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Clinical Practice Guideline: Polysomnography for Sleep-Disordered Breathing Prior to Tonsillectomy in Children

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

Abstract

Objective. This guideline provides otolaryngologists with evidence-based recommendations for using polysomnography in assessing children, aged 2 to 18 years, with sleep-disordered breathing and are candidates for tonsillectomy, with or without adenoidectomy. Polysomnography is the electrographic recording of simultaneous physiologic variables during sleep and is currently considered the gold standard for objectively assessing sleep disorders.

Purpose. There is no current consensus or guideline on when children 2 to 18 years of age, who are candidates for tonsillectomy, are recommended to have polysomnography. The primary purpose of this guideline is to improve referral patterns for polysomnography among these patients. In creating this guideline, the American Academy of Otolaryngology—Head and Neck Surgery Foundation selected a panel representing the fields of anesthesiology, pulmonology medicine, otolaryngology–head and neck surgery, pediatrics, and sleep medicine.

Results. The committee made the following recommendations: (1) before determining the need for tonsillectomy, the clinician should refer children with sleep-disordered breathing for polysomnography if they exhibit certain complex medical conditions such as obesity, Down syndrome, craniofacial abnormalities, neuromuscular disorders, sickle cell disease, or mucopolysaccharidoses. (2) The clinician should advocate for polysomnography prior to tonsillectomy for sleep-disordered breathing in children without any of the comorbidities listed in statement 1 for whom the need for surgery is uncertain or when there is discordance between tonsillar size on physical examination and the reported severity of sleep-disordered breathing. (3) Clinicians should communicate polysomnography results to the anesthesiologist prior to the induction of anesthesia for tonsillectomy in a child with sleep-disordered breathing. (4) Clinicians should admit children with obstructive sleep apnea documented on polysomnography for inpatient, overnight monitoring after tonsillectomy if they are younger than age 3 or have severe obstructive sleep apnea (apnea-hypopnea index of 10 or more obstructive events/hour, oxygen saturation nadir less than 80%, or both). (5) In children for whom polysomnography is indicated to assess sleep-disordered breathing prior to tonsillectomy, clinicians should obtain laboratory-based polysomnography, when available.

Keywords

evidence-based medicine, polysomnography, practice guidelines, sleep, sleep-disordered breathing, obstructive sleep apnea, tonsillectomy, monitoring

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Polysomnography (PSG), commonly referred to as a "sleep study," is presently the gold standard for diagnosing and quantifying sleep-disordered breathing (SDB) in children.[1,2] SDB affects approximately 12% of children with manifestations ranging from simple snoring to potentially serious conditions, including sleep apnea.[3] SDB is also the most common indication for tonsillectomy with or without adenoidectomy in the United States.[4,5] Because more than 530,000 tonsillectomies are performed annually on children younger than age 15, primarily for SDB, clear and actionable guidance on optimal use of PSG is strongly needed.[6]

This guideline is intended to assist otolaryngologists–head and neck surgeons in making evidence-based decisions regarding PSG in children aged 2 to 18 years with a clinical diagnosis of SDB who are candidates for tonsillectomy and may benefit from PSG prior to surgery. The following definitions are used:

- *Polysomnography* is the electrographic recording of simultaneous physiologic variables during sleep and is currently considered the gold standard for objectively assessing sleep disorders. Physiologic parameters typically measured include gas exchange, respiratory effort, airflow, snoring, sleep stage, body position, limb movement, and heart rhythm. PSG may be performed in a sleep laboratory with continuous attendance as defined below.[7]
- *Sleep-disordered breathing* is characterized by an abnormal respiratory pattern during sleep and includes snoring, mouth breathing, and pauses in breathing. SDB encompasses a spectrum of disorders that increase in severity from snoring to obstructive sleep apnea. For example, *obstructive sleep apnea* (OSA) is diagnosed when SDB is accompanied by an abnormal PSG with obstructive events.
- *Tonsillectomy* is defined as a surgical procedure with or without adenoidectomy that completely removes the tonsil, including its capsule, by dissecting the peritonsillar space between the tonsil capsule and the muscular wall. For clarity, the term *tonsillectomy* is used instead of *adenotonsillectomy* in this guideline, recognizing that often, but not always, the adenoid is removed concurrently with the tonsils. A discussion on the merits of intracapsular versus complete tonsillectomy is beyond the scope of this guideline.

Although PSG can help guide medical decision making, assess surgical candidacy, and optimize perioperative monitoring after tonsillectomy, the test is time-consuming and often not readily available.[5] Additional obstacles to testing include lack of consensus on what constitutes an abnormal study and access to a qualified sleep center and specialist to obtain and interpret the results. Consequently, less than 10% of children undergo PSG prior to tonsillectomy, even though a clinical diagnosis of SDB in children is known to be a poor predictor of disease severity.[5,8] The decision to proceed with PSG is, therefore, often at the discretion of the physician or caregiver.[5]

There is increasing interest in portable monitoring (PM) devices, instead of formal PSG, to assess children with SDB. For the purposes of this guideline, the term *PM* is used to refer to home monitoring performed without a technologist present. PM devices will typically measure at least 4 physiologic parameters, including 2 respiratory variables (ie, respiratory effort and airflow), a cardiac variable (ie, heart rate or electrocardiogram), and arterial oxygen saturation via pulse oximetry. In contrast, PSG includes 7 or more channels of monitoring and evaluates sleep stages.

Guideline Scope and Purpose

The primary purpose of this guideline is to provide evidence-based recommendations for PSG prior to tonsillectomy in children aged 2 to 18 years with SDB as the primary indication for surgery. The target audience is otolaryngologists in any practice setting where a child would be evaluated. Although the guideline was developed with input from other specialties, the intent is to provide guidance specifically for otolaryngologists–head and neck surgeons.

Additional goals are to highlight the evidence for obtaining PSG in special populations or in children who have modifiable risk factors. A guideline is necessary given the evidence of practice variation between practitioners and in the literature. The guideline does not apply to children younger than age 2 or older than age 18, to those who have already undergone tonsillectomy, to children having adenoidectomy alone, or to children who are being considered for continuous positive airway pressure (CPAP) or other surgical therapy for SDB.

The guideline is intended to focus on a limited number of quality improvement opportunities, deemed most important by the working group, and is not intended to be a comprehensive, general guide for prescribing PSG for tonsillectomy candidates and patients with SDB. In this context, the purpose is to define actions that could be taken by otolaryngologists to deliver quality care. Conversely, statements in this guideline are not intended to limit or restrict care provided by clinicians based on assessment of individual patients.

The development panel concluded with 5 evidence-based action statements listed in **Table 1**, which are fully described later in the document with supporting evidence profiles.

Background and Significance

SDB represents a spectrum of sleep disorders ranging in severity from snoring to OSA. In children, the estimated prevalence for habitual snoring is 10% to 12%, whereas the estimated prevalence of OSA is only 1% to 3 %.[3,9,10] In addition to nighttime symptoms, SDB also affects daytime behavior, including school performance, neurocognitive

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Table 1. Summary of Action Statements for PSG

Statement	Action	Evidence
1. Indications for PSG	Before performing tonsillectomy, the clinician should refer children with SDB for PSG if they exhibit any of the following: obesity, Down syndrome, craniofacial abnormalities, neuromuscular disorders, sickle cell disease, or mucopolysaccharidoses.	Recommendation based on observational studies with a preponderance of benefit over harm.
2. Advocating for PSG	The clinician should advocate for PSG prior to tonsillectomy for SDB in children *without* any of the comorbidities listed in statement 1 for whom the need for surgery is uncertain or when there is discordance between tonsillar size on physical examination and the reported severity of SDB.	Recommendation based on observational and case-control studies with a preponderance of benefit over harm.
3. Communication with anesthesiologist	Clinicians should communicate PSG results to the anesthesiologist prior to the induction of anesthesia for tonsillectomy in a child with SDB.	Recommendation based on observational studies with a preponderance of benefit over harm.
4. Inpatient admission for children with OSA documented in results of PSG	Clinicians should admit children with OSA documented in results of PSG for inpatient, overnight monitoring after tonsillectomy if they are younger than age 3 or have severe OSA (apnea-hypopnea index of 10 or more obstructive events/hour, oxygen saturation nadir less than 80%, or both).	Recommendation based on observational studies with a preponderance of benefit over harm.
5. Unattended PSG with portable monitoring device	In children for whom PSG is indicated to assess SDB prior to tonsillectomy, clinicians should obtain laboratory-based PSG, when available.	Recommendation based on diagnostic studies with limitations and a preponderance of benefit over harm.

Abbreviations: OSA, obstructive sleep apnea; PSG, polysomnography; SDB, sleep-disordered breathing.

function, and quality of life.[11-13] Upper airway obstruction caused by the tonsils, adenoid, or both causes most SDB in children, making tonsillectomy (with or without adenoidectomy) the most common surgical intervention in managing the disorder. The prevalence of SDB as an indication for tonsillectomy is increasing.[14]

Collecting a patient history, with or without physical examination, fails to reliably predict the presence or severity of SDB or OSA in children. For example, in a systematic review of 10 diagnostic studies, only 55% of all children with suspected OSA, based on clinical evaluation, actually had OSA confirmed by PSG.[8] Another study, which stratified patients' symptoms by severity of OSA, failed to demonstrate a high positive predictive value for clinical history even when children with severe OSA (apnea-hypopnea index [AHI] of 10 or higher) were compared to primary snorers. Parents could report loud snoring, mouth breathing, or pauses, but their history was not consistently confirmed by PSG.[15]

The American Academy of Pediatrics (AAP) clinical practice guideline on diagnosis and management of childhood obstructive sleep apnea syndrome provides a nonspecific recommendation to obtain overnight PSG to confirm the diagnosis of SDB.[2] In addition to identifying the presence of SDB, PSG also helps define its severity, which can aid in perioperative planning. In addition, children with severe OSA documented by PSG are less likely to be cured by tonsillectomy[16,17] and are more likely to suffer perioperative complications.[18,19] Despite the AAP recommendations and documented utility of PSG, only about 10% of pediatric otolaryngologists obtain a preoperative PSG before tonsillectomy for SDB.[5] The variability in obtaining PSG prior to tonsillectomy in children with SDB may be due to lack of access, cost, time expended, and concern over the child's emotional distress.

The burden of PSG is emotional, practical, and logistical because of the prolonged wait times for the procedure and lack of "child-friendly" sleep laboratories. In a survey of pediatric otolaryngologists, 17% of respondents did not have access to a sleep laboratory, and only 60% had access to a dedicated pediatric center.[5] The typical wait time for the study was 6 weeks or longer. The emotional burden is increased when a reliable study is not obtained. On rare occasions, the child becomes combative and will not sleep, and no useful information is obtained. However, despite the foreign sleep environment, a good-quality study is obtained the vast majority of the time.

The role of PM, as an alternative to formal PSG, in assessing children with SDB is controversial. PM in the home may improve access and perhaps lower costs. The American Academy of Sleep Medicine (AASM) has endorsed PM as an alternative to PSG for diagnosing OSA in at-risk adults; however, the validity of PM among children is largely unknown.[20] Furthermore, the physiologic variables monitored during PM are inconsistent and may be as simple as oximetry alone or may include other measures, including chest wall movement, air flow, and sometimes electroencephalography (EEG). Including more variables increases the accuracy but also the complexity of the study. Simple oximetry is usually well tolerated but cannot detect (1) events that result in arousal without desaturation, (2) how long the patient slept, (3) carbon dioxide elevation, (4) prolonged flow limitation without discrete

desaturation, or (5) whether they achieved rapid eye movement (REM) sleep (the period when respiratory events are most common).[21]

Methods and Literature Search

This guideline was developed using an explicit and transparent a priori protocol for creating actionable statements based on supporting evidence and the associated balance of benefit and harm.[22] The guideline development panel was chosen to represent the fields of pediatric anesthesiology, pediatric pulmonology, otolaryngology–head and neck surgery, pediatrics, and sleep medicine. Despite the multidisciplinary nature of the development panel, the guideline target audience was defined to be otolaryngology–head and neck surgeons.

Several initial literature searches were performed through February 27, 2010, using MEDLINE, the National Guidelines Clearinghouse (NGC) (www.guideline.gov), The Cochrane Library, Guidelines International Network (GIN), the National Research Register (NRR), ClinicalTrials.gov, the International Clinical Trials Registry Platform, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and EMBASE. The initial search using "polysomnography" or "polysomnograph*" or "PSG" or "sleep apnea syndromes" or "apnea hypopnea index" or "respiratory disturbance index" or "AHI" or "RDI" or "sleep disorder*" or "sleep study*" or "sleep laboratory" in any field showed 5686 potential articles:

1. Clinical practice guidelines were identified by an EMBASE, CINAHL, and MEDLINE and GIN search using *guideline* as a publication type or title word. The search identified 206 guidelines with a topic of polysomnography. After eliminating articles that did not have polysomnography as the primary focus, 49 guidelines were selected for the panel's discussion.
2. Systematic reviews were identified using a validated filter strategy that initially yielded 234 potential articles. The final data set included 34 systematic reviews or meta-analyses on polysomnography that were distributed to the panel members.
3. Randomized controlled trials were identified through the Cochrane Library (Cochrane Controlled Trials Register), MEDLINE, EMBASE, and CINAHL and totaled 24 trials.
4. Original research studies were identified by limiting the MEDLINE, CINAHL, and EMBASE search to articles on humans published in English. The resulting data set of 92 articles yielded 47 related to indications for PSG, 69 to advocating for PSG, 48 to postoperative monitoring, 6 to anesthesiology, and 2 to portable devices.

Results of all literature searches were distributed to guideline panel members, including electronic listings with abstracts (if available) of the searches for randomized trials, systematic reviews, and other studies. This material was supplemented, as needed, with targeted searches to address specific needs identified in writing the guideline through July 2010.

In a series of conference calls, the working group defined the scope and objectives of the proposed guideline. During the 10 months devoted to guideline development ending in September 2010, the group met twice, with interval electronic review and feedback on each guideline draft to ensure accuracy of content and consistency with standardized criteria for reporting clinical practice guidelines.[23]

American Academy of Otolaryngology—Head and Neck Surgery Foundation (AAO-HNSF) staff used GEM-COGS, the Guideline Implementability Appraisal and Extractor, to appraise adherence of the draft guideline to methodological standards, to improve clarity of recommendations, and to predict potential obstacles to implementation.[24] Guideline panel members received summary appraisals in September 2010 and modified an advanced draft of the guideline.

The final draft practice guideline underwent extensive external peer review. Comments were compiled and reviewed by the group chairpersons, and a modified version of the guideline was distributed and approved by the development panel. Recommendations contained in the practice guideline are based on the best available published data through July 2010. Where data were lacking, a combination of clinical experience and expert consensus was used. A scheduled review process will occur at 5 years from publication or sooner if new compelling evidence warrants earlier consideration.

Classification of Evidence-Based Statements

Guidelines are intended to produce optimal health outcomes for patients, to minimize harms, and to reduce inappropriate variations in clinical care. The evidence-based approach to guideline development requires that the evidence supporting a policy be identified, appraised, and summarized and an explicit link between evidence and statements be defined. Evidence-based statements reflect both the quality of evidence and the balance of benefit and harm anticipated when the statement is followed. Definitions of evidence-based statements (AAP SCIM 2004) are listed in **Tables 2** and **3**.

Guidelines are not intended to supersede professional judgment; rather, they may be viewed as a relative constraint on individual clinician discretion in a particular clinical circumstance. Less frequent variation in practice is expected for a "strong recommendation" than might be expected with a "recommendation." "Options" offer the most opportunity for practice variability.[25] Clinicians should always act and decide in a way that they believe will best serve their patients' interests and needs, regardless of guideline recommendations. They must also operate within their scope of practice and according to their training. Guidelines represent the best judgment from a team of experienced clinicians and methodologists addressing the scientific evidence for a particular topic.[26]

Making recommendations about health practices involves value judgments based on the desirability of various outcomes

*High-risk populations include children with obesity, neuromuscular or craniofacial disorders, Down syndrome, mucopolysaccharidoses, or sickle cell disease.

Table 2. Guideline Definitions for Evidence-Based Statements

Statement	Definition	Implication
Strong recommendation	A strong recommendation means the benefits of the recommended approach clearly exceed the harms (or that the harms clearly exceed the benefits in the case of a strong negative recommendation) and that the quality of the supporting evidence is excellent (grade A or B).[a] In some clearly identified circumstances, strong recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Recommendation	A recommendation means the benefits exceed the harms (or that the harms exceed the benefits in the case of a negative recommendation), but the quality of evidence is not as strong (grade B or C).[a] In some clearly identified circumstances, recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits outweigh the harms.	Clinicians should also generally follow a recommendation but should remain alert to new information and sensitive to patient preferences.
Option	An option means that either the quality of evidence that exists is suspect (grade D)[a] or that well-done studies (grade A, B, or C)[a] show little clear advantage to one approach vs another.	Clinicians should be flexible in their decision making regarding appropriate practice, although they may set bounds on alternatives; patient preference should have a substantial influencing role.
No recommendation	No recommendation means there is both a lack of pertinent evidence (grade D)[a] and an unclear balance between benefits and harms.	Clinicians should feel little constraint in their decision making and be alert to new published evidence that clarifies the balance of benefit vs harm; patient preference should have a substantial influencing role.

[a]See Table 3 for definition of evidence grades.

Table 3. Evidence Quality for Grades of Evidence

Grade	Evidence Quality
A	Well-designed randomized controlled trials or diagnostic studies performed on a population similar to the guideline's target population
B	Randomized controlled trials or diagnostic studies with minor limitations; overwhelmingly consistent evidence from observational studies
C	Observational studies (case control and cohort design)
D	Case reports, reasoning from first principles (bench research or animal studies)
X	Exceptional situations where validating studies cannot be performed and there is a clear preponderance of benefit over harm

associated with management options. Values applied by the guideline panel sought to minimize harm and diminish unnecessary and inappropriate therapy. A major goal of the committee was to be transparent and explicit about how values were applied and to document the process.

Financial Disclosure and Conflicts of Interest

The cost of developing this guideline, including travel expenses of all panel members, was covered in full by the AAO-HNSF. Potential conflicts of interest for all panel members in the past 5 years were compiled and distributed before the first conference call. After review and discussion of these disclosures, the panel concluded that individuals with potential conflicts could remain on the panel if they (1) reminded the panel of potential conflicts before any related discussion, (2) recused themselves from a related discussion if asked by the panel, and (3) agreed not to discuss any aspect of the guideline with industry before publication.[27] Last, panelists were reminded that conflicts of interest extend beyond financial relationships and may include personal experiences, how a participant earns a living, and the participant's previously established "stake" in an issue.[28]

Guideline Key Action Statements

Each action statement is organized in a similar fashion: **statement in boldface type**, followed by *strength of the recommendation in italic*. Several paragraphs then discuss the evidence base supporting the statement, concluding with an "evidence profile" of aggregate evidence quality, benefit-harm assessment, and statement of costs. Last, there is an explicit statement of the value judgments, intentional vagueness, the role of patient preferences, potential exclusions, and a repeat statement of the strength of the recommendation. An overview of evidence-based statements in the guideline is shown in **Table 1**.

The role of patient preference in making decisions deserves further clarification. For some statements, the evidence base demonstrates clear benefit, which would minimize the role of patient preference. If the evidence is weak or benefits are

Table 4. Role of PSG in Assessing High-Risk Populations before Tonsillectomy for SDB

Role of PSG	Rationale
Avoid unnecessary or ineffective surgery in children with primarily nonobstructive events	Identify primarily nonobstructive events or central apnea that may not have been suspected prior to the study and may not benefit from surgery.
Confirm the presence of obstructive events that would benefit from surgery	The increased morbidity of surgery in high-risk children requires diagnostic certainty before proceeding.
Define the severity of SDB to assist in preoperative planning	Children with severely abnormal SDB may require preoperative cardiac assessment, pulmonary consultation, anesthesia evaluation, or postoperative inpatient monitoring in an intensive care setting.
Provide a baseline PSG for comparison after surgery	Persistent SDB or OSA despite surgery is more common in high-risk patients than in otherwise healthy children.
Document the baseline severity of SDB	High-risk patients are more prone to complications of surgery or anesthesia.

Abbreviations: OSA, obstructive sleep apnea; PSG, polysomnography; SDB, sleep-disordered breathing.

unclear, however, not all informed patients may opt to follow the suggestion. In such cases, the practice of shared decision making, where the management decision is made collaboratively between the clinician and the informed patient, becomes more useful. Factors related to patient preference include (but are not limited to) absolute benefits (number needed to treat), adverse effects (number needed to harm), cost of drugs or tests, frequency and duration of treatment, and desire to take or avoid antibiotics. Comorbidity can also affect patient preferences by several mechanisms, including the potential for drug-drug interactions when planning therapy.

STATEMENT 1. INDICATIONS FOR PSG: Before performing tonsillectomy, the clinician should refer children with SDB for PSG if they exhibit any of the following: obesity, Down syndrome, craniofacial abnormalities, neuromuscular disorders, sickle cell disease, or mucopolysaccharidoses. *Recommendation based on observational studies with a preponderance of benefit over harm.*

Supporting Text

The purpose of this statement is to improve the quality of care and assist with clinical treatment plans in children with SDB who are at increased risk for surgical or anesthetic complications because of comorbid conditions that include obesity, neuromuscular or craniofacial disorders, Down syndrome, mucopolysaccharidoses, and sickle cell disease.[29-32] Obtaining PSG prior to tonsillectomy in children with any of the conditions mentioned above will benefit clinicians and patients by improving diagnostic accuracy in high-risk populations* and defining the severity of OSA to optimize perioperative planning (**Table 4**).

History and physical exam alone are poor predictors of OSA severity or risk of postoperative complication.[15,33,34] In children who are at high risk of postoperative respiratory compromise due to a comorbid medical condition, preoperative PSG helps determine postoperative level of care and the need for postoperative oximetry. In addition, overnight postoperative monitoring may identify children requiring further treatment of their residual OSA.[35]

Obesity is defined as body mass index (BMI) greater than or equal to the 95th percentile. The BMI-for-age percentile is used because the amount of body fat changes with age and differs between girls and boys.[36] Children are categorized into normal weight (BMI 5th to <85th percentile), overweight (BMI 85th to <95th percentile), and obese (BMI ≥95th percentile). For the purpose of the discussion in this guideline, recommendations are directed at obese (eg, an 8-year-old boy, height 4 foot 10 inches/1.4 meters, would have to weigh 100 lbs/45 kg or more), not overweight, children. BMI percentiles can be calculated by entering a child's height and weight into a calculator at http://apps.nccd.cdc.gov/dnpabmi/.

SDB has a prevalence of 25% to 40% in obese children.[37] Obese children are also more likely to have severe SDB[38-40] and respiratory complications following tonsillectomy.[41] Furthermore, Costa and Mitchell[42] reported in a meta-analysis of 4 studies that tonsillectomy significantly reduced the severity of SDB in obese children but was rarely curative: 60% to 88% of obese children had evidence of persistent SDB following tonsillectomy. Preoperative PSG, therefore, assists in planning perioperative care, and postoperative PSG assists with long-term management.

Neuromuscular diseases (neuropathies, congenital myopathies, muscular dystrophies, myotonias, and myasthenia gravis) form a heterogeneous group based on the etiology of the individual disorder. Neuromuscular disorders often include central apneas, obstructive apneas, and/or hypoventilation that are important to distinguish on preoperative PSG.[43] In children with predominantly nonobstructive events, tonsillectomy may not be indicated, and other management options should be explored.

Craniofacial deformities result from abnormal development of the brain, cranium, and facial skeleton. Premature fusion of cranial growth plates as well as abnormal facial bone development leads to craniofacial anomalies such as Apert, Crouzon, and Pfeiffer syndromes. Children with such craniofacial syndromes are at a high risk for SDB because of oropharyngeal and nasopharyngeal crowding and laryngeal abnormalities.[44] Similarly, children with Down syndrome have multiple anatomic and physiologic factors that predispose

them to SDB, including hypotonia, midfacial and mandibular hypoplasia, relative macroglossia, a narrow nasopharynx, and a shortened palate.[45] Craniofacial deformities of the maxilla and mandible (including Pierre Robin sequence, hemifacial microsomia, Treacher Collins syndrome, and Nager syndrome) fall under this definition.

Mucopolysaccharidoses are a group of genetic disorders characterized by enzyme deficiencies that lead to defective catabolism of lysosomal glycosaminoglycans and accumulation of mucopolysaccharides in the soft tissues of the body. SDB is common in children with mucopolysaccharidosis (>80%) because of upper airway narrowing caused by hypertrophy of the tongue, tonsils, adenoids, and mucous membranes. This narrowing is worsened by a physiological decrease in tone of the supporting muscles of the pharynx and increased airway resistance.[46]

Sickle cell anemia is an autosomal recessive disorder of hemoglobin that alters the properties of red blood cells and is associated with varying degrees of anemia.[47] Strokes, transient ischemic attacks, and seizures are common in sickle cell disease. Both episodic and continuous nocturnal hypoxemia are common in sickle cell disease, possibly because of upper airway obstruction secondary to adenotonsillar hypertrophy. Children with sickle cell anemia and a clinical history of SDB should have routine preoperative PSG. If hypoxemia is present, tonsillectomy is advisable as early as possible because SDB could be an important predisposing factor in the etiology of cerebrovascular accidents in these children.[48]

The conditions explained above demonstrate the need for individual assessment among those with neuromuscular disorders and craniofacial anomalies. A full discussion of each condition as it pertains to this statement is beyond the scope of this guideline.

Evidence Profile for Statement 1: Indications for PSG

- Aggregate evidence quality: grade C, observational studies; 1 systematic review of observational studies on obesity
- Benefit: PSG confirms indications and appropriateness of surgery, helps plan perioperative management, provides a baseline for postoperative PSG, and defines severity of sleep disturbance
- Harm: none
- Cost: procedural cost; indirect cost of missed work
- Benefits-harm assessment: preponderance of benefit over harm
- Value judgments: knowledge gained through PSG can assist in diagnosing those children with significant SDB; belief that PSG can improve surgical outcomes through improved perioperative planning
- Role of patient preferences: limited
- Intentional vagueness: the panel decided to use the broad categories of neuromuscular disorders and craniofacial anomalies, rather than a comprehensive list of diseases and syndromes, to emphasize the need for individualized assessment
- Exclusions: none
- Policy level: recommendation

STATEMENT 2. ADVOCATING FOR PSG: The clinician should advocate for PSG prior to tonsillectomy for SDB in children without any of the comorbidities listed in statement 1 for whom the need for surgery is uncertain or when there is discordance between tonsillar size on physical examination and the reported severity of SDB. *Recommendation based on observational and case-control studies with a preponderance of benefit over harm.*

Supporting Text

The purpose of this statement is to help clinicians decide when to request a polysomnogram prior to tonsillectomy in children *without* any of the conditions in statement 1. Advocating for PSG refers to encouraging, or arguing in favor of using, PSG to assist in decision making when the need for surgery is uncertain or there is discordance between the physical examination and the reported severity of SDB. Although the tonsil size does not predict the severity of OSA, one is less certain of the diagnosis when tonsil hypertrophy is absent. The clinician may fulfill the requirement of advocating for PSG by (*a*) documenting in the medical record that PSG was discussed and encouraged, (*b*) providing an informational brochure or handout that describes the benefits and rationale of PSG in this circumstance, or (*c*) referring the patient for PSG or to a sleep specialist.

In some children who are candidates for tonsillectomy to treat SDB, there may be controversy among clinicians, caregivers, or both regarding the need for surgical intervention. Examples include differing opinions or observations among parents, other family members, primary care clinicians, and surgeons. In addition, at times the severity of SDB by history is inconsistent with the physical examination by the clinician: children with small tonsils may have prominent symptoms suggesting SDB, or children without apparent SDB symptoms may have tonsillar hypertrophy or nasal airway obstruction that appears highly significant. In the above situations, information obtained from PSG should help clarify the diagnosis and severity of SDB, if present, and assist in decision making.

Recent investigations have demonstrated the potential for long-lasting health consequences if SDB remains untreated. A recent meta-analysis demonstrated a significant increase in height, weight, and growth biomarkers after tonsillectomy.[49] Although some children may not be experiencing growth failure, they also may not be meeting their full potential. The implications of untreated SDB may be worse for children with borderline neurocognitive functioning prior to developing a sleep disturbance. Multiple studies in younger children with SDB have shown an intelligence quotient (IQ) loss of more than 5 points.[50] For perspective, the exposure to lead-based paint is associated with an average IQ point loss of less than 4 points.[51]

Treatment of SDB has been shown to improve behavior,[39,52-54] attention,[53] quality of life (QOL),[39,55] neurocognitive functioning,[56] enuresis,[57,58] parasomnias (unusual events that occur while asleep),[59] and restless sleep.[60] Even when a

clinician strongly suspects SDB exists, some families require objective information to facilitate a clinical decision. In these situations, a PSG should be requested.

PSG can also assist in managing children who are tonsillectomy candidates when there is discordance between tonsillar size on physical examination and the reported severity of SDB. When a child with tonsils that do not appear hypertrophic nonetheless has symptoms of SDB, a normal PSG would lead to reassessing the need for surgery or performing more limited surgery if appropriate. Conversely, an abnormal PSG would support the need for surgery because tonsillectomy has been shown to improve PSG-documented SDB even when tonsils are not hypertrophic.[39]

Another clinical scenario involves a child with markedly hyperplastic tonsils and minimal to no symptoms of SDB reported by the caregiver. Caregiver reports of snoring, witnessed apnea, or other nocturnal symptoms may be unreliable if the caregiver does not directly observe the child while sleeping or only observes the child early in the evening. In this situation, PSG may help detect significant sleep disturbance that may otherwise have been overlooked and could be improved after tonsillectomy. Similarly, caregivers may be unaware of, or underappreciate, the impact of SDB on their child's daytime functioning or behavior (eg, hyperactivity, poor school performance) or nighttime symptoms (eg, enuresis, sleep terrors, sleep walking, frequent awakenings).

Until the clinical consequences of SDB and the threshold for intervention are established, clinicians must provide caretakers with the information necessary to make an informed decision. This requires advocating for a PSG when the diagnosis is uncertain. The objective information obtained from a PSG will help direct care and minimize the risk of overtreating or failing to accurately diagnose.

A minority of panelists felt strongly that PSG should be recommended for all children younger than age 2 prior to tonsillectomy. However, the majority of panelists noted there was insufficient evidence in the published, peer-reviewed literature to support such a recommendation.

Evidence Profile for Statement 2: Advocating for PSG

- Aggregate evidence quality: grade C, observational and case-control studies
- Benefit: selection of appropriate candidates for tonsillectomy
- Harm: none
- Cost: time spent counseling the patient or family; financial implications to the family and insurance industry; time commitment for the study and follow-up
- Benefit-harm assessment: preponderance of benefit over harm
- Value judgments: based on expert consensus, there are circumstances in which PSG will improve diagnostic certainty and help inform surgical decisions
- Intentional vagueness: the panel decided to "advocate for" PSG rather than to "recommend" PSG in these circumstances to avoid setting a legal standard for care and to recognize the role for individualized decisions based on needs of the child and caregiver(s). Furthermore, the word *uncertain* is used in the statement to encompass a variety of circumstances regarding the need for tonsillectomy that include, but are not limited to, disagreement among clinicians or caregivers, questions about the severity of SDB or validity of the SDB diagnosis, or any other situation where the additional information provided by PSG would facilitate shared decisions
- Role of patient preferences: limited role in advocating; significant role in deciding whether or not to proceed with PSG
- Exclusions: none

STATEMENT 3. COMMUNICATION WITH ANESTHESIOLOGIST: Clinicians should communicate PSG results to the anesthesiologist prior to the induction of anesthesia for tonsillectomy in a child with SDB. *Recommendation based on observational studies with a preponderance of benefit over harm.*

Supporting Text

The purpose of this statement is to allow the anesthesiologist advance notice of a child who may require a modified approach to anesthesia care. Children with SDB scheduled for tonsillectomy are at an increased risk of perioperative morbidity and mortality.[10,61,62] Patients may have a difficult airway, an abnormal central respiratory drive, or abnormal cardiopulmonary physiology.[63,64] In addition, patients with OSA may be more sensitive to the respiratory depressant effects of anesthetic medications.[65] Communication with the anesthesiologist will allow for early identification of a child who may require preoperative optimization, as well as a modified approach to the anesthetic management and postoperative care of the patient.

Early knowledge of a child's SDB status may alter the anesthetic plan as compared to a child without SDB. Anxious children are often administered an anxiolytic or sedative prior to anesthesia; however, children with OSA may be at a higher risk for oversedation and hypoventilation secondary to the effects of preoperative sedatives and opioids.[66,67] Children with OSA who receive a premedication before surgery may require monitoring to detect hypoventilation and hypoxemia, as well as access to supplemental oxygen, advanced airway equipment, and personnel trained in airway management.[10] Classification of a patient as having OSA by PSG will alert the anesthesiologist to an 8-fold increase in the probability that the patient may have a difficult airway.[61,64] The care of SDB patients, especially with comorbidities such as midfacial anomalies or Down syndrome, may benefit from the American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway to aid in airway management and to have appropriate airway equipment and assistance available in the operating room.[68]

Recognition of a child with OSA may modify intraoperative management. The concentration of anesthetic gases must be carefully titrated because of increased susceptibility to

airway collapse and delayed emergence.[62,63,69] Nitrous oxide can increase pulmonary artery pressure and must be used with caution in patients with SDB who may be at risk for pulmonary hypertension and right ventricular dysfunction.[10,70]

Intraoperative opioids may be reduced or withheld because of the increased analgesic sensitivity to opiates found in children with OSA, who experience recurrent episodes of hypoxemia during sleep.[63,65,70] For example, when compared to children without OSA, children with OSA who received fentanyl had a higher incidence of central apnea and reduced spontaneous minute ventilation under general anesthesia with inhaled anesthetics.[71] Similarly, requirements of morphine were found to be 50% less in children with OSA.[65] Therefore, children with abnormalities on PSG may need changes in the choice of opioid as well as the dose and timing of administration. Because of the real or perceived risk of apnea and delayed emergence in SDB patients, an alternative approach would be to rely less on opioids and more on nonopioid analgesics such as dexmedetomidine or acetaminophen with the goal of minimizing adverse side effects of opioids.[63]

The anesthesiologist, in concert with the surgeon, may elect to escalate the level of postoperative care for a child with SDB, which may involve more intense nursing care and monitoring in the postoperative period compared to non-SDB children having the same procedure.[72] The presence of SDB is associated with an increased incidence of postoperative complications.[61,62,73,74] Anesthetic drugs may have a prolonged effect on the level of consciousness and respiratory function into the postoperative period.[63,75-79] Postoperative pain control may involve choosing a less potent opioid to administer in smaller divided doses or the use of a smaller dose of opioid in combination with a nonopioid analgesic to avoid oversedation and/or possible respiratory depression resulting in death.[63,80,81] Therefore, postoperative management may need to be modified for children with an abnormal PSG as discussed under statement 4.

Evidence Profile for Statement 3: Communication with Anesthesiologist

- Aggregate evidence quality: grade C observational studies and grade D panel consensus
- Benefit: improve communication, provide information to the anesthesiologist that may alter perioperative management, reduce perioperative morbidity
- Harm: none
- Cost: none
- Benefit-harm assessment: preponderance of benefit over harm
- Value judgments: promoting a team approach to patient care will result in improved patient outcomes
- Intentional vagueness: none
- Role of patient preferences: none
- Exclusions: none

STATEMENT 4. INPATIENT ADMISSION FOR CHILDREN WITH OSA DOCUMENTED IN RESULTS OF PSG: Clinicians should admit children with OSA documented in results of PSG for inpatient, overnight monitoring after tonsillectomy, if they are under age 3 years or have severe OSA (apnea-hypopnea index of 10 or more obstructive events/hour, oxygen saturation nadir less than 80%, or both). *Recommendation based on observational studies with a preponderance of benefit over harm.*

Supporting Text

The purpose of this statement is to promote an appropriate, monitored setting after tonsillectomy for children with SDB and abnormal PSG. Child age and OSA severity correlate with postoperative respiratory compromise, which may require medical intervention.[82,83] In particular, children who are younger than age 3 or have severe OSA benefit from inpatient hospital admission and monitoring after surgery. Postoperative care should include continuous pulse oximetry and the availability of more intensive levels of care, including respiratory support (intubation, supplemental O_2, CPAP). Although no widespread interdisciplinary consensus exists on the precise definition of "severe" OSA, many contributions to the literature use an AHI of 10 or an oxygen saturation nadir of 80%. The panel chose to be very specific in order to make this guideline as actionable as possible, based on the best available evidence. The panel, however, does acknowledge that opinions do differ among experienced clinicians as to what constitutes severe sleep apnea. The panel would like to be clear that if a clinician believes a child to have severe OSA based on other criteria, or if the sleep laboratory that performed the study interprets the OSA as severe, it would be prudent to admit the child for observation.

Whereas no validated severity scales are currently available for PSG in children, several publications[10,18,82,84] support defining *severe OSA as having an oxygen saturation nadir below 80% and an AHI of 10 or more obstructive events*. In contrast, a normal PSG has oxygen nadir saturation above 92% and an AHI of 1 or lower.

Children younger than age 3 with SDB symptoms are at increased risk of respiratory compromise after tonsillectomy compared to older children. In a review of 2315 children younger than age 6, 9.8% of children younger than age 3 experienced a respiratory complication postoperatively as compared to 4.9% of older children.[83] A report including 307 children younger than age 3 revealed outpatient tonsillectomy was less cost-effective than hospital admission, primarily due to prolonged recovery room stays in the outpatient group.[85]

Children with OSA confirmed by PSG are at increased risk of respiratory complications in the postoperative period.[18,82,86-88] Postoperative respiratory complications occur in up to 23% of children with OSA undergoing tonsillectomy[18,82] as compared to 1.3% in a general pediatric population.[89] Up to 25% of children with OSA require medical intervention, including supplemental oxygen, CPAP, and reintubation.[18,82,86,88,90]

There is no consensus in the literature on postoperative inpatient monitoring of children with OSA after tonsillectomy, and some controversy exists regarding the criteria for pediatric intensive care unit (PICU) admission. Oximetry monitoring in the recovery room during the initial postoperative period is reported as a routine part of postoperative care

among hospitalized children in many publications. In one study, children older than age 3, without severe OSA or other comorbidity requiring admission, were discharged home, whereas children younger than age 3, children with severe OSA, and children with comorbid conditions were admitted to the pediatric ward with oximetry. Admission to the PICU was reserved for children with very severe OSA, those with comorbidities that could not be managed on the floor, and those who demonstrated significant airway obstruction and desaturation in the initial postoperative period that required interventions beyond repositioning and/or oxygen supplementation.[10,18,82,86,88,90,91] Documentation of mild or moderate OSA should not prevent the clinician from overnight monitoring of a patient who retains clinically significant SDB after surgery. In addition, postoperative admission may be considered in children with comorbid conditions that, independent of OSA severity, increase their risk of postoperative complication.

The postoperative period is defined as the initial 24 hours following completion of surgery. Although tonsillectomy resolves or significantly improves OSA in the majority of children, they may continue to experience upper airway obstruction and oxygen desaturation in the postoperative period. Two studies have reported onset of respiratory compromise during sleep at least 5 hours postoperatively in children with OSA.[92,93] In another study, postoperative respiratory events were observed up to 14 hours postoperatively.[18] Obstructive apneas and desaturation occur primarily during REM sleep because of a greater hypoventilation and reduced responsiveness to hypoxemia or hypercapnia.[2] REM rebound may follow tonsillectomy for severe OSA and may not occur for 18 hours.[88] Most interventions required during the postoperative period include administration of oxygen or repositioning; however, in several studies, children with OSA required more significant interventions with PICU admission.[18,86,88]

One proposed mechanism for identifying potential postoperative upper airway obstruction and oxygen desaturation has been differences in neuromuscular control of the upper airway in children with OSA, which makes them more susceptible to residual effects of anesthetic and analgesic medications.[94,95] Children with OSA who are considered high risk for respiratory compromise require overnight inpatient monitoring postoperatively in a setting where signs of respiratory depression and airway obstruction can be recognized and prompt intervention can be implemented.[2,10,18,96]

Evidence Profile for Statement 4: Impact of PSG on Postoperative Monitoring

- Aggregate evidence quality: grade C, observational studies on age; diagnostic studies, guidelines, and panel consensus on what constitutes a severely abnormal PSG
- Benefit: PSG can help determine the appropriate setting for recovery after tonsillectomy that would allow prompt detection and management of respiratory complications among high-risk children
- Harm: unnecessary admission of children who do not have respiratory complications; occupying a hospital bed that might be better utilized; risk of iatrogenic injury (infection, parenteral narcotics causing respiratory depression, hyponatremia from hypotonic intravenous fluids, etc); reduced "family-centered care" during recovery process
- Cost: hospital admission; cost of monitoring
- Benefit-harm assessment: preponderance of benefit over harm
- Value judgments: despite the lack of consistent data on what constitutes severe OSA on PSG, the panel decided some criteria, based on consensus, should be provided to guide clinical decisions; perception by the panel that inpatient admission after tonsillectomy is underused for children with abnormal PSG and that obstacles exist in the health care system for precertifying inpatient admission, even when appropriate
- Intentional vagueness: none
- Role of patient preferences: limited
- Exclusions: none

STATEMENT 5. UNATTENDED PSG WITH PORTABLE MONITORING DEVICE: In children for whom PSG is indicated to assess SDB prior to tonsillectomy, clinicians should obtain laboratory-based PSG, when available. *Recommendation based on diagnostic studies with limitations and a preponderance of benefit over harm.*

Supporting Text

The purpose of this statement is to provide guidance when the clinician recognizes a need for PSG in a child prior to tonsillectomy, and consideration is given to using a portable monitoring (device) for home testing as a substitute for formal PSG in a sleep laboratory.

PSG in a sleep laboratory remains the gold standard for evaluating SDB in children. PSG not only confirms the diagnosis but also can differentiate OSA from snoring and can rule out other sleep disorders such as periodic limb movements, narcolepsy, and nocturnal seizures. It also quantifies the severity of OSA.

Because of the expense and inconvenience of laboratory-based PSG, there have been several attempts to use simpler, more limited studies to evaluate SDB. Studies in the home have the advantage of a more natural sleeping environment, which may be especially important for children; however, fewer measurements are made in an unmonitored setting, thus reducing its accuracy and precision. In addition, there is no technologist available to solve technical problems, so a percentage of home studies will need to be repeated.

In 1994, the AASM published clinical guidelines for using PM to diagnose OSA in adults. These guidelines were updated in 2007 to include a recommendation that PM record, at minimum, airflow, blood oxygenation, and respiratory effort, preferably including both oronasal thermisters and nasal pressure transducers to improve detection of hypopneas. A suggestion that PM only be used in conjunction with a comprehensive sleep evaluation in uncomplicated adult patients without comorbidities and with a

high pretest probability of OSA was also made. The updated guidelines also state studies should be scored and supervised by trained and accredited sleep technicians and physicians.[20]

The AASM recommendations in the preceding paragraph are based on studies in adults, so their relevance or validity for children is unknown. They highlight, however, the paucity of evidence on PM and restricted circumstances for which it may be of use.

Only 1 study has compared PM to PSG in children with possible OSA. Jacob and colleagues[97] performed both tests in 21 children aged 2 to 12 years using a home PM device that included inductance plethysmography, ECG, and pulse oximetry to assess respiratory events, with a camcorder and microphone to estimate sleep time. This device, in a selected population and in the hands of experienced investigators, was able to separate patients with an AHI greater or less than 5 events per hour of sleep. However, the Jacob study used a sophisticated testing apparatus not currently commercially available for home testing and was not able to define the severity of disease when compared to in-laboratory PSG.[97]

The guideline panel also considered the following issues regarding the suitability of PM devices as an alternative to laboratory-based PSG:

1. There are many PM devices on the market, and validation of one particular device cannot necessarily be extrapolated to others.
2. Few devices have been tested in children. Children are more difficult to study than adults, given the prevalence of shorter events and hypopneas, together with less cooperation. When, and if, comparison studies are performed, their accuracy in predicting the severity of OSA is as important as their ability to differentiate OSA from snoring.
3. Because every study of PM (adult and pediatric) the panel reviewed excluded patients with significant comorbidities, the panel concluded PM is not appropriate for high-risk children, including those with sickle cell disease, craniofacial or neurologic disorders, or Down syndrome.
4. The interpretation of PM results is likely as important as the hardware used in performing the test. If PM is used, the panel recommends that results are interpreted by an expert in sleep medicine who is aware of the differences in scoring for children. Although some commercial devices have a computerized scoring algorithm, these are usually based on adult criteria.

Laboratory-based PSG remains the gold standard for the diagnosis of OSA in children and should be used if a facility skilled in pediatric PSG is available. In areas where pediatric sleep centers are not accessible or in situations where there is strong parental preference for a home-based study, PM may be considered. However, given the paucity of data in this subject area, the panel recommends against the routine use of PM over laboratory-based PSG. Additional research is necessary to validate commercially available PM devices as alternatives to PSG and to clarify the relationship of benefit versus harm related to their use among children.

Evidence Profile for Statement 5: Unattended PSG with PM Device

- Aggregate evidence quality: grade C, 1 small diagnostic study in children and extrapolation from diagnostic studies and guidelines for adults
- Benefit: avoid inaccurate results or misdiagnosis of OSA because of limitations in the precision and accuracy of currently used PM devices
- Harm: potential for delays in testing based on access to PSG and availability of child-friendly test facilities
- Cost: procedure-related direct cost
- Benefit-harm assessment: preponderance of benefit over harm
- Value judgments: the panel chose to emphasize accuracy of test results over convenience of testing. The term “when available” was used to acknowledge that although home studies have limitations, there may be circumstances when the caregivers express a strong preference for home-based testing or when access to laboratory-based PSG is limited by geography, scheduling conflicts, or insurance restrictions
- Intentional vagueness: none
- Role of patient preferences: some role for patient preference in deciding whether or not a PM device would be an acceptable alternative to PSG
- Exclusions: none

Implementation Considerations

The complete guideline is published as a supplement to *Otolaryngology–Head and Neck Surgery* to facilitate reference and distribution. The guideline will be presented to AAO-HNS members as a mini-seminar at the AAO-HNS annual meeting following publication. Existing brochures and publications by the AAO-HNS will be updated to reflect the guideline recommendations. A full-text version of the guideline will also be accessible free of charge at www.entnet.org.

Research Needs

Significant gaps in research remain regarding our knowledge about OSA and its management. The guideline committee identified several areas where future studies could improve the ability of clinicians to manage SDB patients optimally.

1. The ability of PSG to predict the likelihood and time of onset of postoperative complications following tonsillectomy in children has yet to be determined. This is important not only for otherwise normal children but also for patients with Down syndrome, craniofacial abnormalities, neuromuscular disorders, sickle cell disease, mucopolysaccharidoses,

and obesity. Studies are required to determine if the risk of postoperative complications can be stratified to the patient's disease severity as defined by PSG.
2. Determine the degree to which overweight and/or obesity correlates with OSA severity as measured by PSG. PSG parameters that correlate with respiratory compromise perioperatively in obese children undergoing tonsillectomy should also be examined.
3. Conduct a large-scale prospective study to determine the ability of PSG to predict surgical outcomes to determine whether abnormal PSG findings reliably predict the elimination of SDB after surgical intervention. This type of study would also be beneficial for predicting when tonsillectomy would be ineffective or potentially dangerous in the management of SDB.
4. Develop validated severity scales for PSG to benefit inpatient hospital admission and perioperative monitoring in children with severe OSA.
5. Examine the benefits of inpatient postoperative monitoring in children younger than age 3 with Down syndrome, craniofacial abnormalities, neuromuscular disorders, sickle cell disease, mucopolysaccharidoses, or obesity where PSG identified only mild to moderate OSA.
6. Study the impact of PSG findings (severity, including normal) on the need for additional preoperative and postoperative evaluation and testing of children with SDB compared to those without SDB. Studies are needed to determine who would benefit from postoperative PSG.
7. Study the relationship between PSG findings (severity) and the perioperative management of children with SDB.
8. Conduct an outcomes study to determine the optimal anesthetic management to reduce the rate of postoperative complications in light of PSG findings (severity).
9. Study which parameters PM must measure to replicate laboratory findings and accurately predict children at risk for postoperative complications. This is of particular importance to patients who may lack access to a sleep laboratory and to those children who have difficulty sleeping in a foreign environment.
10. Additional studies of intraoperative anesthetic parameters such as end tidal CO_2 may show promise in predicting postoperative respiratory complications in patients with SDB.

Disclaimer

This clinical practice guideline is not intended as a sole source of guidance in prescribing polysomnography. Rather, it is designed to assist clinicians by providing an evidence-based framework for decision-making strategies. The guideline is not intended to replace clinical judgment or establish a protocol for all individuals who may benefit from polysomnography and may not provide the only approach to determining the appropriateness for polysomnography. Where data were lacking, a combination of clinical experience and expert consensus was used. A scheduled review process will occur 5 years from publication or sooner if compelling evidence warrants earlier consideration.

As medical knowledge expands and technology advances, clinical indicators and guidelines are promoted as conditional and provisional proposals of what is recommended under specific conditions but are not absolute. Guidelines are not mandates; these do not and should not purport to be a legal standard of care. The responsible physician, in light of all the circumstances presented by the individual patient, must determine the appropriate treatment. Adherence to these guidelines will not ensure successful patient outcomes in every situation. The American Academy of Otolaryngology–Head and Neck Surgery emphasizes that these clinical guidelines should not be deemed to include all proper treatment decisions or methods of care, or to exclude other treatment decisions or methods of care reasonably directed to obtaining the same results.

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