Diagnosis and Management of Childhood Obstructive Sleep Apnea Syndrome

OBJECTIVES: This revised clinical practice guideline, intended for use by primary care clinicians, provides recommendations for the diagnosis and management of the obstructive sleep apnea syndrome (OSAS) in children and adolescents. This practice guideline focuses on uncomplicated childhood OSAS, that is, OSAS associated with adenotonsillar hypertrophy and/or obesity in an otherwise healthy child who is being treated in the primary care setting.

METHODS: Of 3166 articles from 1999–2010, 350 provided relevant data. Most articles were level II–IV. The resulting evidence report was used to formulate recommendations.

RESULTS AND CONCLUSIONS: The following recommendations are made. (1) All children/adolescents should be screened for snoring. (2) Polysomnography should be performed in children/adolescents with snoring and symptoms/signs of OSAS; if polysomnography is not available, then alternative diagnostic tests or referral to a specialist for more extensive evaluation may be considered. (3) Adenotonsillectomy is recommended as the first-line treatment of patients with adenotonsillar hypertrophy. (4) High-risk patients should be monitored as inpatients postoperatively. (5) Patients should be reevaluated postoperatively to determine whether further treatment is required. Objective testing should be performed in patients who are high risk or have persistent symptoms/signs of OSAS after therapy. (6) Continuous positive airway pressure is recommended as treatment if adenotonsillectomy is not performed or if OSAS persists postoperatively. (7) Weight loss is recommended in addition to other therapy in patients who are overweight or obese. (8) Intranasal corticosteroids are an option for children with mild OSAS in whom adenotonsillectomy is contraindicated or for mild postoperative OSAS. Pediatrics 2012;130:576–584

INTRODUCTION
Obstructive sleep apnea syndrome (OSAS) is a common condition in childhood and can result in severe complications if left untreated. In 2002, the American Academy of Pediatrics (AAP) published a practice guideline for the diagnosis and management of childhood OSAS. Since that time, there has been a considerable increase in publications and research on the topic; thus, the guidelines have been revised.
The purposes of this revised clinical practice guideline are to (1) increase the recognition of OSAS by primary care clinicians to minimize delay in diagnosis and avoid serious sequelae of OSAS; (2) evaluate diagnostic techniques; (3) describe treatment options; (4) provide guidelines for follow-up; and (5) discuss areas requiring further research. The recommendations in this statement do not indicate an exclusive course of treatment. Variations, taking into account individual circumstances, may be appropriate.

This practice guideline focuses on uncomplicated childhood OSAS—that is, the OSAS associated with adenotonsillar hypertrophy and/or obesity in an otherwise healthy child who is being treated in the primary care setting. This guideline specifically excludes infants younger than 1 year of age, patients with central apnea or hypoventilation syndromes, and patients with OSAS associated with other medical disorders, including but not limited to Down syndrome, craniofacial anomalies, neuromuscular disease (including cerebral palsy), chronic lung disease, sickle cell disease, metabolic disease, or laryngomalacia. These important patient populations are too complex to discuss within the scope of this article and require consultation with a pediatric subspecialist.

Additional information providing justification for the key action statements and a detailed review of the literature are provided in the accompanying technical report available online.2

METHODS OF GUIDELINE DEVELOPMENT

Details of the methods of guideline development are included in the accompanying technical report.2 The AAP selected a subcommittee composed of pediatricians and other experts in the fields of sleep medicine, pulmonology, and otolaryngology, as well as experts from epidemiology and pediatric practice to develop an evidence base of literature on this topic. The committee included liaison members from the AAP Section on Otolaryngology-Head and Neck Surgery, American Thoracic Society, American Academy of Sleep Medicine, American College of Chest Physicians, and the National Sleep Foundation. Committee members signed forms disclosing conflicts of interest. An automated search of the literature on childhood OSAS from 1999 to 2008 was performed by using 5 scientific literature search engines.2 The medical subject heading terms that were used in all fields were snoring, apnea, sleep-disordered breathing, sleep-related breathing disorders, upper airway resistance, polysomnography, sleep study, adenoectomy, tonsillectomy, continuous positive airway pressure, obesity, adiposity, hypopnea, hypoventilation, cognition, behavior, and neuropsychology. Reviews, case reports, letters to the editor, and abstracts were not included. Non–English-language articles, animal studies, and studies relating to infants younger than 1 year and to special populations (eg, children with craniofacial anomalies or sickle cell disease) were excluded. In several studies, a total of 3166 hits was reduced to 350 articles, which underwent detailed review.2 Committee members selectively updated this literature search for articles published from 2008 to 2011 specific to guideline categories. Details of the literature grading system are available in the accompanying technical report.

Since publication of the previous guidelines, there has been an improvement in the quality of OSAS studies in the literature; however, there remain few randomized, blinded, controlled studies. Most studies were questionnaire or polysomnography based. Many studies used standard definitions for pediatric polysomnography scoring, but the interpretation of polysomnography (eg, the apnea hypopnea index [AHI] criterion used for diagnosis or to determine treatment) varied widely. The guideline notes the quality of evidence for each key action statement. Additional details are available in the technical report.

The evidence-based approach to guideline development requires that the evidence in support of each key action statement be identified, appraised, and summarized and that an explicit link between evidence and recommendations be defined. Evidence-based recommendations reflect the quality of evidence and the balance of benefit and harm that is anticipated when the recommendation is followed. The AAP policy statement, “Classifying Recommendations for Clinical Practice Guidelines,” was followed in designating levels of recommendation (see Fig 1 and Table 1).

DEFINITION

This guideline defines OSAS in children as a “disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction (obstructive apnea) that disrupts normal ventilation during sleep and normal sleep patterns,”4 accompanied by symptoms or signs, as listed in Table 2. Prevalence rates based on level I and II studies range from 1.2% to 5.7%.5–7 Symptoms include habitual snoring (often with intermittent pauses, snorts, or gasps), disturbed sleep, and daytime neurobehavioral problems. Daytime sleepiness may occur, but is uncommon in young children. OSAS is associated with neurocognitive impairment, behavioral problems, failure to thrive, hypertension, cardiac dysfunction, and systemic inflammation. Risk factors include adenotonsillar hypertrophy, obesity, craniofacial anomalies, and neuromuscular disorders. Only the first 2 risk factors are
discussed in this guideline. In this guideline, obesity is defined as a BMI >95th percentile for age and gender.8

**KEY ACTION STATEMENTS**

**Key Action Statement 1: Screening for OSAS**

As part of routine health maintenance visits, clinicians should inquire whether the child or adolescent snores. If the answer is affirmative or if a child or adolescent presents with signs or symptoms of OSAS (Table 2), clinicians should perform a more focused evaluation. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Almost all children with OSAS snore,9–11 although caregivers frequently do not volunteer this information at medical visits.12 Thus, asking about snoring at each health maintenance visit (as well as at other appropriate times, such as when evaluating for tonsillitis) is a sensitive, albeit nonspecific, screening measure that is quick and easy to perform. Snoring is common in children and adolescents; however, OSAS is less common. Therefore, an affirmative answer should be followed by a detailed history and examination to determine whether further evaluation for OSAS is needed (Table 2); this clinical evaluation alone

### TABLE 1 Definitions and Recommendation Implications

<table>
<thead>
<tr>
<th>Statement</th>
<th>Definition</th>
<th>Implication</th>
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<tr>
<td><strong>Strong</strong></td>
<td>A strong recommendation in favor of a particular action is made when the anticipated benefits of the recommended intervention clearly exceed the harms (as a strong recommendation against an action is made when the anticipated harms clearly exceed the benefits) and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.</td>
<td>Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.</td>
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<tr>
<td><strong>Recommend</strong></td>
<td>A recommendation in favor of a particular action is made when the anticipated benefits exceed the harms but the quality of evidence is not as strong. Again, in some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms.</td>
<td>It would be prudent for clinicians to follow a recommendation, but they should remain alert to new information and sensitive to patient preferences.</td>
</tr>
<tr>
<td><strong>Option</strong></td>
<td>Options define courses that may be taken when either the quality of evidence is suspect or carefully performed studies have shown little clear advantage to one approach over another.</td>
<td>Clinicians should consider the option in their decision-making, and patient preference may have a substantial role.</td>
</tr>
<tr>
<td><strong>No</strong></td>
<td>No recommendation indicates that there is a lack of pertinent published evidence and that the anticipated balance of benefits and harms is presently unclear.</td>
<td>Clinicians should be alert to new published evidence that clarifies the balance of benefit versus harm.</td>
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</table>
Polysomnography

Evidence Profile KAS 2A: Referral

- Aggregate evidence quality: D
- Benefits: Subspecialist may be better able to establish diagnosis and determine severity of OSAS.
- Harm: Expense, time, anxiety/discomfort.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: Panelists weighed the value of establishing a diagnosis as more important than the minor potential harms listed.
- Role of patient preferences: Large.
- Intentional vagueness: None.
- Strength: Option.

Evidence Profile KAS 2B: Polysomnography

- Aggregate evidence quality: A
- Benefits: Establish diagnosis and determine severity of OSAS.
- Harm: Expense, time, anxiety/discomfort.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: Panelists weighed the value of establishing a diagnosis as more important than the minor potential harms listed.
- Role of patient preferences: Small.
- Intentional vagueness: None.
- Strength: Recommendation.

Key Action Statement 2B: Alternative Testing

If polysomnography is not available, then clinicians may order alternative diagnostic tests, such as nocturnal oximetry, daytime nap polysomnography, or ambulatory polysomnography. (Evidence Quality: Grade C, Recommendation Strength: Option.)
families may choose to travel to centers where more extensive facilities are available.

- Exclusions: None.
- Intentional vagueness: None.
- Strength: Option.

Although polysomnography is the gold standard for diagnosis of OSAS, there is a shortage of sleep laboratories with pediatric expertise. Hence, poly-

somnography may not be readily available in certain regions of the country. Alternative diagnostic tests have been shown to have weaker positive and negative predictive values than poly-

somnography, but nevertheless, objective testing is preferable to clinical evaluation alone. If an alternative test fails to demonstrate OSAS in a patient with a high pretest probability, full polysomnography should be sought.

Key Action Statement 3: Adenotonsillectomy

If a child is determined to have OSAS, a clinical examination consistent with adenotonsillar hypertrophy, and does not have a contraindication to surgery (see Table 3), the clinician should recommend adenotonsillectomy as the first line of treatment. If the child has OSAS but does not have adenotonsillar hypertrophy, other treatment should be considered (see Key Action Statement 6). Clinical judgment is required to determine the benefits of adenotonsillectomy compared with other treatments in obese children with varying degrees of adenotonsillar hypertrophy. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 3

- Aggregate evidence quality: B
- Benefit: Improve OSAS and accompanying symptoms and sequelae.
- Harm: Pain, anxiety, dehydration, anesthetic complications, hemorrhage, infection, postoperative respiratory difficulties, velopharyngeal incompetence, nasopharyngeal stenosis, death.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: The panel sees the benefits of treating OSAS as more beneficial than the low risk of serious consequences.
- Role of patient preferences: Low; continuous positive airway pressure (CPAP) is an option but involves prolonged, long-term treatment as compared with a single, relatively low-risk surgical procedure.
- Exclusions: See Table 3.
- Intentional vagueness: None.
- Strength: Recommendation.

Adenotonsillectomy is very effective in treating OSAS. Adenoidectomy or tonsillectomy alone may not be sufficient, because residual lymphoid tissue may contribute to persistent obstruction. In otherwise healthy children with adenotonsillar hypertrophy, adenotonsillectomy is associated with improvements in symptoms and sequelae of OSAS. Postoperative polysomnography typically shows a major decrease in the number of obstructive events, although some obstructions may still be present. Although obese children may have less satisfactory results, many will be adequately treated with adenotonsillectomy; however, further research is needed to determine which obese children are most likely to benefit from surgery. In this population, the benefits of a 1-time surgical procedure, with a small but real risk of complications, need to be weighed against long-term treatment with CPAP, which is associated with discomfort, disruption of family lifestyle, and risks of poor adherence. Potential complications of adenotonsillectomy are shown in Table 4. Although serious complications (including death) may occur, the rate of these complications is low, and the risks of complications need to be weighed against the consequences of untreated OSAS. In general, a 1-time only procedure with a relatively low morbidity is preferable to lifelong treatment with CPAP; furthermore, the efficacy of CPAP is limited by generally suboptimal adherence. Other treatment options, such as anti-inflammatory medications, weight loss, or tracheostomy, are less effective, are difficult to achieve, or have higher morbidity, respectively.

Key Action Statement 4: High-Risk Patients Undergoing Adenotonsillectomy

Clinicians should monitor high-risk patients (Table 5) undergoing adenotonsillectomy as inpatients postoperatively. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

### TABLE 4 Risks of Adenotonsillectomy

<table>
<thead>
<tr>
<th>Risk</th>
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<tr>
<td>Minor: Pain, bleeding attributable to postoperative anesthesia</td>
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<tr>
<td>Nausea/vomiting and poor oral intake</td>
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<tr>
<td>Major: Anesthetic complications</td>
</tr>
<tr>
<td>Acute upper airway obstruction during induction or emergence from anesthesia</td>
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<tr>
<td>Postoperative respiratory compromise</td>
</tr>
<tr>
<td>Hemorrhage</td>
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<tr>
<td>Velopharyngeal incompetence</td>
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<tr>
<td>Nasopharyngeal stenosis</td>
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<tr>
<td>Death</td>
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</tbody>
</table>
TABLE 5  Risk Factors for Postoperative Respiratory Complications in Children With OSAS Undergoing Adenotonsillectomy

<table>
<thead>
<tr>
<th>Younger than 3 y of age</th>
<th>Severe OSAS on polysomnography a</th>
</tr>
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<tbody>
<tr>
<td>Cardiac complications of OSAS</td>
<td>Failure to thrive</td>
</tr>
<tr>
<td>Obesity</td>
<td>Craniofacial anomalies b</td>
</tr>
<tr>
<td>Neuromuscular disorders b</td>
<td>Current respiratory infection</td>
</tr>
</tbody>
</table>

a It is difficult to provide exact polysomnographic criteria for severity, because these criteria will vary depending on the age of the child; additional comorbidities, such as obesity, asthma, or cardiac complications of OSAS; and other polysomnographic criteria that have not been evaluated in the literature, such as the level of hypercapnia and the frequency of desaturation (as compared with lowest oxygen saturation). Nevertheless, on the basis of published studies (primarily Level III; see Technical Report), it is recommended that all patients with a lowest oxygen saturation <80% (either on preoperative polysomnography or during observation in the recovery room postoperatively) or an AHI ≥24/h be observed as inpatients postoperatively as they are at increased risk for postoperative respiratory compromise. Additionally, on the basis of expert consensus, it is recommended that patients with significant hypercapnia on polysomnography (peak PCO2 ≥50 mm Hg) be admitted postoperatively. The committee noted that most published studies were retrospective and not comprehensive, and therefore these recommendations may change if higher-level studies are published.

b Clinicians may decide to admit patients with less severe polysomnographic abnormalities based on a constellation of risk factors (age, comorbidities, and additional polysomnographic factors) for a particular individual.

Key Action Statement 5: Reevaluation

Clinicians should clinically reassess all patients with OSAS for persisting signs and symptoms after therapy to determine whether further treatment is required. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 5A

- Aggregate evidence quality: B
- Harm: Expense, time.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: Data show that a significant proportion of children continue to have abnormalities postoperatively; therefore, the panel determined that the benefits of follow-up outweigh the minor inconveniences.
- Role of patient preferences: Minimal; follow-up is good clinical practice.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Recommendation.

Clinicians should reassess OSAS-related symptoms and signs (Table 2) after 6 to 8 weeks of therapy to determine whether further evaluation and treatment are indicated. Objective data regarding the timing of the postoperative evaluation are not available. Most clinicians recommend re-evaluation 6 to 8 weeks after treatment to allow for healing of the operative site and to allow time for upper airway, cardiac, and central nervous system recovery. Patients who remain symptomatic should undergo objective testing (see Key Action Statement 2) or be referred to a sleep specialist for further evaluation.

Key Action Statement 5B: Reevaluation of High-Risk Patients

Clinicians should reevaluate high-risk patients for persistent OSAS after adenotonsillectomy, including those who had a significantly abnormal baseline polysomnogram, have sequelae of OSAS, are obese, or remain symptomatic after treatment, with an objective test (see Key Action Statement 2) or refer such patients to a sleep specialist. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 5B

- Aggregate evidence quality: B
- Harm: Expense, time, anxiety/discomfort.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: None.
- Role of patient preferences: Minimal; follow-up is good clinical practice.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Recommendation.
• Value judgments: Given the panel's concerns about the consequences of OSAS and the frequency of postoperative persistence in high-risk groups, the panel believes that the follow-up costs are outweighed by benefits of recognition of persistent OSAS. A minority of panelists believed that all children with OSAS should have follow-up polysomnography because of the high prevalence of persistent postoperative abnormalities on polysomnography, but most panelists believed that persistent polysomnographic abnormalities in uncomplicated children with mild OSAS were usually mild in patients who were asymptomatic after surgery.

• Role of patient preferences: Minimal. Further evaluation is needed to determine the need for further treatment.

• Exclusions: None.

• Intentional vagueness: None.

• Strength: Recommendation.

Numerous studies have shown that a large proportion of children at high risk continue to have some degree of OSAS postoperatively, thus, ob-

Key Action Statement 6: CPAP

 Clinicians should refer patients for CPAP management if symptoms/signs (Table 2) or objective evidence of OSAS persists after adenotonsillectomy or if adenotonsillectomy is not performed. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 6

• Aggregate evidence quality: B

• Benefit: Improve OSAS and accompanying symptoms and sequelae.

• Harm: Expense, time, anxiety; parental sleep disruption; nasal and skin adverse effects; possible midface remodeling; extremely rare serious pressure-related complications, such as pneumothorax; poor adherence.

• Benefits-harms assessment: Preponderance of benefit over harm.

• Value judgments: Panelists believe that CPAP is the most effective treatment of OSAS that persists postoperatively and that the benefits of treatment outweigh the adverse effects. Other treatments (e.g., rapid maxillary expansion) may be effective in specially selected patients.

• Role of patient preferences: Other treatments may be effective in specially selected patients.

• Exclusions: Rare patients at increased risk of severe pressure complications.

• Intentional vagueness: None.

• Policy level: Recommendation.

CPAP therapy is delivered by using an electronic device that delivers air at positive pressure via a nasal mask, leading to mechanical stenting of the airway and improved functional residual capacity in the lungs. There is no clear advantage of using bilevel pressure over CPAP. CPAP should be managed by an experienced and skilled clinician with expertise in its use in children. CPAP pressure requirements vary among individuals and change over time; thus, CPAP must be titrated in the sleep laboratory before prescribing the device and periodically readjusted thereafter. Behavioral modification therapy may be required, especially for young children or those with developmental delays. Objective monitoring of adherence, by using the equipment software, is important. If adherence is suboptimal, the clinician should institute measures to improve adherence (such as behavioral modification, or treating side effects of CPAP) and institute alternative treatments if these measures are ineffective.

Key Action Statement 7: Weight Loss

Clinicians should recommend weight loss in addition to other therapy if a child/adolescent with OSAS is overweight or obese. (Evidence Quality: Grade C, Recommendation Strength: Recommendation.)

Evidence Profile KAS 7

• Aggregate evidence quality: C

• Benefit: Improve OSAS and accompanying symptoms and sequelae; non-OSAS-related benefits of weight loss.

• Harm: Hard to achieve and maintain weight loss.

• Benefits-harms assessment: Preponderance of benefit over harm.

• Value judgments: The panel agreed that weight loss is beneficial for both OSAS and other health issues, but clinical experience suggests that weight loss is difficult to achieve and maintain, and even effective weight loss regimens take time; therefore, additional treatment is required in the interim.

• Role of patient preferences: Strong role for patient and family preference regarding nutrition and exercise.

• Exclusions: None.

• Intentional vagueness: None.

• Strength: Recommendation.

Weight loss has been shown to improve OSAS, although the degree of weight loss required has not been determined. Because weight loss is a slow and unreliable process, other treatment modalities (such as adenotonsillectomy or CPAP therapy) should be instituted until sufficient weight loss has been achieved and maintained.
Key Action Statement 8: Intranasal Corticosteroids

Clinicians may prescribe topical intranasal corticosteroids for children with mild OSAS in whom adenotonsillectomy is contraindicated or for children with mild postoperative OSAS. (Evidence Quality: Grade B, Recommendation Strength: Option.)

Evidence Profile KAS 8

- Aggregate evidence quality: B
- Benefit: Improves mild OSAS and accompanying symptoms and sequelae.
- Harm: Some subjects may not have an adequate response. It is not known whether therapeutic effect persists long-term; therefore, long-term observation is required. Low risk of steroid-related adverse effects.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: The panel agreed that intranasal steroids provide a less invasive treatment than surgery or CPAP and, therefore, may be preferred in some cases despite lower efficacy and lack of data on long-term efficacy.
- Role of patient preferences: Moderate role for patient and family preference if OSAS is mild.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Option.

Mild OSAS is defined, for this indication, as an AHI <5 per hour, on the basis of studies on intranasal corticosteroids described in the accompanying technical report. Several studies have shown that the use of intranasal steroids decreases the degree of OSAS; however, although OSAS improves, residual OSAS may remain. Furthermore, there is individual variability in response to treatment, and long-term studies have not been performed to determine the duration of improvement. Therefore, nasal steroids are not recommended as a first-line therapy. The response to treatment should be measured objectively after a course of treatment of approximately 6 weeks. Because the long-term effect of this treatment is unknown, the clinician should continue to observe the patient for symptoms of recurrence and adverse effects of corticosteroids.

AREAS FOR FUTURE RESEARCH

A detailed list of research recommendations is provided in the accompanying technical report. There is a great need for further research into the prevalence of OSAS, sequelae of OSAS, best treatment methods, and the role of obesity. In particular, well-controlled, blinded studies, including randomized controlled trials of treatment, are needed to determine the best care for children and adolescents with OSAS.

SUBCOMMITTEE ON OBSTRUCTIVE SLEEP APNEA SYNDROME*

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REFERENCES


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