readmission with a risk ratio of 0.92 (95% CI: 0.70 to 1.20) and an absolute risk difference of 10 fewer readmissions/1,000 patients (95% CI: −39 to 26 events/1,000) (**Table S12** and **Figure S11**). The certainty of evidence was low due to imprecision.

### *Important outcomes*

The following outcomes were determined by the TF to be important outcomes but not critical for evaluating the efficacy of PAP to treat hospitalized adults with SDB: length of hospitalization, daytime sleepiness, quality of life, and sleep quality. None of the studies identified in our literature review reported

data for the following important outcomes: PAP adherence, time to diagnosis, time to treatment, or time to postdischarge follow-up.

**Length of hospitalization:** The efficacy of PAP to reduce length of hospitalization was evaluated using a meta-analysis of 3 RCTs[59,67,68] including a total of 196 participants. The meta-analysis demonstrated a nonclinically meaningful reduction in length of hospitalization, reporting a mean difference of −0.33 days (95% CI: −1.82 to 1.15) (**Table S13** and **Figure S12**). The certainty of evidence was low due to imprecision.

**Daytime sleepiness:** The efficacy of PAP to reduce daytime sleepiness was evaluated using a meta-analysis of 2 RCTs[65,67] including a total of 166 participants. The duration of patient follow-up after treatment ranged from 3 weeks to 6 months. The meta-analysis demonstrated a nonclinically meaningful improvement in change in Epworth Sleepiness Score, reporting a mean difference of −1.30 points (95% CI: −2.58 to −0.02) (**Table S14** and **Figure S13**). The certainty of evidence was very low due to risk of bias and imprecision.

**Quality of life:** The efficacy of PAP to improve quality of life as measured by European Quality of Life-5D score was evaluated using a meta-analysis of 2 RCTs[65,67] including a total of 166 participants. The duration of patient follow-up after treatment ranged from 3 weeks to 6 months. The meta-analysis demonstrated a nonclinically meaningful improvement in change in European Quality of Life-5D score, reporting a mean difference of 0.03 points (95% CI: −0.04 to 0.1) (**Table S15** and **Figure S14**).

The efficacy of PAP to improve quality of life as measured by Patient Health Questionnaire-9 score was evaluated using an analysis of 1 RCT[65] including a total of 126 participants. The duration of patient follow-up after treatment was 6 months. The analysis demonstrated a nonclinically meaningful decline in change in Patient Health Questionnaire-9 score, reporting a mean difference of 1.8 points (95% CI: −0.5 to 4.1) (**Table S16** and **Figure S15**).

The certainty of evidence for quality of life was low due to risk of bias and imprecision.

**Sleep quality:** The efficacy of PAP to improve sleep quality as measured by Pittsburgh Sleep Quality Index score was evaluated using an analysis of 1 RCT[65] including a total of 126 participants. The duration of patient follow-up after treatment was 6 months. The analysis demonstrated a nonclinically meaningful decline in change in Pittsburgh Sleep Quality Index score, reporting a mean difference of 0.6 points (95% CI: −1.1 to 2.3) (**Table S17** and **Figure S16**). The certainty of evidence was low due to risk of bias and imprecision.

**Overall certainty of evidence:** The TF determined that the overall certainty of evidence for the use of PAP in hospitalized adults diagnosed with SDB was low based on the critical outcomes and downgrading of the evidence due to risk of bias and imprecision (**Table S18**).

**Benefits vs harms:** The potential benefits of PAP in hospitalized adults diagnosed with SDB include clinically meaningful improvements in mortality and cardiovascular events. In addition, nonclinically meaningful improvements in stroke recovery, readmission, length of hospitalization, daytime sleepiness, and quality of life (European Quality of Life-5D) were also seen. The potential harms include a nonclinically meaningful decline in quality of life (Patient Health Questionnaire-9) and sleep quality. Based on these findings and their combined clinical experience, the TF judged that the potential benefits of PAP in hospitalized adults diagnosed with SDB outweigh the potential harms.

**Resource use:** The TF judged the costs for the use of PAP in the hospital to be moderate.

**Patients' values and preferences:** The TF judged that there is probably no important uncertainty or variability in how much patients value the critical outcomes. The TF judged that most hospitalized adults diagnosed with SDB would generally be accepting of treatment with PAP, although a substantial minority may decline therapy for a variety of reasons.

## Inpatient sleep consultation of medically hospitalized adults at increased risk or with an established diagnosis of OSA

One observational study[25] investigated the use of inpatient consultation for hospitalized adults at risk or with a diagnosis of OSA to improve the number of follow-up PSG diagnoses. Participants in the study had a mean age of 59 years (50% female). Analyses were performed to assess the efficacy of inpatient consultation for hospitalized adults with OSA. The analyses are provided in **Table S19** and **Table S20** and **Figure S17** and **Figure S18**. A summary of the findings in table format is provided in **Table S21**. A summary of the evidence for each outcome is provided below.

### *Critical outcomes*

The following outcome was determined by the TF to be critical for evaluating the efficacy of inpatient consultation for hospitalized adults with OSA: number of follow-up PSG diagnoses. None of the studies identified in our literature review reported data for the following critical outcomes: prevention of escalation in level of care (eg, intubation, rapid response team support), readmission, mortality, incidence of OSA-related comorbidities (eg, hypertension, CV events), or stroke recovery.

**Number of follow-up PSG studies:** The efficacy of inpatient consultation to improve the number of follow-up PSG studies was evaluated using an analysis of 1 observational study[25] including a total of 1,272 participants. The duration of patient follow-up was 1 year. The analysis demonstrated a clinically meaningful increase in follow-up PSG studies with a risk ratio of 149 (95% CI: 21 to 1,061) and an absolute risk difference of 233 more PSG studies/1,000 patients (95% CI: 200 to 266 events/1,000) (**Table S19** and **Figure S17**). The certainty of evidence was very low due to selection bias.

**Number of OSA diagnoses:** The efficacy of inpatient consultation to improve the number of OSA diagnoses was evaluated using an analysis of 1 observational study[25] including a total of 1,272 participants. The duration of patient follow-up was 1 year. The analysis demonstrated a clinically meaningful increase in follow-up PSG diagnoses with a risk ratio of 129 (95% CI: 18 to 920) and an absolute risk difference of 201 more diagnoses/1,000 patients

(95% CI: 168 to 234 events/1,000) (**Table S20** and **Figure S18**). The certainty of evidence was very low due to selection bias.

**Overall certainty of evidence:** The TF determined that the overall certainty of evidence for the use of inpatient consultation in hospitalized adults at risk or diagnosed with OSA was very low based on the critical outcomes and downgrading of the evidence due to selection bias (**Table S21**).

**Benefits vs harms:** The potential benefits of inpatient consultation for hospitalized adults at risk or diagnosed with OSA include clinically meaningful improvements in follow-up PSG diagnoses. Based on their combined clinical experience, the TF judged that the potential benefits of inpatient consultation in hospitalized adults at risk or diagnosed with OSA outweigh the potential harms.

**Resource use:** The TF judged the costs of inpatient consultation to vary, depending on the availability of staff and equipment. Cost will also depend on the decided-upon structure of how inpatient sleep consultation would look at a given institution (see Discussion section). For example, for some institutions the infrastructure including personnel and equipment may be readily available and starting more formalized inpatient consultation may be feasible at little additional investment. In other less-resource-rich institutions, substantial investment in personnel and equipment might be required and thus a more informal and less costly approach (ie, screening, no testing, ensuring outpatient follow-up) may be more practical and economically viable.

**Patients' values and preferences:** The TF judged that there is probably no important uncertainty or variability in how much patients value the critical outcomes. The TF judged that most hospitalized adults at risk or diagnosed with OSA would generally be accepting of inpatient consultation.

## Peri-discharge management of medically hospitalized adults at increased risk or with an established diagnosis of OSA

One RCT[71] and 6 observational studies[41,72–76] investigated the use of a discharge management plan for hospitalized adults at risk or with a diagnosis of OSA to improve 1 or more of the following outcomes: mortality, incidence of OSA-related comorbidities (recurrent myocardial infarction, cardiovascular events), and readmission. Participants in the studies had a mean age of 62 years (40% female). Meta-analyses were performed to assess the efficacy of a discharge management plan for hospitalized adults with OSA. The meta-analyses are provided in **Tables S22–S27** and **Figures S19–S23**. A summary of the findings in table format is provided in **Table S28** in the supplemental material. A summary of the evidence for each outcome is provided below.

### *Critical outcomes*

The following outcomes were determined by the TF to be critical for evaluating the efficacy of a discharge management plan for hospitalized adults with OSA: mortality, incidence of OSA-related comorbidities (recurrent myocardial infarction, cardiovascular events), stroke recovery, and readmission.

**Mortality:** The efficacy of a discharge management plan to reduce mortality was evaluated using a meta-analysis of 3 observational studies[41,75,76] including a total of 634 participants. The duration of patient follow-up ranged from 12 months to 5 years. The meta-analysis demonstrated a clinically meaningful reduction in mortality with a risk ratio of 0.60 (95% CI: 0.40 to 0.90) and an absolute risk difference of 68 fewer deaths/1,000 patients (95% CI: −102 to −17 events/1,000) (**Table S22** and **Figure S19**). The certainty of evidence was very low due to risk of bias associated with observational studies and imprecision.

**Incidence of OSA-related comorbidities—recurrent myocardial infarction:** The efficacy of a discharge management plan to reduce the incidence of recurrent myocardial infarction was evaluated using an analysis of 1 observational study[72] including a total of 123 participants. The duration of patient follow-up after treatment was 1 year. The analysis demonstrated a clinically meaningful reduction in recurrent myocardial infarction with a hazard ratio of 0.16 (95% CI: 0.03 to 0.76) and an absolute risk difference of 83 fewer events/1,000 patients (95% CI: −97 to −23 events/1,000) (**Table S23**). The certainty of evidence was very low due to risk of bias associated with observational studies and imprecision.

**Incidence of OSA-related comorbidities—cardiovascular events:** The efficacy of a discharge management plan to reduce the incidence of cardiovascular events was evaluated using an analysis of 1 observational study[74] including a total of 96 participants. The duration of patient follow-up after treatment was 5 years. The analysis demonstrated a clinically meaningful reduction in cardiovascular events with a risk ratio of 0.47 (95% CI: 0.20 to 1.09) and an absolute risk difference of 203 fewer events/1,000 patients (95% CI: −306 to 34 events/1,000) (**Table S24** and **Figure S20**). The certainty of evidence was very low due to risk of bias associated with observational studies and imprecision.

**Stroke recovery:** The efficacy of a discharge management plan to improve stroke recovery, as measured by the Barthel index score, was evaluated using an analysis of 1 RCT[71] including a total of 29 participants. The duration of patient follow-up after treatment was 3 months. The analysis demonstrated a nonclinically meaningful difference in the improvement of the posttreatment Barthel index score, reporting a mean difference of −3.40 points (95% CI: −14.21 to 7.41) (**Table S25** and **Figure S21**). The certainty of evidence was low due to imprecision.

**Readmission:** The efficacy of a discharge management plan to reduce readmission was evaluated using an analysis of 1 observational study[73] including a total of 81 participants. The duration of patient follow-up after treatment was 3 months. The analysis demonstrated a clinically meaningful reduction in readmission with a risk ratio of 0.38 (95% CI: 0.18 to 0.82) and an absolute risk difference of 334 fewer readmissions/1,000 patients (95% CI: −442 to −97 events/1,000) (**Table S26** and **Figure S22**). The certainty of evidence was very low due to risk of bias associated with observational studies and imprecision.

### *Important outcomes*

The following outcome was determined by the TF to be an important outcome but not critical for evaluating the efficacy of

a discharge management plan for hospitalized adults with OSA: PAP adherence. None of the studies identified in our literature review reported data for the following important outcomes: length of hospitalization, daytime sleepiness, time to diagnosis, time to treatment, or time to postdischarge follow-up, sleep quality, or dyspnea.

**PAP adherence:** The efficacy of a discharge management plan to improve PAP adherence was evaluated using an analysis of 1 RCT[71] including a total of 29 participants. The duration of patient follow-up after treatment was 3 months. The analysis demonstrated a clinically meaningful increase in PAP adherence, reporting a mean difference of 76 minutes (95% CI: 16.7 to 135.2) (**Table S27** and **Figure S23**). The certainty of evidence was moderate due to imprecision.

**Overall certainty of evidence:** The TF determined that the overall certainty of evidence for the use of a discharge management plan in hospitalized adults at risk or diagnosed with OSA was very low based on the critical outcomes and downgrading of the evidence due to risk of bias associated with observational studies and imprecision (**Table S28**).

**Benefits vs harms:** The potential benefits of a discharge management plan for hospitalized adults at risk or diagnosed with OSA include clinically meaningful improvements in mortality, recurrent myocardial infarction, cardiovascular events, readmission, and PAP adherence. Based on their combined clinical experience, the TF judged that the potential benefits of a discharge management plan in hospitalized adults at risk or diagnosed with OSA outweigh the potential harms.

**Resource use:** The TF judged the costs of a discharge management plan to vary, depending on the availability of staff and equipment. The cost will depend on the existing infrastructure at a given institution and how well embedded sleep medicine services are with the institution. For example, if formal inpatient sleep consultation exists at an institution, then the transition to outpatient follow-up and care should be associated with minimal additional cost. However, if there is no clear pathway to outpatient testing, treatment, and follow-up at a given institution, then instituting the protocols and pathways necessary to successfully transition patients to outpatient care may carry some significant investment in personnel and equipment.

**Patients' values and preferences:** The TF judged that there is probably no important uncertainty or variability in how much patients value the critical outcomes. The TF judged that most hospitalized adults at risk or diagnosed with OSA would generally be accepting of a discharge management plan.

## DISCUSSION AND FUTURE DIRECTIONS

### Overall important considerations for interpreting the evidence (eg, resource use, patients' values, and preferences)

The systematic review and its accompanying clinical practice guideline provide a comprehensive evaluation of the available literature addressing OSA management in hospitalized medical adult patients. In clinical practice, clinicians are increasingly asked to address questions about the appropriate diagnostic approach, treatment, and follow-up for patients with known or suspected OSA in the inpatient setting. Despite an increasing body of literature examining this topic, the TF found an overall small number of acceptable studies characterized by heterogeneity regarding hospital settings, populations, and outcomes and an overall low certainty of evidence. These factors contributed to substantial imprecision and low certainty of evidence for each of the PICOs evaluated. Acknowledging these limitations, the TF offers clinical recommendations whenever possible to help guide sleep clinicians and other providers in the inpatient setting in navigating this complex and relatively new frontier of inpatient sleep medicine. Overall, the TF recommends diagnosis and treatment of OSA in hospitalized patients with a high pretest probability of having OSA or who are at high risk for OSA-related complications and that sleep consultative services be available with discharge management planning to facilitate transition to outpatient care.

The TF recognizes that strong consideration be given to local resource needs, logistics, clinical judgment, and patient values and preferences when determining how to apply the recommendations in any given health care facility and/or for a given patient. For instance, many health care settings may not have the personnel or equipment resources to perform systematic patient screening, testing, or treatment interventions in the inpatient setting. Reimbursement for diagnostic testing in hospitalized patients may be an issue depending on insurance policies, and some patients might decline testing and/or treatment during their hospitalization.

Strengths of the existing body of literature include the following: (1) researchers have utsed a variety of different approaches for screening (questionnaires, oximetry) and diagnosing (limited-channel sleep studies, PSG) OSA in hospitalized patients; (2) different patient populations, mostly focused on those where OSA is prevalent, have been studied; (3) standardized treatment approaches were used; and (4) a spectrum of clinically relevant outcomes have been examined. However, these strengths are balanced by significant limitations that make it challenging to provide strong clinical recommendations. Study design is a problem in this field because there is a lack of appropriately sized RCTs for all the PICOs, and many of the observational data are missing suitable control populations for comparison. Many of the studies are underpowered for the outcomes of interest and/or evaluate only a small subset of outcomes. Others fail to include important patient-related outcomes, thus limiting conclusions. Stroke recovery outcomes in particular varied greatly between studies, making a synthesis of the data difficult, and thus only the modified Rankin scale score and Barthel index were included in the analysis. The majority of the studies examined patients admitted for cardiovascular disease or stroke, thereby limiting generalizability to other hospitalized populations.

For each of the PICO sections listed below, the findings will be discussed and placed in the context of clinical practice. Gaps in the evidence will also be reviewed and areas where future research is warranted will be discussed.

As the TF reviewed the literature based on each PICO, it became evident that screening, testing, and treatment were all

steps in an overall care pathway or approach to dealing with OSA in hospitalized patients, and that assessing outcomes based on each part of this process would not be possible. As a result, the TF combined PICOs 1–3 for analysis of outcomes. For patients with a known diagnosis of OSA and are adherent with therapy prior to admission (PICO 4), a Good Practice Statement was issued. PICOS 5–7 were analyzed individually and are discussed separately.

### PICOs 1–3: screening, evaluation, and management for patients without a known diagnosis of OSA or already diagnosed with OSA but not on treatment

Although the TF analyzed data for PICOs 1–3 (inpatient screening, testing and treatment for medically hospitalized patients at risk for OSA or already diagnosed but not on treatment) together, the discussion will still address each aspect of the overall patient care pathway to highlight important aspects of each component.

### Comments regarding the studies included in the meta-analysis for PICOs 1–3

Only RCTs were included for the meta-analyses for PICOs 1–3. Observational studies were not included due to the potential for significant bias and concerns that the timing of initiation of PAP treatment was either not clearly stated or beyond the 3-month postdischarge window, a time period that the TF felt represented an inpatient-driven process. Database studies were deemed to be too biased to include in the meta-analyses given the high rates of underdiagnosis in the inpatient population, suspected bias toward treating sicker patients, and uncertainty about treatment and adherence to treatment.

Given the limited number of studies with treatment initiated during a medical hospitalization, additional studies were included if treatment was implemented within 3 months postdischarge as a result of OSA identification during acute hospitalization, and relevant short-term outcomes were reported. Studies with treatment initiated in inpatient stroke rehabilitation facilities were included.

It should be also noted that regarding the analysis, the baseline risk estimate may represent an underestimation of the true prevalence of OSA in the target population as other observational studies have suggested higher prevalence rates.[77]

### Screening

Although the direct impact of screening medically hospitalized patients on outcomes has not been fully investigated, screening alone could be beneficial if other mitigating interventions that do not require objective testing are implemented for patients screening as high risk for OSA. Examples of this include lateral positioning, pain medicine regimen modification, and/or enhanced physiological monitoring. There are data in the perioperative literature to suggest benefit from identifying those at risk for OSA[78]; however, data in medically hospitalized patients are not currently available.

The studies in this analysis did not compare screening approaches. Screening questionnaires validated in the outpatient setting may not be as accurate for hospitalized patients. Studies attempting to validate screening questionnaires in some hospitalized patient populations (ie, poststroke) have found relatively poor accuracy.[79,80] This, in part, results from patients with stroke, as well as those with heart failure, tending to be less sleepy and less likely to report other typical symptoms of OSA such as snoring or witnessed apneas when compared to the general population.[81,82] In the outpatient setting, asymptomatic patients may be less likely to benefit from therapy compared to symptomatically sleepy patients; however, translation to the inpatient setting is unclear.[83,84] Conversely, a high percentage of hospitalized medical patients are likely to screen positive with questionnaires like the STOP-Bang, many of whom will have mild OSA and thus unlikely to need urgent evaluation. In a setting of limited resources, more objective screening such as use of a high-resolution pulse oximetry (HRPO) offers a reasonably low-cost option that might help prioritize patients needing expedited formal diagnostic testing and treatment.[85] However, HRPO is not considered sufficient as a stand-alone test for the diagnosis of OSA and prescriptions for PAP therapy based solely on the results of HRPO are usually not covered.

The US Preventive Services Task Force has recommended against screening for OSA in stable asymptomatic ambulatory patients.[86] However, these recommendations do not apply to persons with symptoms or concerns about OSA. In that regard the current guideline is not in conflict with US Preventive Services Task Force because the TF recommends screening in hospitalized patients with high-risk comorbidities that indicate increased risk of moderate-to-severe OSA.[20] Acknowledging the potential limitations inherent to screening for OSA, the TF decided that screening as part of an overarching evaluation and management patient care pathway will lead to much higher rates of detection of OSA compared to standard clinical practice. Systematic screening of high-risk inpatient populations should be paired with clinical judgement, and the use of additional screening tools such as HRPO may help with clinical decision-making.

### Diagnostic testing

For hospitalized patients suspected of having OSA, objective testing can formally diagnose as well as ascertain severity of OSA, factors important to inform indication for and timing of treatment. Testing for OSA includes formal attended or unattended full-montage PSG as well as limited-channel sleep study devices. Although formal PSG testing can be done in the inpatient setting,[87,88] the resource requirement and concerns about reimbursement have often rendered it impractical, but further research in this area is recommended, especially for patients at high risk of readmission and mortality. Limited-channel sleep study devices are more feasible options for inpatient testing, and there are a small number of studies validating the accuracy of certain limited-channel sleep studies in hospitalized patients,[89,90] though more validation studies are needed. There are some data suggesting that limited-channel sleep studies may significantly improve testing follow-up rate, diagnosis rate, and time to treatment and be more cost-effective when compared to PSG for patients identified as being at risk for OSA during admission.[91]

Diagnostic sleep testing during acute illness in the hospitalized setting may not accurately reflect the chronic stable state and may lead to the overdiagnosis of OSA. Conversely, poor and fragmented sleep in a hospitalized patient could result in underestimation of the presence and/or severity of OSA. However, available literature suggests that patients diagnosed with OSA or other forms of SDB by objective testing during admission (including CSA) will continue to have SDB upon retesting following recovery from their acute illness.[22,92]

Recognizing the concerns of testing for OSA during hospitalization, the TF concluded that inpatient sleep study testing, as part of a comprehensive evaluation and management patient care pathway, will allow for the diagnosis and risk stratification of OSA in hospitalized patients, something that is currently systematically lacking in standard clinical practice. Sleep study testing of high-risk inpatient populations should consider engagement and/or involvement of local sleep medicine expertise to optimize clinical decision-making.

## PAP therapy

Overall, the evidence was largely derived from studies in patients with a moderate-to-severe degree of OSA or SDB hospitalized with stroke, heart failure, or other cardiovascular disease. Most of the studies evaluated CPAP or bilevel PAP whereas only 1 evaluated adaptive servo-ventilation in a population of patients with predominantly CSA. There were no studies that evaluated alternative therapies to PAP therapy for OSA treatment. Based on RCTs, clinically meaningful improvements with treatment were found in the critical outcomes of mortality and cardiovascular events while nonclinically meaningful improvements were observed with readmissions and stroke recovery.[55–70] The certainty of evidence for all critical outcomes suffered from imprecision and was downgraded to low certainty. Important outcomes were clinically meaningful for daytime sleepiness whereas nonclinically meaningful improvements were observed with length of hospitalization and quality of life. Similar to the critical outcomes, evidence for the important outcomes was found to be very low to low due to the small sample size and lack of blinding, thereby resulting in major imprecisions.

Despite the small effect size for the critical outcomes, the TF weighed these outcomes favorably given the consistent direction across outcomes and the perceived clinically relevant effect size of OSA-related cardiovascular event reduction. The TF also considered costs and resource requirements in their decision-making. There were no undesirable effects of treatment in the trials examined. These factors guided the recommendation in favor of treatment with a low degree of certainty.

The TF also examined nonrandomized studies addressing the question of treatment in the hospitalized setting, but due to residual confounding, selection bias, and misclassification bias, these did not affect the decision.

Some RCTs were not included in the meta-analysis because they did not report on outcomes of interest, yet they do provide some useful information. One small RCT demonstrated that implementing a PAP therapy protocol in patients admitted with heart failure exacerbation and pulmonary hypertension resulted in improved pulmonary pressures and ejection fraction within 48 hours.[93] In another RCT of patients with heart failure, no significant difference was observed in the intent-to-treat population, though patients who were adherent with PAP therapy showed a dose-dependent improvement in ejection fraction and a reduced 6-month readmission rate.[94] RCT studies of PAP treatment in poststroke patients have shown improvement in several outcomes including depression[64] and motor outcomes.[57]

The Barthel index scale and modified Rankin scale score in the setting of stroke were considered as outcome assessments in this systematic review given these measures were most consistently reported and represent overall functional improvement. Neither of these scales, however, captures more subtle motor or neurocognitive improvements. Patients with stroke receiving thrombolytics may be less likely to manifest improvements from PAP therapy due to better clinical outcomes following thrombolytics. The ongoing Sleep SMART trial of poststroke OSA initiates treatment in the hospital with PAP therapy and should help to more definitively address these knowledge gaps.[95]

There were some studies that initiated PAP therapy during the hospitalization,[56,58–61,65,68–70] whereas others initiated PAP therapy within 3 months of discharge.[55,57,63,64] Most studies used limited-channel sleep study testing to diagnosis OSA prior to starting therapy,[55–59,61–65,67,70] but others initiated treatment empirically with delayed testing to determine whether ongoing treatment was necessary.[60,61,66,68,70] The immediate treatment of OSA with PAP therapy has the potential to improve recovery by protecting at-risk brain or heart following stroke and myocardial infarction, thus mitigating the extent of acute injury. In a multicenter RCT of patients with acute myocardial infarction who underwent percutaneous coronary intervention with moderate-to-severe SDB (apnea-hypopnea index > 15 events/h), early initiation of adaptive servo-ventilation was associated with improved myocardial salvage index and reduced infarct size compared to standard therapy alone.[96] Patient safety is also a major inpatient issue related to OSA and PAP therapy. In a study of inpatients with acute heart failure, those with undetected OSA who received opioids during admission were at increased risk for escalation of care.[28] Another study found that patients screened as high risk for OSA had a higher incidence of rapid response team events during the hospital stay that were reduced by PAP therapy during hospitalization.[29] More studies are needed to evaluate these potential near-term benefits.

Some of the potential benefits of PAP therapy started during or shortly after hospitalization may only be seen with longer-term treatment. For example, reduced readmission to the hospital and emergency department have been observed up to 12 months.[97] However, these findings need to be placed in the context of multiple RCTs of outpatient PAP therapy for OSA that have failed to show a reduction in the prevention of cardiovascular outcomes, though those RCTs excluded patients with substantial nocturnal hypoxemia as well as sleepy patients and those with overall low adherence to PAP therapy. Further research is required to ascertain whether long-term benefits over 5–10 years are observed from PAP therapy initiated during or following hospitalization.

Concern has been raised about the potential for lower PAP adherence in those that start treatment in the hospital. Possible

reasons include higher-acuity patients being targeted for therapy in the hospital, patients receiving less encouragement and support with PAP therapy initiation (eg, acclimation, desensitization), and fewer equipment resources in the hospital (ie, limited mask selection, use of humidification). Patient engagement and empowerment is key to the success of any medical intervention.[98,99] Preliminary data suggest that patients diagnosed with OSA during hospitalization who were educated about OSA and PAP therapy and showed a positive disposition toward use of inpatient PAP therapy may have improved adherence.[76,100,101] Higher inpatient PAP therapy adherence has been shown to predict postdischarge adherence.[100] Therefore, with appropriate support and patient motivation, starting inpatient therapy provides the opportunity to counsel patients and help them acclimatize to the therapy. In the RCTs that included inpatient initiation of PAP therapy with adherence data, 2 studies showed that better PAP adherence resulted in improved stroke recovery at 30 days[60] and reduced vascular event rates at 90 days,[61] whereas another did not find a correlation between PAP adherence and 3-year cardiovascular outcomes.[56] Patient discharge disposition is another factor to consider regarding timing of PAP therapy initiation. Patients being discharged to long-term care facilities may not be permitted to undergo outpatient sleep diagnostics while residing in the long-term care facility, thereby necessitating predischarge inpatient sleep testing and initiation of PAP therapy. Long-term care facilities often use facility-owned PAP devices, and therefore adherence data are less likely to be available to monitor and adjust treatment.[73] Also, there are inherent challenges of arranging for follow-up with a sleep medicine specialist for patients admitted to long-term care facilities. The impact that patient discharge disposition has on outcomes is an area in need of future research.

## Potential risk of a screening, diagnosis, and treatment pathway

The diagnostic accuracy of screening questionnaires for OSA is variable. The low specificity of the STOP-Bang questionnaire, for example, leads to a high false positive rate.[102] Conversely, HRPO and limited-channel sleep testing may lead to false negative test results due to the inability to directly measure sleep.[103] Both of these may result in increased emotional burden for patients and potentially increased costs due to pursuing sleep testing that may not be necessary.

There are potential risks to early treatment with PAP therapy. Patients with low-ejection-fraction heart failure and a small minority of poststroke patients are at risk for CSA, and inpatient initiation of PAP therapy, particularly in the absence of an attended PAP titration study, may worsen the SDB by increasing central events. In addition, sleep may become more disrupted during initial acclimation to PAP therapy, which could negatively affect outcomes. Both OSA and CSA may temporarily worsen in the short term due to enforced supine positioning during admission, worsened underlying morbidity, or medication use limited to the inpatient setting (ie, pain medications). It is therefore conceivable that some patients may be started on treatment that is not needed long-term. Use of PAP devices in some patients (ie, poor mental status with inability to manage secretions) could conceivably increase the risk of aspiration. Despite these concerns, no adverse events were reported in the studies evaluating PAP therapy in hospitalized patients.

Resource use will vary substantially depending on the type of patient care pathway developed and implemented, with the least inpatient resources used when positively screened patients are referred for urgent outpatient evaluation and management. The use of HRPO or limited-channel sleep study devices may help triage patients to maximize resource allocation. There may also be financial implications for the patient. In one study, 28% of the reasons for poor adherence with CPAP appeared to be due to the high cost of acquisition.[104]

## How these guidelines align with other guidelines on screening, diagnosis, and treatment pathways

There are no other current guidelines available for the screening, diagnosis, and treatment of OSA in the medically hospitalized adult population. These current guideline recommendations are consistent with recommendations from prior outpatient OSA quality measures and guidelines from the AASM for screening,[105] diagnosis,[9] and treatment with the use of PAP therapies.[10] In addition, these guidelines are closely aligned with the goals of the Patient-Centered Outcomes Research Institute, which emphasizes patient-centered outcomes research aimed at the early detection and intervention of diseases (https://www.PCORI.org). The Patient-Centered Outcomes Research Institute also prioritizes addressing the needs of the underserved, underrepresented, and historically excluded populations within health care. Sleep health disparities have persisted over decades, with racial/marginalized minorities and rural communities having high prevalence but less diagnosis and treatment of OSA. Implementation of an inpatient OSA screening program has resulted in more equitable screening and testing opportunities in underserved populations.[24,106]

## Inpatient sleep consultation

Acknowledging limited data of very low certainty, the TF suggests that sleep-medicine consultation be available for medical hospitalized adults at risk for OSA or with known OSA diagnoses who need testing or therapy optimization, rather than no sleep medicine consultation. Recognizing the significant variability in resources across institutions and locations, and the lack of research examining the specific elements necessary to optimize inpatient sleep medicine consultation, the TF feels that inpatient sleep medicine consultation can be implemented in a variety of manifestations, from care coordinators with some sleep training/oversight to a clinician available for telehealth consultations to more traditional consultation with sleep fellows and an attending seeing patients on an inpatient service. As such, sleep medicine consultation may include any or all of a multidisciplinary team of physicians, advanced practitioners, nurses, sleep technologists, respiratory therapist, health educators, care coordinators, care managers, or other available resources within the institution. In ideal circumstances, sleep-medicine consultation would be overseen by an AASM-accredited sleep disorders center in which e-consult and telehealth may be available in addition to more traditional consultation.

There is a lack of research on the direct influence of sleep-medicine consultation on early detection and management of OSA and its subsequent impact on postdischarge outcomes. Only 1 observational study involving 636 participants designed to examine the number of follow-up PSG studies and number of OSA diagnoses postdischarge was available for review.[25] After 1 year of follow-up, there was an increase in follow-up PSG studies with an absolute risk difference of 233 more PSG studies/1,000 patients (95% CI: 200 to 266 events/1,000) after patients were screened during admission. There was also an increase in OSA diagnoses with an absolute risk difference of 201 more diagnoses/1,000 patients (95% CI: 168 to 234 events/1,000). These data suggest that the inpatient setting represents an opportunity to facilitate OSA diagnosis in high-risk patients.

The role of sleep-medicine consultation has not been well-described and should be tailored based on available resources and needs as noted earlier. Close collaboration with other subspecialties, such as pulmonary medicine, and partnering with established programs, such as heart failure and stroke programs, could mitigate the need for extra resources and additional personnel.

RCTs are needed to better understand the impact of establishing sleep-medicine consultation on critical outcomes such as mortality, hospital readmissions, and the incidence of OSA-related comorbidities. Additionally, the impact of sleep medicine consultation on health care costs (ie health care use and hospital readmissions)[107] requires further investigation.

## Inpatient physiological monitoring

There was absence of evidence to inform the use of physiological monitoring for medically hospitalized patients with or at risk for OSA. Clinical trials on the use of respiratory monitoring, such as continuous oximetry or capnography, have been conducted in anesthesia, surgical, and emergency department settings. Postoperative continuous oximetry surveillance has been shown to reduce rates of rescue events and intensive care unit transfer[108] but not to improve postoperative mortality or complications.[109] Meta-analysis comparing continuous oximetry with routine monitoring also did not show differences in intensive care unit transfer or noninvasive ventilation use.[110]

Extrapolation from the postoperative literature is problematic given that these populations are distinctly different from medically hospitalized patients: Surgical patients typically have fewer comorbidities and lower illness acuity than hospitalized medical patients, and the risk of respiratory depression due to use of anesthesia agents, anxiolytics, and opioids administered in the peri-operative period may not apply to a medical population. Patients with OSA have sleep-related respiratory events chronically, and it is not evident that monitoring and detection of this during hospitalization changes the patient outcomes acutely. Further research on this topic in the inpatient medical setting is warranted.

## Peri-discharge management

Clinical pathways consist of multidisciplinary care plans meant to incorporate evidence-based medicine into processes of clinical care that respect the unique culture, resources, and environment of each health care institution.[111] Health care systems should develop a discharge management pathway rather than having no plan for patients who are at risk or diagnosed with OSA during a recent inpatient admission. This would expedite the management of OSA, leading to improvement in postdischarge outcomes in select high-risk subgroups.[41,71–76,112] In particular, observational data have shown that peri-discharge pathways for OSA management may potentially lead to reductions in mortality,[41,75,76] post-discharge myocardial infarctions,[72] postdischarge cardiovascular events,[74] and readmission rates.[73] Though RCTs are needed to determine whether OSA is a modifiable risk factor for readmission, limited data suggests OSA is such a risk factor.[113] In addition, a small single RCT of peri-discharge management in patients with newly diagnosed OSA following stroke showed improved PAP adherence and stroke recovery with implementation of a proactive telemedicine monitoring program.[71]

A Veterans Health Administration database study showed higher health care use due to emergency room visits (37% vs 32% vs 15%, respectively; $P < .05$) and hospitalizations (24% vs 17% vs 7%, respectively; $P < .05$) in newly diagnosed OSA when compared to chronic OSA vs no OSA. This suggests that early OSA recognition may reduce health care use, though the impact of treatment is unknown.[114] In patients identified with OSA and started on PAP during admission, studies have found that those nonadherent to PAP vs those adherent to PAP were more likely to be readmitted or seen in the emergency room postdischarge[97] and had worse recovery following stroke/more vascular events.[60,61] These results should be interpreted with caution given the low prevalence of OSA and potential of healthy adherer bias.

For the purposes of peri-discharge management, identifying the key stakeholders is essential. These include, but are not limited to, discharge coordinators, sleep-board-certified clinicians, respiratory therapists, nurses, patients, caregivers, and durable medical equipment companies. Identifying the outpatient sleep clinics and understanding the outpatient workflow including types of sleep studies that are available and processes for prior authorization of sleep studies or PAP therapy is also clinically important. Sleep medicine is often under-resourced,[115] and therefore using telemedicine opportunities[116] when feasible could bridge the gap during the transition of care and contribute to fewer sleep health disparities.[3,14] Implementation of these types of clinical pathway care pathways will initially require upfront allocation of resources, but it will likely have positive effects on downstream patient outcomes while reducing hospital costs and readmission.[37]

## Future directions and gaps in the evidence

Whereas the data suggest that inpatient screening, testing, and treatment of high-risk patients may be beneficial in increasing diagnoses and potentially reducing daytime sleepiness, cardiovascular events, and mortality in the hospital, future RCTs should be designed to identify the subset of patients most likely to benefit from this patient care pathway. Most of the studies included in this analysis included patients with high-risk comorbidities such as stroke, heart attack, or heart failure or involved older adult patients on medical wards, and thus the

potential benefits may not be generalizable to other inpatient populations. Gaps also exist in locations other than cardiac and medical units, including hospitalized patients with pregnancy complications such as preeclampsia,[117] psychiatric admissions, and the emergency department.

Optimization and validation of screening and testing tools is needed, including validation in different inpatient populations. RCTs comparing immediate vs delayed (ie, outpatient) evaluation and/or treatment with PAP therapy are warranted to determine optimal timing of intervening with testing and treatment. Consideration of both inpatient and postdischarge outcomes and identifying subgroups of patients that would most benefit from these management approaches is in need of study. Clarifying approaches in patients who have a high risk for CSA or sleep-related hypoventilation is also warranted.

Economic cost–benefit analysis comparing inpatient vs outpatient evaluation and management pathways should be studied and take into account the well-established economic burden of undiagnosed and untreated OSA,[118] which will continue to be a problem in the absence of systematic patient care pathways.

Further randomized data should also be collected regarding the impact of inpatient sleep medicine consultation on not just the critical inpatient outcomes noted in this guideline, but also regarding how this service could help to expedite care, improve follow-up and completion of testing and treatment, and improve adherence to OSA therapies that may affect longer-term outcomes. The role of sleep consultative services in managing conditions such as hypercapnic respiratory failure also warrants further investigation. Specifically, identifying and ruling out OSA as a contributing factor may enable appropriate discharge of patients on noninvasive ventilation—a strategy shown to improve both morbidity and mortality.[119]

Given that OSA may affect in-hospital outcomes, particularly regarding patient safety in the setting of opioid and/or sedative administration, RCTs are needed to determine which, if any, patient populations at-risk for or with newly diagnosed OSA may benefit from enhanced physiologic monitoring. If additional physiologic monitoring does indeed improve patient safety, optimal monitoring systems, and how to do this in a cost-effective manner, would require clarification.

Further research is recommended to evaluate the impact of the sleepy vs nonsleepy phenotype on outcomes to better identify patients who may benefit most from targeted interventions. Postdischarge follow-up rates for patients screened or diagnosed with sleep disorders during hospitalization remain low. Preliminary data suggest that factors such as health literacy and distance from sleep centers may contribute to this gap.[120] Additional studies are needed to explore these barriers in depth and develop effective interventions.

Finally, incorporating patient engagement into shared decision-making is essential for the success of OSA treatment. Studies assessing patient perceptions of OSA diagnosis and therapy are necessary to support this approach.

Increasingly, data are supporting the expansion of sleep medicine into a more active role in the inpatient setting. The potential impact on patient care from the involvement of sleep medicine in the hospital appears to hold significant promise. Although additional research on patient outcomes and optimization of inpatient sleep medicine services is warranted, there is now sufficient evidence to begin to develop these protocols and patient care pathways in clinical practice.

## ABBREVIATIONS

AASM, American Academy of Sleep Medicine
CI, confidence interval
CMT, clinically meaningful threshold
CSA, central sleep apnea
HRPO, high-resolution pulse oximetry
OSA, obstructive sleep apnea
PAP, positive airway pressure
PICO, Patient, Intervention, Comparison, and Outcomes
PSG, polysomnography
RCT, randomized controlled trial
SDB, sleep-disordered breathing
TF, task force

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## DISCLOSURE STATEMENT

The development of this paper was funded by the American Academy of Sleep Medicine.

- Dr. Patil serves on the AASM Board of Directors and is Chair of the Guidelines Advisory Panel (GAP), having been the GAP liaison from June 2023–August 2025. Dr. Patil is a consultant for Primasun, Inc.
- Mr. Carandang is employed by the AASM.
- Dr. Mustafa is a paid consultant for the AASM and an affiliated member of the US GRADE Network and the Evidence Foundation.
- Dr. Falck-Ytter is a paid consultant for the AASM and an affiliated member of the US GRADE Network and the Evidence Foundation.
- Dr. Mehra has served as a paid consultant for Merck Pharmaceuticals. She has received research grants from Enhale Medical and the National Institutes of Health for studies on sleep apnea treatment. She is the author of a sleep-related guidance document titled "Sleep-Disordered Breathing and Cardiac Arrhythmias in Adults: Mechanistic Insights and Clinical Implications: A Scientific Statement from the American Heart Association."
- Dr. Auckley was the President (2019–2020) and member of the Board of Directors (2018–2024) of the Society of Anesthesia and Sleep Medicine. He has served as Chair of the Test Writing Committee (2020–2022) and Sleep Medicine/MOC Approval Committee (2019–2024) for the American Board of Internal Medicine. He has received a research grant from Medtronic for a study on inpatient monitoring via oximetry and capnography. He receives royalties for having served as a consultant for UpToDate. He is the author of a sleep-related guidance document titled "Society of Anesthesia and Sleep Medicine Guidelines on Preoperative Screening and Assessment of Adult Patients with Obstructive Sleep Apnea."
- Dr. Johnson has received a research grant from Apnimed for a study on an oral treatment for sleep apnea.
- Dr. Billings has received a donation of continuous positive airway pressure devices from the ResMed foundation for a study on treatment of sleep apnea in stroke patients. She is the author of a sleep-related guidance document titled "Clinical Practice Guideline: Summary for Clinicians: The Role of Weight Management in the Treatment of Adult Obstructive Sleep Apnea."
- Dr. Sharma has served as a speaker on the topic of central sleep apnea for ZOLL Respicardia (2023–2024).

No other task force members have relevant conflicts of interest to disclose.