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Clinical Practice Guideline: Tonsillectomy in Children

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Introduction

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Clinical alterations observed both by pediatricians and ENTs during their daily practice, caused by tonsils and adenoid (T & A) hyperplasia, are very important for the correct diagnosis and clinical / surgical approach. A broad variety of signs and symptoms that result in obstruction of the upper respiratory airways may occur (sleep disorders, dysphagia, smell and taste disorders, craniofacial alterations due to mouth breathing, recurrent otitis media episodes and adenoiditis, amongst others), that affect the patient's quality of life and, in some cases, may even hinder their school performance and growth development.

The importance of an early and appropriate diagnosis will indicate the need to remove the hyperplastic structures, a resolution process that will eliminate the obstruction and its consequences.

Clinical Practice Guideline*

This guideline provides evidence based recommendations on the preoperative, intraoperative, and postoperative care and management of children 1 to 18 years old under consideration for tonsillectomy. In addition, this guideline is intended for all clinicians in any setting who interact with children 1 to 18 years of age who may be candidates for tonsillectomy.

Purpose. The primary purpose of this guideline is to provide clinicians with evidence-based guidance in identifying children who are the best candidates for tonsillectomy. Secondary objectives are to optimize the perioperative management of children undergoing tonsillectomy, emphasize the need for evaluation and intervention in special populations, improve counseling and education of families of children who are considering tonsillectomy for their child, highlight the management options for patients with modifying factors, and reduce inappropriate or unnecessary variations in care.

Tonsillectomy is one of the most common surgical procedures in the United States, with more than 530 000 procedures performed annually in children younger than 15 years. [1] Indications for surgery include recurrent throat infections and sleep-disordered breathing (SDB), [2] both of which can substantially affect child health status and quality of life (QoL). Although there are benefits of tonsillectomy, complications of surgery may include throat pain, postoperative nausea and vomiting, delayed feeding, voice changes, hemorrhage, and rarely death. This document is intended for all clinicians who diagnose or manage

patients aged 1 to 18 years for whom tonsillectomy is being considered for indications of recurrent throat infection and/or SDB as defined as follows:

- *Tonsillectomy* is defined as a surgical procedure performed 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. Depending on the context in which it is used, it may indicate tonsillectomy with adenoidectomy, especially in relation to SDB.
- *Throat infection* is defined as sore throat caused by viral or bacterial infection of the pharynx, palatine tonsils, or both, which may or may not be culture positive for group A streptococcus. This includes the terms *strep throat* and *acute tonsillitis*, *pharyngitis*, *adenotonsillitis*, or *tonsillopharyngitis*.
- *Sleep-disordered breathing is characterized by abnormalities of respiratory pattern or the adequacy of ventilation during sleep, which include snoring, mouth breathing, and pauses in breathing. SDB encompasses a spectrum of obstructive disorders that increases in severity from primary snoring to obstructive sleep apnea (OSA). Daytime symptoms associated with SDB may include excessive sleepiness, inattention, poor concentration, and hyperactivity.*
- *Caregiver is used throughout the document to refer to parents, guardians, or other adults providing care to patients undergoing tonsillectomy.*

The importance of tonsillectomy as an intervention relates to its documented benefit on child QoL. For example, when compared with healthy children, children with recurrent throat infections have more bodily pain and poorer general health and physical functioning.[3] Tonsillectomy may improve QoL by reducing throat infections, health care provider visits, and the need for antibiotic therapy.[4] Similarly, SDB is associated with cognitive and behavioral impairment in children that usually improves after tonsillectomy[5-8] along with QoL,[6,9-12] sleep disturbance,[5,10,13,14] and vocal quality.[15,16]

Guideline Scope and Purpose

This guideline is intended for all clinicians in any setting who interact with children aged 1 to 18 years who may be candidates for tonsillectomy. The guideline does not apply to tonsillotomy, intracapsular surgery, or other partial removal techniques of the tonsil. Similarly, the guideline does not apply to populations of children excluded from most tonsillectomy research studies, including those with diabetes mellitus, cardiopulmonary disease, craniofacial disorders, congenital anomalies of the head and neck region, sickle cell disease, and other coagulopathies or immunodeficiency disorders. The primary purpose of this guideline is to provide clinicians with evidence-based guidance in identifying children who are the best candidates for tonsillectomy. This guideline predominantly addresses indications for tonsillectomy based on obstructive and infectious causes.

Incidence of Tonsillectomy

Tonsillectomy is the second most common ambulatory surgical procedure performed on children in the United States.[1] In 2006, there were 530 000 tonsillectomies performed in children younger than 15 years, constituting 16%

of all ambulatory surgery in this age group. The only procedure with greater frequency was myringotomy with insertion of tube, for which 667 000 procedures were reported the same year. Reports from 1978 to 1986 showed that the rate of tonsillectomy for treatment of throat infections declined; however, the frequency of SDB as the primary indication for the procedure increased.[2] A recent study reported that the overall incidence rates of tonsillectomy have significantly increased in the past 35 years, with SDB being the primary indication for surgery.[23]

Indications for Surgery

The 2 most common indications for tonsillectomy are recurrent throat infections and SDB. Throat infections are a common reason to see a primary care physician and often result in antibiotic treatment.[24] Indirect costs associated with throat infections and SDB are substantial due to missed school and loss of time from work for caregivers. Treatment of SDB is associated with an increase in health care utilization and cost. Children with SDB, compared with controls, have a significantly higher rate of antibiotic use, 40% more hospital visits, and an overall elevation of 215% in health care usage mostly from increased respiratory tract infections.[25] impact when compared with healthy children.[3] SDB represents a spectrum of disorders ranging in severity from primary snoring to OSA. The prevalence of OSA in the pediatric population is 1% to 4%26; as many as 10% of children have primary snoring.[27] Up to 30% to 40% of children with clinically diagnosed SDB exhibit behavioral problems that include enuresis,28 hyperactivity, aggression, anxiety, depression, and somatization.[29] OSA is also associated with poor school performance and a decrease in QoL.[8] A growing body of evidence indicates that tonsillectomy is an effective treatment for SDB,[32] based on the idea that tonsillar hypertrophy is a principal cause. A meta-analysis of case series[33] and a recent study[34] showed that tonsillectomy was effective at improving or resolving SDB in most children. There is also evidence that behavioral parameters, school performance, and QoL improve after resolution of this sleep disorder.[8]

Harms and Adverse Events of Tonsillectomy

Tonsillectomy is a surgical procedure with an associated morbidity that includes possible hospitalization, risks of anesthesia, prolonged throat pain, and financial costs. A common complication of tonsillectomy is bleeding during or after the surgery. In published reports, the rate of primary hemorrhage (within 24 hours of surgery) has ranged from 0.2% to 2.2% and the rate of secondary hemorrhage (more than 24 hours after surgery) from 0.1% to 3%.[35] Other complications of tonsillectomy include trauma to the teeth, larynx, pharyngeal wall, or soft palate; difficult intubation; laryngospasm; laryngeal edema; aspiration; respiratory compromise; endotracheal tube ignition; and cardiac arrest. Postoperative complications include nausea, vomiting, pain, dehydration, referred otalgia, postobstructive pulmonaryedema, velopharyngeal insufficiency, and nasopharyngeal stenosis. Complications are more common in patients with craniofacial disorders, Down syndrome, cerebral palsy, major heart disease, or bleeding diatheses and in children younger than 3 years with polysomnography (PSG)–proven OSA.[37-41]

Mortality rates for tonsillectomy have been estimated at between 1 in

16,000 to 1 in 35,000, based on data from the 1970s.[44] About one-third of deaths are attributable to bleeding, while the remainder are related to aspiration, cardiopulmonary failure, electrolyte imbalance, or anesthetic complications.[35,45] Similarly, airway compromise is the major cause of death or major injury in malpractice claims after tonsillectomy.[46]

Structure and Function of the Tonsils

The palatine tonsils are lymphoepithelial organs located at the junction of the oral cavity and the oropharynx. They are strategically positioned to serve as secondary lymphoid organs, initiating immune responses against antigens entering the body through the mouth or nose. The greatest immunological activity of the tonsils is found between the ages of 3 and 10 years.[47] As a result, the tonsils are most prominent during this period of childhood and subsequently demonstrate age-dependent involution.[48] The epithelium of the tonsils is cryptic and reticulated and contains a system of specialized channels lined by "M" cells.[49] These cells take up antigens into vesicles and transport them to the extrafollicular region or the lymphoid follicles. In the extrafollicular region, interdigitating dendritic cells and macrophages process the antigens and present them to helper T lymphocytes. These lymphocytes stimulate proliferation of follicular B lymphocytes and their development into either antibody -expressing B memory cells capable of migration to the nasopharynx and other sites or plasma cells that produce antibodies and release them into the lumen of the crypt.[49] While all 5 immunoglobulin (Ig) isotypes are produced in the palatine tonsils, IgA is arguably the most important product of the tonsillar immune system. In its dimeric form, IgA may attach to the transmembrane secretory component to form secretory IgA, a critical component of the mucosal immune system of the upper airway. Although the secretory component is produced only in the extratonsillar epithelium, the tonsils do produce immunocytes bearing the J (joining) chain carbohydrate.[50] This component is necessary for binding of IgA monomers to each other and to the secretory component and is an important product of B-cell activity in the follicles of the tonsil.

Effects of Tonsillitis and Tonsillectomy on Immunity

With chronic or recurrent tonsillitis, the controlled process of antigen transport and presentation is altered due to shedding of the M cells from the tonsil epithelium.[49] The direct influx of antigens disproportionately expands the population of mature B-cell clones and, as a result, fewer early memory B cells go on to become J-chain–positive IgA immunocytes. In addition, the tonsillar lymphocytes can become so overwhelmed with persistent antigenic stimulation that they may be unable to respond to other antigens. Once this immunological impairment occurs, the tonsil is no longer able to function adequately in local protection, nor can it appropriately reinforce the secretory immune system of the upper respiratory tract. There would therefore appear to be a therapeutic advantage to removing recurrently or chronically diseased tonsils. On the other hand, some studies demonstrate minor alterations of Ig concentrations in the serum and adjacent tissues following tonsillectomy.[51-54] Nevertheless, there are no studies to date that demonstrate a significant clinical impact of tonsillectomy on the immune system.[51-53]

Methods and Literature Search

The 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.[55] This material was supplemented, as needed, with targeted systematic searches to address specific needs identified in developing the guideline through April 11, 2010.

Classification of Evidence-Based Statements

Guidelines are intended to reduce inappropriate variations in clinical care, to produce optimal health outcomes for patients, and to minimize harm. Guidelines represent the best judgment of a team of experienced clinicians and methodologists addressing the scientific evidence for a particular topic.[62]

Guideline Key Action Statements

Each evidence-based statement is organized in a similar fashion: **an evidence-based statement in bold**, followed by a *strength of the recommendation in italic.* Lastly, there is an explicit statement of the value judgments, the role of patient preferences, clarification of any intentional vagueness by the panel, and a repeat statement of the strength of the recommendation (**Table 1**).

Table 1. Summary of Evidence-Based Statements

Point of Care (Evidence-Based Statement)	Statement Strength
Surgical indications and planning	
Watchful waiting (**Statement 1**)	*Recommendation*
Recurrent throat infection with documentation (**Statement 2**)	*Option*
Tonsillectomy for recurrent infection with modifying factors (**Statement3**)	*Recommendation*
Tonsillectomy for sleep-disordered breathing (**Statement 4**)	*Recommendation*
Tonsillectomy and polysomnography (**Statement 5**)	*Recommendation*
Outcome assessment for sleep-disordered breathing	*Recommendation*
(**Statement 6**)	
Perioperative care	
Steroids (**Statement 7**)	*Strong recommendation*
Antibiotics (**Statement 8**)	*Strong recommendation against*
Postoperative care	
Pain control (**Statement 9**)	*Recommendation*
Posttonsillectomy hemorrhage (**Statement 10**)	*Recommendation*

STATEMENT 1. WATCHFUL WAITING FOR RECURRENT THROAT INFECTION:

Clinicians should recommend watchful waiting for recurrent throat infection if there have been fewer than 7 episodes in the past year or fewer than 5 episodes per year in the past 2 years or fewer than 3 episodes per year in the past 3 years.

Recommendation based on randomized controlled trials with limitations and observational studies with a preponderance of benefit over harm.

Supporting Text

The purpose of this statement is to avoid unnecessary intervention in children with recurrent throat infection who have a favorable natural history and are likely to improve on their own without surgery. Watchful waiting does not imply inaction; rather, patients should be closely monitored and episodes of pharyngotonsillitis accurately documented. The clinical characteristics of each episode should include the symptoms, physical findings, and culture results if performed, as well as days of school absence and any QoL issues. Only with this information can the clinician assess the significance of the impact of recurrent pharyngotonsillitis for the patient and caregiver. In one study of patients observed for 1 year, only 17% of patients meeting the "Paradise criteria" (**Table 2**) actually had adequate documentation and confirmation of their clinical course.[66]

Table 2. Paradise Criteria for Tonsillectomy[31]

Criterion	Definition
Minimum frequency of sore throat episodes	7 or more episodes in the preceding year, OR
	5 or more episodes in each of the preceding 2 y, OR
	3 or more episodes in each of the preceding 3 y
Clinical features (sore throat plus the presence of one or more qualifies as counting episode)	Temperature > 38.3°C, OR
	Cervical lymphadenopathy (tender lymph nodes or >2 cm), OR
	Tonsillar exudate, OR
	Positive culture for group A b-hemolytic streptococcus
Treatment	Antibiotics had been administered in conventional dosage for proved or suspected streptococcal episodes
Documentation	Each episode and its qualifying features had been substantiated by contemporaneous notation in a clinical record, OR
	If not fully documented, subsequent observance by the clinician of 2 episodes of throat infection with patterns of frequency and clinical features consistent with the initial history

History less than 12 months. Because of this tendency to improve with time, at least a 12-month period of observation is recommended prior to consideration of tonsillectomy as an intervention. This statement should not restrict access to tonsillectomy prior to 1 year of observation for all patients who do not meet frequency criteria for tonsillectomy (see Statement 3). Patients with a history of recurrent severe infections requiring hospitalization, complications of infection such as peritonsillar abscess or Lemierre syndrome (thrombophlebitis of the internal jugular vein), or a family history of rheumatic heart disease or numerous repeat infections in a single household ("pingpong spread") may reasonably be considered for the procedure.

History greater than 12 months. Observation of frequent pharyngotonsillitis beyond 1 year may be indicated even in patients meeting the Paradise criteria. A Cochrane review on the efficacy of tonsillectomy for recurrent tonsillitis concludes that some cases may resolve without surgery.[68] Additional information

regarding the natural history of recurrent pharyngotonsillitis is found for patients awaiting tonsillectomy. Patients and caregivers should be educated on the limited benefits of tonsillectomy when performed in less severely affected children and adolescents. Prompt medical treatment should be implemented when indicated in cases of pharyngitis caused by Group A b-hemolytic streptococcus (GABHS).

Evidence Profile for Statement 1: Watchful waiting for recurrent throat infection

• Policy level: *Recommendation*

STATEMENT 2. RECURRENT THROAT INFECTION WITH DOCUMENTATION:

Clinicians may recommend tonsillectomy for recurrent throat infection with a frequency of at least 7 episodes in the past year or at least 5 episodes per year for 2 years or at least 3 episodes per year for 3 years with documentation in the medical record for each episode of sore throat and one or more of the following: temperature >38.3°C, cervical adenopathy, tonsillar exudate, or positive test for GABHS.

Option based on systematic reviews and randomized controlled trials with minor limitations, with a balance between benefit and harm.

Supporting Text

Defining and documenting "throat infection." Patients referred for tonsillectomy are rarely evaluated by the surgeon during an acute episode of throat infection. It is important to describe an individual episode of throat infection and to document the frequency of these events. The presence of sore throat is necessary. When a child is evaluated for sore throat, the examining clinician should record a subjective assessment of the patient's severity of illness; physical findings including body temperature, pharyngeal and/or tonsillar erythema, tonsil size, tonsillar exudate, cervical adenopathy (presence, size, and tenderness); and the results of microbiologic testing for GABHS. In children with recurrent sore throat whose tests for GABHS are repeatedly positive, it may be desirable to rule out streptococcal carriage concurrent with viral infection as carriers are unlikely to transmit GABHS or to develop suppurative complications or nonsuppurative sequelae of the disease such as acute rheumatic fever.[76,77] Supportive documentation in children who meet criteria for tonsillectomy may include absence from school, spread of infection within the family, and a family history of rheumatic heart disease or glomerulonephritis.

Patients with undocumented histories of severe recurrent sore throat may still be offered surgery provided they continue to suffer severe sore throats with similar frequency after an additional period of observation and documentation. Whenever there is doubt or hesitation about the appropriateness of surgery, a consultation with an otolaryngologist and a period of watchful waiting to confirm persistence of a problem should be considered.

Evidence Profile for Statement 2: Recurrent throat infection with documentation

• Policy level: *Option*

STATEMENT 3. TONSILLECTOMY FOR RECURRENT INFECTION WITH MODIFYING FACTORS:

Clinicians should assess the child with recurrent throat infection who does not meet criteria in Statement 2 for modifying factors that may nonetheless favor tonsillectomy, which may include but are not limited to multiple antibiotic allergy/intolerance, PFAPA (periodic fever, aphthous stomatitis, pharyngitis, and adenitis), or history of peritonsillar abscess.

Recommendation based on randomized controlled trials and observational studies with a preponderance of benefit over harm.

Supporting Text

Modifying factors, which can lead to significant morbidity, may be especially important in situations for which, in general, the benefits and risks of surgery are closely matched but compelling individual features (such as excessive morbidity) may nonetheless warrant tonsillectomy. Modifying factors are defined within 3 categories: (1) exceptions to recognized criteria based on individual features of illness such as multiple antibiotic allergies, (2) specific clinical syndromes such as PFAPA[82] or recurrent tonsillitis associated with peritonsillar abscess [83-85], for treating pediatric autoimmune neuropsychiatric disorders associated with streptococcal infections (PANDAS)[86], and (3) poorly validated clinical indications (eg, chronic tonsillitis, febrile seizures, muffled "hot potato" speech, halitosis, malocclusion of teeth, tonsillar hypertrophy, cryptic tonsils, or chronic pharyngeal carriage of GABHS).

Evidence Profile for Statement 3: Tonsillectomy for recurrent infection with modifying factors

• Policy level: *Recommendation*

STATEMENT 4. TONSILLECTOMY FOR SLEEP - DISORDERED BREATHING:

Clinicians should ask caregivers of children with sleep-disordered breathing and tonsil hypertrophy about comorbid conditions that might improve after tonsillectomy, including growth retardation, poor school performance, enuresis, and behavioral problems.

Recommendation based on observational before-and-after studies with a preponderance of benefit over harm.

Supporting Text

The purpose of this statement is to: (1) help clinicians and caregivers make informed decisions about tonsillectomy in children with clinically diagnosed SDB and (2) highlight the importance of eliciting a history about modifying factors that affect the decision to proceed with surgery. Although PSG is the gold standard for diagnosing SDB in children, it is unnecessary (or not necessary) to perform in every case and does not establish the effects of the sleep disorder on the child's wellbeing. The initial approach to a child with suspected SDB should include an assessment of these factors (behavioral problems, poor school performance, decreased QoL, failure to thrive, and enuresis) by history and physical examination. Failure to identify such factors may lead to suboptimal care with an inability to address the underlying problem.

SDB is characterized by recurrent partial or complete upper airway obstruction during sleep, resulting in disruption of normal ventilation and sleep patterns.[87] The diagnosis of SDB in children may be based on history, physical examination, audio/video taping, pulse oximetry, or limited or full-night PSG. History and physical examination are the most common initial methods for diagnosis. The presence or absence of snoring neither includes nor excludes SDB, as not all children who snore have SDB, and caregivers may not observe intermittent snoring that occurs during the night.[88] Although caregivers often describe their children as having excessive daytime sleepiness, this seems to be less of a problem in children than adults. Children with SDB display sleepiness scores that are within the normal range for adults. However, they are higher than controls, and primary snorers exhibit similar scores to those of children with OSA.[89]

Tonsillar and adenoid hypertrophy is recognized as the most common cause of SDB in children. Tonsil size is readily identified using a tonsil grading scale (**Table 3**),[90] with tonsillar hypertrophy defined as grades 3+ or 4+. Tonsillar size alone does not correlate with the severity of SDB,[91] although the combined volume of the tonsils and adenoids more closely correlate with SDB severity.[92,93] It is likely that the severity of SDB is related to a combination of tonsillar and adenoid hypertrophy, craniofacial anatomy, and neuromuscular tone. For example, tonsils that are only 1+ or 2+ in size may nonetheless contribute to airway obstruction in healthy children and especially those with hypotonia or craniofacial anomalies.[94]

Table 3. Gradation of Tonsillar Enlargement [90]

Grade	Definition	Description
0	Not visible	Tonsils do not reach tonsillar pillars
1+	Less than 25%	Tonsils fill less than 25% of the transverse oropharyngeal space measured between the anterior tonsillar pillars
2+	25% to 49%	Tonsils fill less than 50% of the transverse oropharyngeal space
3+	50%-74%	Tonsils fill less than 75% of the transverse oropharyngeal space
4+	75% or more	Tonsils fill 75% or more than the transverse oropharyngeal space

SDB is known to increase the risk for externalizing (eg, aggression, hyperactivity) and internalizing behaviors (eg, depression) in some children, leading to symptoms of attention- deficit hyperactivity disorder.[8,95,96] Problems with memory and attention, often associated with SDB, may lead to poor school performance [97]. Studies have found that the QoL in children with SDB is worse than that of controls. For example, in one study, the QoL of children with SDB was similar to, or worse than, that of children with chronic diseases such as asthma or juvenile rheumatoid arthritis.[98] It is therefore important to view SDB as a condition that can dramatically affect the well-being of the child, family, and the primary caregiver.

Several studies have shown that up to 50% of children with SDB have enuresis.[99-103] Since enuresis can be embarrassing for the child and family, its presence may not be mentioned during routine evaluations. The primary care physician and the caregiver may also not be aware of an association between SDB

and enuresis. SDB can also lead to failure to thrive and should be considered in children evaluated for growth failure. [104] It remains unknown whether growth failure is a result of hormonal changes caused by SDB or simply excessive energy expenditures to overcome the airway obstruction. Consequently, a child with mild SDB may have significant behavioral problems, poor school performance, reduced QoL, enuresis, and growth failure that may equally contribute to the decision to proceed with tonsillectomy.

Several studies have shown improvement or resolution of these modifying factors following tonsillectomy for SDB in children. Behavioral and neurocognitive problems have been shown to improve significantly after tonsillectomy for SDB by both objective [95,96] and subjective testing.[105] This improvement in behavior has been shown to continue for at least 2 years after tonsillectomy.[8] School performance has also been shown to improve significantly in children with SDB following tonsillectomy as compared with those who do not undergo surgical intervention [97]. There is also a dramatic improvement in QoL in children after tonsillectomy for SDB,[10,11,98] and this improvement is maintained for up to 2 years after surgery.[98] Enuresis has been shown to resolve or improve in most children with SDB after tonsillectomy. One study showed that 61% of children were free of enuresis and 23% had a decrease in enuresis after surgical therapy for SDB.[28] Other studies that have followed children beyond 1 year have reported similar results, with the resolution rate increasing proportionally as the time following surgery increases.[102,103] A systematic review and meta-analysis of studies that evaluated height and weight changes after tonsillectomy for SDB[104] reported that height, weight, and growth biomarkers increased significantly after tonsillectomy, concluding that SDB, secondary to tonsil and adenoid hypertrophy, should be considered when screening, treating, and referring children with growth failure.

Tonsillar asymmetry can be seen in children and may have an effect on the decision to proceed with tonsillectomy. Tonsillar asymmetry can lead to concern as it may suggest the presence of a tumor, specifically lymphoma, in the larger tonsil. Careful assessment of the patient with tonsillar asymmetry is necessary to determine if a lymphoma is present. This would include a history, physical examination, and appropriate lab testing. However, in isolation, the presence of tonsillar asymmetry alone is not an indication for tonsillectomy.[107-109]

Evidence Profile for Statement 4: Tonsillectomy for Sleep-Disordered Breathing

• Policy level: *Recommendation*

STATEMENT 5. TONSILLECTOMY AND POLYSOMNOGRAPHY: Clinicians should counsel caregivers about tonsillectomy as a means to improve health in children with abnormal polysomnography who also have tonsil hypertrophy and sleep-disordered breathing.

Recommendation based on observational before-and-after studies with a preponderance of benefit over harm.

Supporting Text

The purpose of this statement is to guide the clinician in making decisions about tonsillectomy in a child with hypertrophy of the tonsils who has already had PSG and the test is interpreted as "abnormal" by the sleep laboratory.

The guideline panel recognizes that children do not routinely need PSG before tonsillectomy, for some children who present for surgical consideration, a PSG has already been obtained, and the clinician therefore needs to incorporate the result into decision making. Overnight PSG is recognized as the most reliable and objective test to assess the presence and severity of OSA.[112]

Most sleep specialists consider PSG in a child to be abnormal if there are pulse oximetry levels less than 92% or an AHI >1 (greater than 1 apneic or hypopneic event in 2 or more consecutive breaths per hour) or both.[115] Furthermore, an AHI >5 is considered by many to warrant tonsillectomy.[116] There is no evidence-based cutoff value, however, to indicate the need for tonsillectomy in children, and some children with AHI <5 may still be symptomatic and require intervention.[117,118]

Some authors have advocated the use of respiratory disturbance index (RDI) instead of AHI to score and report abnormal airflow that could lead to clinical symptoms in children.[117,118] The scoring and reporting of RDI helps to identify abnormal breathing events that are less dramatic than apnea and hypopnea but are significant enough to cause arousal and sleep fragmentation. Any decision to recommend tonsillectomy should not be based solely on PSG findings but should be based on clinical history, examination, and the likelihood that adenotonsillectomy will improve the sleep-related breathing issues.

The measure of oxygenation by pulse oximetry is standard for PSG. Hypoxemia and repetitive oxygen desaturation can be frequent in children with SDB. Children may have significant oxygen desaturation (<85%) yet have a low apnea index or AHI.[120] There is also evidence that even mild oxygen desaturation can negatively affect academic performance.[27] Therefore, the interpretation of oxygen desaturation levels is as important as the AHI in assessing the severity of OSA.

Oxygen saturation <85% is clearly abnormal, and treatment should be recommended. However, mild desaturation (<92%) may still be clinically relevant in the presence of high suspicion of SDB based on clinical examination and history. Despite the documented improvement, after tonsillectomy PSG is often not normalized, and many children either continue to have residual symptoms of SDB and remain symptomatic or have recurrence of symptoms.[32,33,110,123-126] Risk factors for persistent or recurrent OSA include severe preoperative OSA, obesity, children with craniofacial and neuromuscular anomalies, positive family history of OSA, and African American ethnicity.[32,110,123-126]

Tonsillectomy is typically performed in an outpatient setting. Children with complicated medical histories including cardiac complications of OSA, neuromuscular disorders, prematurity, obesity, failure to thrive, craniofacial anomalies, or recent respiratory infection should be treated in an inpatient setting. [112]

Obesity increases the postoperative risk of respiratory complications in SDB with an overall odds ratio of 7.13; therefore, overnight hospitalization may be recommended.[127] SDB severity is a risk factor for postoperative respiratory complications128- 131 and is therefore an indication for postoperative admission for children.[116,128] The level of desaturation correlates with the number of obstructive events, thereby reflecting a higher AHI.[128,132] Although there is no

general consensus in defining the level of severity of SDB in children based on AHI, the American Society of Anesthesiologists guideline defines severe OSA as AHI >10.[133] Young children with SDB also have been shown to have higher risk of postoperative airway complications, [134-136] and hospitalization is generally recommended for children less than 3 years of age.[112,116]

Evidence Profile for Statement 5: Tonsillectomy and Polysomnography

• Policy level: *Recommendation*

STATEMENT 6. OUTCOME ASSESSMENT FOR SLEEP-DISORDERED BREATHING:

Clinicians should counsel caregivers and explain that SDB may persist or recur after tonsillectomy and may require further management.

Recommendation based on observational studies, case-control and cohort design, with a preponderance of benefit over harm.

Supporting Text

The purpose of this statement is to emphasize that SDB may persist after tonsillectomy, despite perceptions by caregivers and clinicians that surgery is curative. As a result, clinicians should counsel, or educate, caregivers of patients who may require further management (**Table 4**). Counseling may be accomplished by either (1) discussing briefly the reasons why SDB may persist or recur after tonsillectomy and require further management or (2) providing an informational brochure or summary handout. The method of counseling should be documented in the medical record.

Table 4. Tonsillectomy and Sleep-Disordered Breathing (SDB) Caregiver Counseling Summary

1. Hypertrophic tonsils may contribute to SDB in children.
2. SDB often is multifactorial.
3. Obesity plays a key role in SDB in some children.
4. PSG is considered the best test for diagnosing and measuring outcomes in children, but it is not necessary in all cases and access may be limited by availability of sleep laboratories and willingness of insurers and third-party payers to cover the cost of testing.
5. Tonsillectomy is effective for control of SDB in 60%-70% of children with significant tonsillar hypertrophy.
6. Tonsillectomy produces resolution of SDB in only 10%-25% of obese children.
7. Caregivers need to be counseled that tonsillectomy is not curative in all cases of SDB in children, especially in children with obesity.

Children with SDB may have other underlying medical conditions, such as obesity, which contribute to their symptoms and persist after tonsillectomy. PSG is considered the gold standard for evaluating patients with suspected SDB and is also the most reliable outcome measure for treatment evaluation. PSG may be difficult to obtain because of limited availability and restrictions in coverage by insurers or third party payers.

Observational studies show that tonsillectomy has a variable effect on resolving SDB as measured by PSG; however, less than 10% of children undergo preoperative PSG, and an even smaller percentage undergo postoperative studies.[8]

A recent meta-analysis[32] reported an improvement in SDB in most children but a resolution in only 60% to 70% of subjects. The percentage of children in whom SDB has resolved is also dependent on the proportion of children, in the study population, who are overweight or obese. In a meta-analysis of 4 studies, resolution of SDB in obese children after tonsillectomy occurred in 10% to 25% of patients.[137] This is in contrast to a reported resolution of SDB in 70% to 80% of normal weight children.[111]

When children have tonsillectomy for specific comorbid conditions related to SDB (eg, growth retardation, poor school performance, enuresis, or behavioral problems), the SDB is often considered cured when the caregiver reports symptom resolution after surgery. In this situation, a postoperative PSG would generally be unnecessary, unless the symptoms later relapsed. Postoperative caregiver report of continuing symptoms is a good indicator of persistent SDB[34] and indicates the need for further evaluation, including PSG.

Evidence Profile for Statement 6: Outcome Assessment for Sleep-Disordered Breathing

• Policy level: *Recommendation*

STATEMENT 7. INTRAOPERATIVE STEROIDS:

Clinicians should administer a single, intraoperative dose of intravenous dexamethasone to children undergoing tonsillectomy.

Strong recommendation based on randomized controlled trials and systematic reviews of randomized controlled trials with a preponderance of benefit over harm.

Supporting Text

One of the most important morbidities associated with pediatric tonsillectomy is postoperative nausea and vomiting (PONV). PONV occurs independent of dissection technique[138] and in more than 70% of children who do not receive prophylactic antiemetics.[139-141] Because of its very nature to cause discomfort and pain, PONV is acutely distressing to the patient. PONV often necessitates overnight hospital admission to provide intravenous hydration and analgesic administration and is associated with decreased patient satisfaction and increased use of resources.[142-144]

For several decades, evidence has accumulated that the administration of a single intraoperative dose of dexamethasone in children undergoing tonsillectomy results in decreased PONV.[145-154] A systematic review from the Cochrane Collaboration showed that children receiving dexamethasone were less likely to vomit in the first 24 hours than children receiving placebo (relative risk, 0.54; 95% CI, 0.42-0.69) and more likely to advance to a soft or solid diet on post tonsillectomy day 1 (relative risk, 1.69; 95% CI, 1.02-2.79).[153] On average, about 4 children would need to receive intravenous dexamethasone to result in 1 fewer patient experiencing post tonsillectomy emesis (number needed to treat = 4).[153,154] The mechanism of efficacy of dexamethasone is unknown but may be related to its anti-inflammatory properties that reduce pain and swelling.[155-157] Most published studies used a dexamethasone dose of 0.5 mg/kg150; however, lower doses may be equally effective.158,159 In one systematic review of randomized controlled trials, for example, doses ranged from 0.15 to 1.00 mg/kg, with a maximum dose range of 8 to 25 mg.[153]

Additional comorbidities after tonsillectomy include pain, poor oral intake, and changes in voice character. In addition to having a beneficial effect on PONV, dexamethasone also decreases throat pain after tonsillectomy and time to resumption of oral intake,[160-162] which may be of particular benefit when electrosurgery is used to remove the tonsils. There is little evidence that administration of a single dose of dexamethasone in nondiabetic patients results in harmful effects. No adverse events were reported in any of the trials included in the Cochrane review, nor were any reports found in the literature of complications from using a single intravenous dose of corticosteroid during pediatric tonsillectomy.[153]

Evidence Profile for Statement 7: Intraoperative Steroids

• Policy level: *Strong recommendation*

STATEMENT 8. PERIOPERATIVE ANTIBIOTICS:

Clinicians should not routinely administer or prescribe perioperative antibiotics to children undergoing tonsillectomy.

Strong recommendation against administering or prescribing based on randomized controlled trials and systematic reviews with a preponderance of benefit over harm.

Supporting Text

The purpose of this statement is to address the issue of how antimicrobial therapy affects recovery after tonsillectomy and whether routine use is justified. Early randomized controlled trials of antibiotic therapy have largely shaped the delivery of care by otolaryngologists, suggesting improved recovery after tonsillectomy when antibiotics were prescribed.[164,165] Up to 79% of polled otolaryngologists in the United States use antibiotics in patients undergoing tonsillectomy to reduce postoperative morbidity, presumably through a reduction in bacteremia or through the anti-inflammatory properties of some antibiotics.[166]

In an outpatient setting, the term *perioperative* in considered to mean the 24 hours prior to and following the surgical procedure. Patients excluded were those requiring preoperative prophylactic antibiotics because of heart murmurs, implants, or other recognized reasons. Other exclusions included unilateral tonsillectomy, tonsillar biopsy, known tonsillar carcinoma, or tonsillectomy in conjunction with palatal surgery. A Cochrane review of 10 randomized controlled trials found "no evidence to support a consistent, clinically important impact of antibiotics in reducing the main morbid outcomes after tonsillectomy."[167] The impact of antibiotics on pain, diet, and activity was not suitable for meta-analysis in the Cochrane review, but individual trials primarily showed no benefits.

Any real or theoretical benefit of antibiotics on recovery after tonsillectomy must be balanced against the known risks, harms, and adverse events of therapy.[171] Aside from the direct costs of acquiring the drug, adverse events include rash, allergy, and gastrointestinal upset or diarrhea. Adverse events from antibiotics account for about 20% of all drug-related emergency department visits in the United States, most of which are attributable to allergic reactions.[171] Allergy to b-lactam antibiotics is cited as 2% per course, and anaphylaxis is estimated to occur in 0.01% to 0.05% of all penicillin courses.[167] Antimicrobial use is also a well-known promoter of bacterial resistance, which is of particular concern

in young children, who often require antimicrobials for otitis media, bacterial sinusitis, and other infections. Last, an important consideration not discussed in the literature is the burden of trying to get the patient to swallow another liquid he or she struggles to take postoperative fluids. This creates an additional load on caregivers in the early postoperative period and may explain the high overall dropout rate observed in many studies of antibiotics and tonsillectomy.

The routine use of antibiotics after tonsillectomy in the face of increasing bacterial resistance, risk of allergic reactions, or other side effects should be weighed against the possible reduction in postoperative fever, which is the only outcome for which a significant benefit has been observed. The absence of good evidence for the effectiveness of antibiotics to provide clinically relevant benefit confirms that there is insufficient evidence to support their routine use as a method to reduce morbidity after pediatric tonsillectomy.

Evidence Profile for Statement 8: Perioperative Antibiotics

- Exclusions: Patients with cardiac conditions requiring perioperative antibiotics for prophylaxis against bacterial endocarditis or implants; patients undergoing tonsillectomy with concurrent peritonsillar abscess
- Policy level: *Strong recommendation against*

STATEMENT 9. POSTOPERATIVE PAIN CONTROL:

The clinician should advocate for pain management after tonsillectomy and educate caregivers about the importance of managing and reassessing pain.

Recommendation based on randomized controlled trials with limitations and observational studies with a preponderance of benefit over harm.

Supporting Text

The purpose of this statement is to prevent pain and decrease morbidity following tonsillectomy, based on a perception by the panel that pain control may be underemphasized or inadequately discussed with the child's caregiver (**Table 5**). The main cause of morbidity after tonsillectomy is oropharyngeal pain, which may result in decreased oral intake, dysphagia, dehydration, and weight loss. As discussed previously, a single dose of intravenous dexamethasone reduces PONV and pain after tonsillectomy, but perioperative antibiotics are ineffective and not recommended. Clinicians should advocate for pain management by establishing strategies to control pain after tonsillectomy. The panel avoided a recommendation to prescribe specific drugs, since pain can often be managed with over-the-counter analgesics and hydration. Clinicians are encouraged to advocate and educate prior to surgery and to reinforce the education prior to discharge on the day of tonsillectomy. Documentation should appear in the medical record describing how this was accomplished (eg, verbal discussion, written handout, educational brochure).

Intraoperatively, local anesthesia injections in the tonsillar fossae have been used to reduce morbidity. A Cochrane review assessed the effects of preoperative and postoperative local anesthesia for pain reduction following tonsillectomy.[176] Randomized controlled trials of adults and children that were included in the review found no evidence that the use of perioperative local anesthetic in patients undergoing tonsillectomy improves postoperative pain control.

The results suggest that local anesthetics should not be used as they have not been proven to be effective for postoperative pain control.

Table 5. Posttonsillectomy Pain Management Education for Caregivers

1. Throat pain is greatest the first few days following surgery and may last up to 2 weeks.
2. Encourage your child to communicate with you if he or she experiences significant throat pain since pain may not always be expressed and therefore not recognized promptly.
3. Discuss strategies for pain control with your health care provider before and after surgery; realize that antibiotics after surgery do not reduce pain and should not be given routinely for this purpose.
4. Make sure your child drinks plenty of fluids after surgery. Staying well hydrated is associated with less pain.
5. Ibuprofen can be used safely for pain control after surgery.
6. Pain medicine should be given as directed by your health care provider. Especially for the first few days following surgery, it should be given often.
7. Many clinicians recommend not waiting until your child complains of pain. Instead, the pain medication should be given on a regular schedule.
8. Expect your child to complain more about pain in the mornings—this is normal.
9. Rectal administration may be given if your child refuses to take pain medication orally. Call your health care provider if you are unable to adequately control your child's pain.

Despite the efforts of surgeons intraoperatively to decrease postoperative pain, the first few days following tonsillectomy are problematic. Oral intake improves over time but is highly variable between children.[172,177] Investigations into the oral fluid intake at home following tonsillectomy in the United States is limited but strongly suggests hydration is inadequate for most children following tonsillectomy.[177-180] This is important because inadequate hydration has been reported to be associated with increased reports of pain following tonsillectomy.[181] Most reported studies do not control or report the fluid intake of their subjects. Food intake is similarly reduced and often results in weight loss. It has not been the focus of extensive research, but dietary restrictions following surgery do not appear to be important.[182,183]

Oral analgesics after tonsillectomy. Although widely used, acetaminophen with codeine does not provide superior control of pain compared with acetaminophen only following tonsillectomy either at rest or with swallowing.[192,193] Postoperative nausea, vomiting, and constipation from acetaminophen with codeine use has led some to use just acetaminophen; however, acetaminophen alone may not provide adequate analgesia.[198] Rectal administration of medication was better tolerated than oral administration of acetaminophen and codeine.[199]

The use of nonsteroidal anti-inflammatory drugs (NSAIDs) after tonsillectomy has been controversial because of adverse effects on platelet function that may prolong bleeding time and other parameters.[200,201] A review from the Cochrane Collaboration [202] with nearly 1000 children from 13 randomized controlled trials found that NSAIDs did not significantly alter postoperative bleeding compared with placebo or other analgesics (odds ratio, 1.46; 95% CI, 0.49-4.40).

Administration of pain medication according to a fixed schedule is widely embraced but has not been proven to be superior to dosing the medication as needed (PRN).[205] Discomfort after tonsillectomy is greater in the mornings than the evenings, independent of the dosing schedule, even when around-the-clock dosing was employed.[172,190]

In summary, regardless of the dosing regimen used, postoperative analgesic management is best determined by basing the starting dose on the child's weight and adequately monitoring pain levels. No ideal postoperative medication has been identified for postoperative pain following tonsillectomy, nor has the frequency of administration of pain medication been detailed.

Evidence Profile for Statement 9: Postoperative Pain Control

• Policy level: *Recommendation*

STATEMENT 10. POST TONSILLECTOMY HEMORRHAGE:

Clinicians who perform tonsillectomy should determine their rate of primary and secondary post tonsillectomy hemorrhage at least annually. *Recommendation based on observational studies with a preponderance of benefit over harm.*

Supporting Text

The purpose of this statement is to encourage self-assessment by clinicians who perform tonsillectomy to determine how their personal rate of hemorrhage compares with expected rates based on audit data and published reports. This allows communication of surgical risk during the informed consent discussion with caregivers and may identify circumstances in which a surgeon needs to reassess his or her technique and process of care for quality improvement opportunities.

Hemorrhage after tonsillectomy may be categorized as primary or secondary. Primary hemorrhage is defined as bleeding that occurs within the first 24 hours after the procedure and is generally attributed to surgical technique and the reopening of a blood vessel(s). Rates of primary hemorrhage range from 0.2% to 2.2% of patients. Secondary hemorrhage occurs more than 24 hours following the procedure, often between 5 and 10 days, and is usually caused by sloughing of the primary eschar as the tonsil bed heals by secondary intention. Rates of secondary hemorrhage range from 0.1% to 3%.[35]

Volume of bleeding may be difficult to accurately quantify. Minimal bleeding is frequently managed at home with observation alone. However, more than minimal bleeding that requires reevaluation of the patient in a clinical setting, and bleeding (of any volume) requiring intervention (cauterization, hospitalization, transfusion, or surgery) must be documented. Additional information such as emergency department and/or hospital admission,requirement for further treatment, and surgery to control bleeding must be conveyed to the operating surgeon in the event that he or she was not the clinician rendering that postoperative care. Good communication and continuity of care is necessary to facilitate quality improvement.

Impact of surgical technique on bleeding. The traditional cold (metal instruments) dissection technique for tonsillectomy involves removal of the

tonsil by dissecting the peritonsillar space, with continuous hemostasis obtained through ligation of blood vessels during tonsil removal. This is still considered the standard with which to compare the effectiveness and safety of other newer techniques. Electrosurgical dissection (diathermy) remains a common tonsillectomy technique and is also used or hemostasis during cold tonsillectomy. Many of the newer "hot" techniques (radiofrequency, coblation, and harmonic scalpel) have been introduced to reduce postoperative morbidity and risk of hemorrhage. The heat produced by these techniques produces hemostasis during tonsil dissection.[42,215]

The National Prospective Tonsillectomy Audit (NPTA), performed in the United Kingdom in 2005, investigated the occurrence of postoperative hemorrhage in 33 921 patients undergoing tonsillectomy in England and Northern Ireland over a 14-month period from 2003 to 2004.42 Primary posttonsillectomy hemorrhage rates were 0.6%, and secondary hemorrhage rates were 3%. Hot surgical techniques for both dissection and hemostasis (diathermy or coblation) increased the risk of secondary hemorrhage by 3-fold when compared with cold steel tonsillectomy without the use of any hot technique. The risk of secondary hemorrhage for operations using cold steel for dissection and bipolar diathermy for hemostasis was approximately 1.5 times higher than for cold steel operations using only ties/packs for hemostasis. The use of coblation was associated with an elevated risk of return to the operating room for bleeding.

A Cochrane review from 2001 investigated randomized controlled trials comparing morbidity associated with tonsillectomy performed using dissection versus diathermy.[216] Only 2 of the 22 studies met the necessary inclusion criteria. There was no difference in the rate of secondary bleeding overall, although the power of both studies to detect small differences was insufficient. There were insufficient data to show that one method of tonsillectomy was superior. A systematic review of electrosurgery for tonsillectomy indicated that the risk of postoperative hemorrhage is higher following hot techniques compared with cold dissection.[217] In the meta-analysis models, bipolar diathermy dissection and hemostasis were associated with statistically significant lower odds of primary hemorrhage, including primary hemorrhage requiring return to the operating room compared with cold steel dissection with ties/packs hemostasis. Coblation was associated with a statistically significant increase in secondary hemorrhage requiring return to the operating room. Monopolar and bipolar diathermy dissection and hemostasis, coblation, and cold steel dissection with monopolar or bipolar diathermy hemostasis were all associated with statistically significant higher odds of secondary hemorrhage. In addition, a randomized controlled trial [218] and large prospective cohort studies demonstrated a higher risk of postoperative hemorrhage after hot tonsillectomy compared with cold dissection.[219-221] In a systematic review of hot (monopolar electrosurgery) versus cold knife tonsillectomy, only 6 of 815 prospective trials met the necessary inclusion criteria and revealed that postoperative hemorrhage rates were not significantly different when comparing the 2 methods. [222]

In a systematic Cochrane review of coblation versus other surgical techniques

for tonsillectomy, 19 randomized controlled trials were evaluated.[223] Nine trials met inclusion criteria, and there was no significant difference between coblation and other tonsillectomy techniques with respect to postoperative bleeding. A case series of 1997 pediatric patients undergoing coblation adenotonsillectomy from January 2000 to June 2004 demonstrated that coblation tonsillectomy had similar rates of primary and secondary hemorrhage when compared with electrocautery tonsillectomy.[224] Regarding harmonic scalpel tonsillectomy compared with conventional methods for tonsillectomy, Neumann et al concluded in a systematic review that the current evidence regarding the use of harmonic scalpel and postoperative hemorrhage is of low quality and does not support any difference in postoperative hemorrhage rates.[225]

Impact of medications on posttonsillectomy bleeding. A Cochrane review of NSAIDs and perioperative bleeding in pediatric tonsillectomy included 13 randomized controlled trials involving 955 children and examined bleeding requiring surgical intervention, in addition to 7 trials involving 471 children that examined bleeding not requiring surgical intervention.[202] NSAIDs did not significantly increase bleeding following tonsillectomy in either review. A meta-analysis demonstrated an increased risk of posttonsillectomy hemorrhage with the use of aspirin after tonsillectomy but not for nonaspirin NSAIDs such as diclofenac and ibuprofen.[226] A Cochrane review demonstrated that perioperative antibiotics were not associated with a reduction in significant secondary hemorrhage rates or total secondary hemorrhage rates.[167] In a review of 11 studies that met inclusion criteria for an Evidence Report from the Center for Clinical Effectiveness in Clayton, Australia, antibiotic and steroid therapy had no effect on either primary or secondary hemorrhage.[229]

Other factors influencing posttonsillectomy bleeding. The UK NPTA audit demonstrated that there was a higher risk of postoperative bleeding with increasing patient age, male gender, and those with a history of recurrent acute tonsillitis (3.7%) and previous peritonsillar abscess. The rate was highest in quinsy patients (5.4%) compared with patients with pharyngeal obstruction and OSA (1.4%).[42]

Evidence Profile for Statement 10: Posttonsillectomy Hemorrhage

• Policy level: *Recommendation*

Summary: The panel made ***recommendations*** for (1) watchful waiting for recurrent throat infection if there have been fewer than 7 episodes in the past year or fewer than 5 episodes per year in the past 2 years or fewer than 3 episodes per year in the past 3 years; (2) assessing the child with recurrent throat infection who does not meet criteria in statement 2 for modifying factors that may nonetheless favor tonsillectomy, which may include but are not limited to multiple antibiotic allergy/intolerance, periodic fever, aphthous stomatitis, pharyngitis and adenitis, or history of peritonsillar abscess; (3) asking caregivers of children with sleep-disordered breathing and tonsil hypertrophy about comorbid conditions that might improve after tonsillectomy, including growth retardation, poor school performance, enuresis, and behavioral problems; (4) counseling caregivers about tonsillectomy as a means to improve health in children with abnormal polysomnography who also have tonsil hypertrophy and sleep-disordered breathing; (5) counseling

caregivers that sleep-disordered breathing may persist or recur after tonsillectomy and may require further management; (6) advocating for pain management after tonsillectomy and educating caregivers about the importance of managing and reassessing pain; and (7) clinicians who perform tonsillectomy should determine their rate of primary and secondary posttonsillectomy hemorrhage at least annually. The panel offered ***options*** to recommend tonsillectomy for recurrent throat infection with a frequency of at least 7 episodes in the past year or at least 5 episodes per year for 2 years or at least 3 episodes per year for 3 years with documentation in the medical record for each episode of sore throat and 1 or more of the following: temperature >38.3°C, cervical adenopathy, tonsillar exudate, or positive test for group A b-hemolytic streptococcus.

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