Acute Otitis Media in Children

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Eleni M. Rettig and David E. Tunkel

Introduction

Acute otitis media (AOM) is one of the most common illnesses of early childhood. Acute otitis media is generally managed by primary care providers, but occasionally requires referral to an otolaryngologist for management of refractory symptoms, recurrent disease, or concerns about complications. This chapter describes the epidemiology, pathophysiology, diagnosis, treatment, complications, and prevention of AOM in children. We aim to provide treating clinicians with an evidence-based understanding of contemporary diagnostic and management issues for AOM.

E. M. Rettig
Division of Pediatric Otolaryngology, Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, USA
e-mail: erettig@jhmi.edu

D. E. Tunkel (✉)
Division of Pediatric Otolaryngology, Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, USA

Johns Hopkins University School of Medicine, Baltimore, MD, USA
e-mail: dtunkel@jhmi.edu

Epidemiology of AOM

Acute otitis media is diagnosed in an estimated 10–12% of children in the United States (U.S.) each year [1, 2]. The treatment of AOM is responsible for more antibiotic prescriptions in the U.S. than any other childhood illness [3, 4]. In 2006, the financial impact of AOM management was an estimated $2.8 billion in the U.S. [2]. Analysis of a 2009 sample of U.S. children estimated that AOM treatment was associated with an increase in healthcare costs of $314 per child per year [1, 2].

Most AOM occurs in children ages 6–24 months, as maternal antibody protection wanes after the newborn period. Acute otitis media incidence peaks between 9 and 15 months, and declines after 5 years of age [5]. Children who develop AOM before age 6 months have an increased risk of subsequent frequent AOM [5].

The epidemiology of AOM has changed in recent decades. In the U.S., a 33% decrease in outpatient visits for otitis media was observed for children younger than 5 years of age from 1995–1996 to 2005–2006 [3]. There was a significant downward trend in otitis media-related healthcare usage, as measured by annual OM visit rates and recurrent OM visit rates, from 2001 to 2011 [6]. These trends have been attributed to several factors including: the introduction of the 7-valent pneumococcal vaccine (PCV7) in 2000 and the 13-valent version (PCV13) in 2010; broader use

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of influenza vaccination since 2004; dissemination of clinical practice guidelines that emphasize favorable natural history of AOM; improved public understanding about the viral etiology and favorable natural history of most upper respiratory tract infections (URTI); and possibly changing access to healthcare and other socioeconomic considerations [6, 7].

Host risk factors for AOM have been well documented. They include group child-care outside the home, exposure to second-hand tobacco smoke, pacifier use, and lack of breastfeeding. The presence of craniofacial anomalies, immune deficiencies, family history of recurrent acute otitis media (RAOM), and gastroesophageal reflux also are associated with AOM [8, 9].

Diagnosis of AOM

Acute otitis media is defined as the rapid onset of signs and symptoms of middle ear inflammation (Table 4.1) [7, 10]. Acute otitis media can also be characterized by the presence of fluid in the middle ear (that is, middle ear effusion) together with signs and symptoms of an acute infection [11]. The 2013 American Academy of Pediatrics (AAP) guideline for the management of AOM emphasizes stringent diagnostic criteria based on otoscopic findings, stating that the diagnosis of AOM should be made in children with "moderate to severe bulging of the tympanic membrane (TM) *or* new onset of otorrhea not due to acute otitis externa," and in those with "mild bulging of the TM *and* recent (<48 h) onset of ear pain (holding, tugging, rubbing of the ear in a nonverbal child) or intense erythema of the TM [7]."

Table 4.1 Classification of otitis media[a]

Term	Definition
Acute Otitis Media (AOM)	Rapid onset of signs and symptoms of middle ear inflammation *Specific/sensitive*: new onset otorrhea; bulging, opaque, immobile, and/or markedly erythematous tympanic membrane on otoscopy *Less sensitive/specific*: otalgia, tugging/pulling ear, fever, irritability, decreased appetite, difficulty sleeping
Recurrent Acute Otitis Media (RAOM)	Three or more AOM episodes in previous 6 months, OR 4 or more AOM episodes in previous 12 months with at least one in previous 6 months[b]
Otitis Media with Effusion (OME)	Fluid in the middle ear without signs or symptoms of acute ear infection
Chronic Otitis Media with Effusion (COME)	OME persisting for 3 months or longer from the date of onset (if known) or from the date of diagnosis (if onset unknown)

[a]Definitions adapted from Rosenfeld et al. [59], Casselbrant et al. [68], Bluestone and Klein [69] and Rosenfeld and Bluestone [70]

[b]Episodes should be well documented and separate

Acute otitis media should be distinguished from otitis media with effusion (OME), where a middle ear effusion is present without signs and symptoms of acute infection. Otitis media with effusion should not be routinely treated with antibiotics (Table 4.1) [10]. Acute otitis media should also be distinguished from viral URTI, which usually precedes and often accompanies AOM. Viral URTI shares nonspecific signs and symptoms, such as fever and irritability, with AOM, but generally does not require antibiotics for treatment [12, 13].

Precise diagnosis of AOM can be challenging for a variety of reasons. Accompanying signs and symptoms are often nonspecific, such as the fever, irritability, or insomnia that accompany other childhood illnesses. Otoscopic examination can be difficult in uncooperative children or in those with cerumen impaction. Signs and symptoms evolve and change throughout the course of the disease.

Otoscopic examination, with pneumatic otoscopy to fully evaluate TM mobility, is the cornerstone for diagnosing AOM [14]. The 2013 AAP guideline emphasizes bulging of the TM, or new onset otorrhea not due to otitis externa, as criteria for diagnosing AOM [7]. Tympanic membrane bulging and other signs of TM inflammation have been key diagnostic criteria for AOM in several recent high-quality randomized, controlled clinical trials evaluating treatment of AOM [15–17]. Training and experience in otoscopy is crucial in the proper identification of the bulging tympanic membrane [18]. Shaikh et al. have created an excellent resource for assessing the appearance of the tympanic membrane in AOM, with otoscopic images and videos that are available online [19].

Other signs and symptoms of AOM are less specific than the aforementioned otoscopic findings, and multiple studies have found that symptoms alone are neither sensitive nor specific enough to reliably diagnose AOM [7, 14]. Symptom assessment often centers around caregiver report, which may be unreliable or affected by pre-existing suspicion for the disease; a study of nearly 500 patients ages 6–35 months suspected to have AOM by caregivers found that only 50% met strict diagnostic criteria for AOM [20]. Nevertheless, assessment of symptoms may help refine clinical suspicion for AOM, and may be the only information available to clinicians for children who are difficult to examine. Otalgia is perhaps the most useful symptom with a relatively high specificity of 80–90%, but may only be observed by caregivers in 50–60% of children with AOM [7, 14]. Ear discomfort can also be caused by the presence of middle ear effusion even without acute infection. Fever, cough, rhinitis, excessive crying, and poor appetite are also frequently present in children with AOM [14].

Diagnosis of AOM in infants is particularly challenging. A prospective study of 193 infants followed through their first year of life and examined during each episode of URTI found that symptoms of earache, fever, poor feeding, restless sleep, and irritability could predict accompanying AOM. In a multivariable predictive model that incorporated symptoms, daycare attendance, and age, the most useful symptoms for predicting AOM in the context of URTI were severity of earache and cough. Still, though specificity was high (95%), sensitivity was low in this model (33%) [21]. Although symptoms are useful in shaping clinical concern for AOM, otoscopic examination is critical to confirm the diagnosis.

Pathophysiology and Microbiology of AOM

Aeration of the middle ear is achieved by intermittent opening of the Eustachian tube to the nasopharynx during swallowing, yawning, or valsava, allowing for pressure equalization of the middle ear with the environment. Mucociliary clearance of middle ear secretions through the Eustachian tube into the nasopharynx and mucosal production of antimicrobial proteins also contribute to a healthy middle ear [11]. In the setting of a URTI, viral-induced inflammation and edema impair pressure equilibration and mucociliary function [22]. Negative pressure develops in the middle ear and fluid collects from decreased clearance of secretions, with pressure differential-related movement of microbe-containing secretions from the nasopharynx. Bacterial replication and infection may ensue, with release of inflammatory mediators. Acute otitis media may also be caused by severe viral infection in the absence of bacteria [11]. Young children are at increased risk for AOM because of their underdeveloped Eustachian tubes at baseline, which are smaller and more horizontal than in adults, and subject to impairment by large adenoid pads. Young children may also have immature immunity with increased susceptibility as well as greater exposure to infectious diseases [11, 23, 24].

The microbiology of AOM varies by locale, and can be affected by antibiotic prescribing habits and vaccination practices [5]. The most common bacteria isolated from middle ear aspirates in AOM in the U.S. are *Streptococcus pneumoniae*, non-typeable *Haemophilus influenzae*, and *Moraxella catarrhalis* [5, 25]. Viruses are commonly isolated along with bacteria, consistent with the observation that AOM is often associated with viral URTI. A 2006 Finnish study of the middle ear fluid in 79 children with AOM and indwelling tympanostomy tubes using sensitive assays including culture, antigen detection, and polymerase chain reaction found that 66% had bacteria and viruses, 27% had bacteria alone, and 4% had only viruses [26]. The most common viruses in this study were picornaviruses (rhinovirus, enterovirus, nontypeable picornaviruses), present in 41% of all cases, while next most common were respiratory syncytial virus (14%) and parainfluenza virus (6%).

Vaccines and AOM

The 7-valent and then 13-valent pneumococcal vaccines (PCV7 and PCV13) were introduced in the U.S. in 2000 and 2010, respectively, and have led to significant changes in the microbiology of AOM in the U.S. and other countries with high vaccine penetrance. Both vaccines were found to reduce vaccine serotypes of *S. pneumoniae*, assessed in nasopharyngeal aspirates and middle ear fluid of children with AOM. However, serotype replacement with non-vaccine strains occurred after the introduction of both PCV7 and PCV13, and the overall carriage rate of *S. pneumoniae* did not dramatically decrease [25, 27–31]. Despite serotype replacement, pneumococcal vaccines have appeared to coincide with modest decreases in measures of AOM incidence [6, 32, 33]. One study showed a 20% reduction in otitis media-related outpatient visits in U.S. children under 2 years of age after PCV7 [3], and another found a decrease in otitis media-related annual clinic visits by 0.27 per child after PCV13 [6]. Interestingly, the incidence of complex or recurrent AOM has decreased concomitant with widespread pneumococcal vaccination, to a greater degree than would be expected with pneumococcal serotype coverage by current vaccines. This has been attributed to a decrease in AOM from invasive *S. pneumoniae* serotypes in early childhood, preventing the initiation of a pathogenic process that leads to subsequent recurrent and more severe disease with its associated sequelae [34].

Influenza vaccination also has significant potential to decrease AOM, given the frequent comorbidity of viral illness and AOM. Indeed, a Cochrane review found that influenza vaccination is associated with a small 4% reduction in AOM frequency, and a 15% reduction in antibiotic prescriptions, for children aged 6 months to 6 years who received the influenza vaccine [35].

Treatment of AOM

The goals of management in AOM are reduced symptom severity and duration, as well as prevention of sequelae such as infectious complications or hearing loss. Management should be guided by existing evidence-based clinical practice guidelines in the context of shared decision-making with individual patients and caregivers. While the AAP 2013 guideline on AOM will be discussed here, many other developed and developing countries offer AOM guidelines that have similar diagnostic criteria, pain control recommendations, and options for initial observation (in mild or moderate disease) versus antibiotic therapy (for younger children or more severe disease) [36].

Analgesia

Pain is often a prominent symptom of AOM, and should be assessed by caregivers and clinicians [7]. Acetaminophen and/or ibuprofen have been shown to be effective in reducing pain compared to placebo, but there is not enough high-quality evidence to determine which drug is superior, or whether the combination of both is more effective than monotherapy [37]. Ototopical anesthetic drops have also been reported to provide some pain relief, but there is insufficient evidence to recommend routine use [38]. Pain control strategies should be discussed with caregivers, including pain assessment in young children as well as medication options, dosing, and administration schedule [7, 39].

Antibiotics or Initial Observation Without Antibiotics

A key management decision in treating AOM is whether to use antibiotics at the time of diagnosis or to initially observe and use antibiotics for persistent or worsening signs and symptoms. Although AOM has a very favorable natural history without antibiotic treatment for most children, several trials have shown that antibiotic treatment does improve symptom scores and outcomes in select patients [15, 16, 40–42]. The clinical significance of such demonstrated advantages of antibiotics for AOM remains debated. A Cochrane review of randomized controlled trials of antibiotic treatment for AOM evaluating over 3000 children from high-income countries found

that 24 h after diagnosis most (60%) children had improvement in symptoms, and antibiotic treatment had no bearing on whether or not symptoms improved. In the ensuing days to weeks, antibiotics were associated with small reductions in pain, TM perforations, and risk of contralateral AOM, but did not impact late AOM recurrences or hearing loss at 3 months. In general, antibiotics held the greatest benefit for children <2 years old with bilateral AOM, and children with AOM accompanied by otorrhea [42]. Notably, children treated with antibiotics did suffer increased risk of rash and gastrointestinal symptoms such as vomiting and diarrhea. Given the small benefit of antibiotics and the adverse events associated with their use, this review concluded that initial observation without immediate antibiotics was reasonable for most children with AOM [42].

The 2013 AAP guideline, which applies to children 6 months through 12 years of age, recommends a treatment decision algorithm based on the child's age, severity of signs, and symptoms including otalgia and fever, otorrhea, and laterality of disease, combined with joint decision making with the patient and caregiver. According to this guideline, clinicians should prescribe antibiotics for children with AOM with severe symptoms (e.g., fever, severe otalgia, otalgia for >48 h) or AOM with otorrhea, and for children 6–23 months of age with bilateral AOM. Children 6–23 months old with unilateral AOM without severe symptoms, and older children with non-severe AOM (unilateral or bilateral) may be offered either antibiotic therapy or observation with close follow-up (Table 4.2) [7].

The 2013 AAP guideline represents a change from the 2004 AAP guideline, which introduced concepts to guide antibiotic stewardship in the midst of concerns over rising antimicrobial resistance and AOM treatment-related costs as well as antibiotic-related side effects [7, 43, 44]. The 2004 guideline introduced the option for initial observation of non-severe illness, acknowledging the generally favorable natural history of AOM and the potential harms of antibiotic overuse. The 2004 guideline allowed for and incorporated diagnostic uncertainty into treatment decisions [44]. The 2013 guideline also recommends initial observation in select groups, but emphasizes precise diagnosis to guide subsequent treatment decisions. Two randomized trials that used such stringent diagnostic criteria including otoscopic findings and acute onset of symptoms demonstrated a rate of clinical improvement of 26–35% with antibiotics over placebo, which was greater than the 6–12% rates that had previously been reported in studies with less restrictive inclusion criteria [7]. Both the trials used amoxicillin-clavulanate in the treatment arms [15, 16].

The decision for initial observation rather than antibiotic treatment in appropriately selected children should be made together with caregivers, with an agreed-upon plan for initial analgesia and re-evaluation in 48–72 h [7]. A useful strategy is to give caregivers a "wait-and-see prescription ('WASP')" [45] that should only be filled in the event of worsening or persistent symptoms.

Table 4.2 Treatment of acute otitis media: immediate antibiotics or initial observation?[a]

Disease severity[b]	Age	Laterality	Treatment
Severe disease and/or otorrhea	All ages	Unilateral or Bilateral	Prescribe antibiotics
Non-severe disease	<6 months[c]	Unilateral or Bilateral	Prescribe antibiotics
	6–23 months	Bilateral	Prescribe antibiotics
		Unilateral	Prescribe antibiotics *or* offer observation with close follow-up[d]
	≥24 months	Unilateral or Bilateral	Prescribe antibiotics *or* offer observation with close follow-up[d]

[a]Adapted from Lieberthal et al. [7]
[b]Severe disease: moderate or severe otalgia or otalgia for ≥48 h, or temperature 39 °C or higher
[c]Infants <6 months not included in most trials evaluating acute otitis media treatment
[d]Observation consists of initial symptom management only, with a plan in place to start antibiotic therapy if symptoms worsen or do not improve in 48–72 h

This approach resulted in avoidance of antibiotics in up to two-thirds of children managed with initial observation [45, 46]. The initial observation approach can be well received by caregivers with appropriate education and emphasis on shared decision-making [47, 48], and has not resulted in increased rate of suppurative AOM complications such as mastoiditis [49, 50].

Antibiotic Selection for AOM

When the decision is made to administer antibiotics to a child with AOM, the choice of first-line therapy is guided by knowledge of the most common bacteria causing AOM, antibiotic resistance patterns, patient allergies, or intolerances, whether the patient has received antibiotics in the past 30 days, and potential side effects. The most commonly recommended drug for first-line treatment, in a non-penicillin allergic child who has not received amoxicillin in the previous 30 days, is "high-dose" amoxicillin (90 mg/kg/day). Although sensitivity data for uncomplicated AOM are difficult to obtain as it requires tympanocentesis for culture of middle ear fluid, data from the Centers for Disease Control and Prevention antibiotic resistance surveillance program indicate that approximately 95% of *S. pneumoniae* from all the sites were penicillin susceptible in 2014 [51], and another report found 73% of *H. influenzae* isolates from 2008 to 2010 in 71 U.S. medical centers were susceptible to ampicillin [52]. *Moraxella catarrhalis* produces beta-lactamase and is nearly 100% resistant to penicillin [52], but AOM caused by this organism still exhibits high rates of clinical response with few complications when treated with amoxicillin [7]. In cases where a child has received amoxicillin within 30 days, has recurrent AOM that does not respond to amoxicillin, or also has purulent conjunctivitis, the addition of a beta-lactamase stable drug such as amoxicillin-clavulanate is recommended.

Penicillin-allergic patients may be treated with a second or third-generation cephalosporin (cefdinir, cefuroxime, cefpodoxime, or ceftriaxone). While the incidence of "cross-reactivity" of penicillin and cephalosporins has often been quoted as high as 10%, more critical and recent analysis summarized in the 2013 AAP guideline suggests this actual cross-reactivity risk is about 0.1%—and likely lowest for the later generation cephalosporins [7]. While trimethoprim-sulfamethoxazole or erythromycin-sulfisoxazole combinations are reasonable choices for initial treatment of AOM in children with severe penicillin reaction or a history of documented cephalosporin allergy, the considerable rate of pneumococcal resistance to these drugs makes them unsuitable for treating AOM after initial treatment failure. Clindamycin has no activity against *H. influenzae*, and also may lack activity against highly resistant serotypes of *S. pneumoniae*.

If symptoms persist or worsen after 48–72 h of first-line antibiotic therapy, clinicians should consider switching to an alternative second-line agent. This may include amoxicillin-clavulanate, ceftriaxone (intramuscular or intravenous), or a combination of clindamycin and an extended-spectrum cephalosporin. Infections that persist despite second line treatment, or infections in children with multiple drug sensitivities, may require tympanocentesis (or myringotomy and tympanostomy tube placement) for culture and sensitivity testing [7].

The use of ototopical antibiotic drops in place of oral antibiotics for AOM with an associated TM perforation has not been studied. Indirect evidence from a trial demonstrating efficacy of antibiotic ear drops in children with tympanostomy tube otorrhea [53] suggests that drops may be beneficial in the setting of AOM with TM perforation; however, an evidence-based recommendation cannot currently be made for or against their use. If clinicians choose to prescribe topical antibiotics in these cases, ototopical fluoroquinolones should be used rather than potentially ototoxic preparations that contain aminoglycosides [54]. While topical fluoroquinolones are not approved for use in very young children with AOM and tympanostomy tubes (e.g., 6 months of age for ciprofloxacin-dexamethasone otic, or 1 year of age for ofloxacin otic), at least one study of treatment of post-tympanostomy otorrhea with such drops included children as young as age 6 months [55].

Duration of Antibiotic Therapy

The ideal duration of antibiotic therapy for AOM is still debated. For children ages 2–5 years with mild or moderate AOM, a 7-day course has been recommended, and for children 6 years and older a 5–7 day course is considered adequate [7, 56]. A recent randomized controlled trial of 520 children ages 6–23 months compared a 5-day course of amoxicillin-clavulanate with a 10-day course. Those treated for 5 days were more likely to have clinical failure and had significantly worse symptom scores at 12–14 days after treatment, while the longer regimen did not have significantly different adverse event rates or emergence of antibiotic resistance [17].

Complications

Complications of AOM are rare, but prompt diagnosis and treatment are needed to avoid severe morbidity. The most common complication is TM perforation with resultant otorrhea. Although a full discussion of AOM complications is beyond the scope of this chapter, a useful schema for classifying complications of AOM is by anatomic site: (1) *Intracranial*, *extratemporal*; (2) *Extracranial*, *intratemporal*; and (3) *Extracranial*, *extratemporal* (Table 4.3). Complications may be suspected or diagnosed based on history and physical exam findings, but often require imaging such as contrast-enhanced computed tomography (CT) and/or magnetic resonance imaging (MRI), or possibly a lumbar puncture (if there is suspicion for meningitis), to clarify the diagnosis. Treatment may include parenteral antibiotics, myringotomy with or without tympanostomy tube placement, and/or mastoidectomy. Neurosurgical consultation should be obtained for intracranial complications.

Table 4.3 Complications of acute otitis media

Complication	Presentation
Intracranial, *extratemporal*	
Meningitis	Headache, altered mental status, nausea, vomiting, lethargy, seizures, neck stiffness, photophobia, focal neurologic deficits
Intracranial abscess	
Subdural, epidural, or brain abscess	
Otitic hydrocephalus (elevated intracranial pressure with normal cerebrospinal fluid cytology)	Headache, vomiting, blurred vision, seizures, diplopia, abducens palsy, papilledema
Thrombosis of dural venous sinuses (lateral or sigmoid sinus thrombophlebitis)	Headache, neck stiffness, fever, otalgia, postauricular pain and erythema
Extracranial, *intratemporal*	
Acute mastoiditis	Postauricular erythema, tenderness, edema, protrusion of pinna
Subperiosteal abscess	Postauricular erythema, tenderness, fluctuance
Petrositis ('Gradenigo's syndrome')	Abducens palsy, retrobulbar pain
Facial nerve palsy	Acute onset facial weakness
Labyrinthitis	Acute onset sensorineural hearing loss and vertigo
Tympanic membrane perforation	Otorrhea, possibly following abrupt decrease in pain
Extracranial, *extratemporal*	
Sepsis	Fever, lethargy, tachycardia, hypotension

Sources for this table: Bluestone and Klein [69], Naseri and Sobol [71], Ropposch et al. [72], Rettig and Tunkel [43]

Recurrent Acute Otitis Media (RAOM)

Recurrent acute otitis media is a common reason for referral to an otolaryngologist. Male gender, exposure to tobacco smoke, and winter season all increase the risk of RAOM. While tympanostomy tubes are commonly used to prevent AOM in children with a history of RAOM, few studies have assessed tympanostomy tubes for this indication, particularly in the absence of chronic OME. The 2013 AAP guideline recommended *offering* tympanostomy tubes to children with RAOM on the basis of studies that show a modest reduction in AOM by 1.5 episodes in 6 months [57], and improved disease-specific quality of life after tympanostomy tube placement [7, 58]. The American Academy of Otolaryngology-Head and Neck Surgery, in its 2013 tympanostomy tube guideline, also recommended *offering* tympanostomy tubes for RAOM, but only if a middle ear effusion was present in one or both

ears at the time of evaluation [59]. An important advantage to tympanostomy tube placement is that uncomplicated AOM after such surgery, manifested by post-tympanostomy otorrhea, can be treated with ototopical drops rather than oral antibiotics, reducing potential for systemic side effects [60]. Of note, prophylactic antibiotics for RAOM are not recommended due to demonstrated minimal benefit in preventing AOM, associated side effects of antibiotics, and the potential for encouraging bacterial resistance [7].

Prevention

There are several host-level interventions that can reduce the risk of AOM. Breastfeeding during infancy is associated with significantly lower risk of AOM and RAOM, with greater protection afforded by exclusive and longer duration breastfeeding [61]. The AAP advises exclusive breastfeeding for at least 6 months [7]. Exposure to second-hand tobacco smoke significantly increases the risk of AOM, so that caregiver smoking cessation should be strongly advised [7, 62, 63]. Pneumococcal and influenza vaccinations appear to reduce the frequency of AOM, as described previously [7, 35, 64]. Other potentially modifiable risk factors for AOM are pacifier use and exposure to a group childcare setting [63, 65].

Various other prophylactic strategies have been attempted, including zinc or vitamin D, probiotics, and other dietary supplements and homeopathic remedies [66]. While support for such regimens is seen in lay publications, high-quality evidence does not exist for recommending routine use. Xylitol is a natural sugar substitute that has been shown in meta-analysis to reduce the risk of AOM by 22–30% as compared with control groups among children attending daycare centers. However, it must be taken 3–5 times daily, limiting its practicality [67].

Conclusion

Appropriate management of AOM requires skill in clinical assessment and otoscopic examination, familiarity with the generally favorable natural history of the disease, and shared decision-making with parents and caregivers. Although many children will recover with initial observation without antibiotics, clinicians should be familiar with the indications for immediate antibiotic treatment for AOM. Pain assessment and management is necessary for all children with AOM. Vaccines are changing the epidemiology and microbiology of AOM, and appear to be reducing the burden and severity of disease. Clinical practice guideline updates should be consulted for contemporary evidence-based practice recommendations.

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