

# Guideline for

# Guideline for the Diagnosis and Management of Acute Otitis Media

*This clinical practice guideline (CPG) was developed by an Alberta Clinical Practice Guideline working group. The guideline is intended for use with the immunocompetent individual and does not apply to infants less than 6 weeks old, premature infants who are hospitalized, patients with craniofacial abnormalities such as cleft palate, patients with severe underlying systemic disease, or those with complications of AOM (e.g., sepsis, mastoiditis).*

## DEFINITIONS

- ◆ Acute otitis media (AOM): inflammation and pus in the middle ear accompanied by symptoms and signs of ear infection.
- ◆ Myringitis (“red eardrum”): inflammation of the tympanic membrane alone or in association with otitis externa.
- ◆ Otitis media with effusion (OME): also known as Serous Otitis Media: fluid in the middle ear without symptoms or signs of acute inflammation of the ear.
- ◆ Chronic suppurative otitis media - persistent inflammatory process associated with perforated tympanic membrane and draining exudate for more than 6 weeks.

## ISSUES

- ◆ It is critical to differentiate between i) AOM, ii) myringitis, and iii) OME.
- ◆ The overuse of antibiotics in ill defined ear infections has led to increasing antimicrobial resistance.
- ◆ In children aged 2 years or older, the need for antibiotics in AOM is controversial.
- ◆ Antibiotics may reduce the risk of complications in AOM; however, the incidence of these complications is low.
- ◆ Evidence indicates that 5 days of antibiotic therapy is sufficient for first line treatment of uncomplicated AOM in the majority of patients.

## GOALS

- ◆ To increase the accuracy of the diagnosis of acute otitis media.
- ◆ To optimize the management of acute otitis media.
- ◆ To reduce antibiotic use for the treatment of myringitis and OME.

## PREVENTION

- ◆ Handwashing.
- ◆ Breast feeding.
- ◆ Avoidance of exposure to environmental tobacco smoke.
- ◆ Avoidance of feeding in a supine, flat position.

## DIAGNOSIS

### Acute Otitis Media (AOM)

- ◆ Symptoms: pain, fever, irritability.
- ◆ On direct otoscopy the only specific sign of AOM is a bulging, inflamed eardrum.
- ◆ In the absence of bulging, the eardrum must demonstrate acute inflammation **and** decreased mobility on pneumatoscopy.
- ◆ Routine cultures of ear drainage offer no diagnostic advantage in identifying potential pathogens.

### PRACTICE POINT

#### Diagnosis of Myringitis

- ◆ Normal mobility on pneumatoscopy with redness which may be peripheral.
- ◆ Antibiotics are **not** indicated.

*Note: Inflammation only at the superior pole may progress to AOM; consider follow-up.*

#### Diagnosis of Otitis Media with Effusion (OME)

- ◆ Lack of acute inflammation despite visible fluid or reduced mobility on pneumatoscopy.
- ◆ Antibiotics are **not** indicated.

## MANAGEMENT

### General

- ◆ Pain/fever should be controlled with systemic analgesics (acetaminophen, ibuprofen).
- ◆ Decongestants/antihistamines are not beneficial in the treatment of AOM itself.\*  
*\*Note: Some experts believe that antihistamines and/or decongestants may be of benefit when allergies play a role in the etiology.*
- ◆ Topical corticosteroid/antibiotic preparations are **not** recommended.

### Antibiotic Therapy

- ◆ **Myringitis**
  - Antibiotics are not indicated.
- ◆ **Otitis Media with Effusion**
  - Antibiotics are not indicated.
- ◆ **Acute Otitis Media**

#### Children less than 24 months old:

- Treat with antibiotics (See Table 1).

#### Children aged 2 years or older:

- Most cases of AOM resolve with symptomatic treatment alone and do not require antibiotics.
- Treat symptomatically for 48-72 hours from symptom onset if pain/fever is manageable with systemic analgesics, **providing adequate follow-up can be assured.**
- If symptoms worsen or fail to respond to symptomatic treatment with systemic analgesics after 48-72 hours, treat with antibiotics (See Table 1. See Background for further information on dosage and duration.)

### Follow-Up

- ◆ If the patient remains symptomatic at 48 to 72 hours (following treatment with analgesics or first line antibiotics), or is deteriorating, follow-up is recommended.
  - Reassess patient for:
    - acute complications of AOM (e.g., mastoiditis, meningitis, facial paralysis);
    - other diagnoses;
    - compliance with medications.

- Non-responders (See Table 2).

- ◆ A follow-up exam at completion of treatment is not required if the patient is asymptomatic.  
*Note: Up to 50% of children will have an effusion 1 month post AOM. Further antibiotic therapy is not required.*
- ◆ Follow-up 3 months post AOM episode is recommended to assess for persistent OME, which may lead to hearing loss.  
*Note: Up to 10% of children will have an effusion 3 months post AOM.*
  - Perform hearing evaluation if effusion present at 3 months post AOM.
  - Refer to an ear, nose, and throat specialist if hearing loss.
- ◆ Given the increasing incidence of resistant organisms, diagnostic tympanocentesis should be considered where there has been failure of 2 consecutive courses of antibiotics (first line followed by second line agent) with persistent symptoms.

### Antibiotics NOT Recommended in AOM

- Cephalexin: - poor activity against penicillin intermediate/resistant *S. pneumoniae*  
- no activity against *Haemophilus/Moraxella*
- Cefaclor<sup>1,2</sup>: - no activity against penicillin intermediate/resistant *S. pneumoniae*  
- marginal activity against *Haemophilus*
- Cefixime: - no activity against penicillin intermediate/resistant *S. pneumoniae*.  
- excellent activity against *Haemophilus*.
- Ceftriaxone: - routine use of this agent is not recommended in otitis media due to potential for increased resistance to 3<sup>rd</sup> generation cephalosporins.  
- may be an option in severe cases who have failed therapy. Three days of IM/IV therapy are recommended. (Single dose not as effective in eradicating penicillin resistant *S. pneumoniae*.)
- Erythromycin: - poor activity against *Haemophilus and Moraxella*
- Quinolones: - not recommended in patients <16 years old, broad spectrum, potential to induce resistance.
- Clindamycin: - no activity against *Haemophilus and Moraxella*.

## RECURRENT AOM

### Management

- ◆ If recurrences are more than 6 weeks apart, treat with first line agents (See Table 1).

*Note: Use high dose amoxicillin (90 mg/kg/day PO divided BID or TID for 10 days)*

- ◆ If recurrences are less than 6 weeks apart, treat with second line agents (See Table 2).

### Frequent Recurrences of AOM

- ◆ Observation over time is reasonable because of a decreasing incidence of AOM with advancing age.
- ◆ Consider ENT referral for tympanostomy tubes if:
  - OME for  $\geq 3$  months with bilateral hearing loss  $\geq 20$  dB.
  - $\geq 3$  episodes in 6 months
  - $\geq 4$  episodes in 12 months
  - Retracted tympanic membrane
  - Cleft plate or craniofacial malformations.

### Antibiotic Prophylaxis

- ◆ With increasing antibiotic resistance, antibiotic prophylaxis is not recommended. On average, antibiotic prophylaxis decreases AOM by  $\sim 1$  episode per year.

## BACKGROUND

### Introduction

Acute otitis media is the most frequently diagnosed bacterial infection in pediatric patients. It has been suggested that otitis media is overdiagnosed in North America, as it is said that 84% of children have at least 1 episode of AOM by 3 years of age.<sup>1</sup> In the United Kingdom, the incidence is approximately 70%.<sup>2</sup>

### Epidemiology and Risk Factors

Acute otitis media is a disease of infancy and childhood, with a peak incidence between 6 and 9 months.<sup>3</sup> Studies indicate that by 1 year of age, more than 60% of children have had 1 episode of AOM, and 17%<sup>3</sup> of children have had at least 3 episodes of AOM.

After the age of 6, less than 40% of children develop AOM and only 30% have 3 or more episodes.<sup>3</sup>

The earlier the age of onset of AOM, the greater the recurrence rates.<sup>1,3</sup> Studies indicate that 60% of children who had their first episode of AOM before the age of 6 months have 2 or more recurrences in 2 years.

Persistent effusion is seen after AOM in 50% of children 1 month<sup>3</sup> post AOM, 20% at 2 months and 10% at 3 months.<sup>3</sup> The earlier the onset of AOM, the greater the likelihood of persistent effusion.<sup>1,3</sup> Persistent fluid in the middle ear is associated with conductive hearing loss, and can hinder language development and school performance.<sup>3</sup>

Environmental exposure to tobacco smoke may be an important risk factor for middle ear disease.<sup>4</sup>

Daycare attendance has been associated with an increased incidence of AOM.<sup>1,3,5</sup> This is likely due to an increased incidence of respiratory tract infections in group day-care settings.<sup>2</sup> The incidence of myringotomy and tympanostomy tubes is also greater in this population of children.<sup>3</sup>

Male sex is associated with an increased incidence of AOM.<sup>1,3</sup> The Boston study<sup>6,7</sup> showed that breastfeeding for a period as short as even 3 months decreased the incidence of AOM in the first year of life.

First Nations children appear to be more prone to develop chronic suppurative otitis media which can be very resistant to treatment.<sup>8</sup> It is unclear whether genetic or environmental factors play the most significant role.

There is a seasonal aggregation of AOM with a peak in the fall and winter.<sup>2</sup> The incidence may be related to an increased rate of viral upper respiratory tract infections at those times.

### Etiology

Reliable microbiological diagnosis of AOM requires culture of tympanocentesis fluid through an intact drum.

The major bacterial pathogens causing AOM have not changed significantly over the last 2 decades and are similar for infants, children and adults.<sup>7,8,11,12</sup>

**Table 1: 1st Line Agents in the Treatment of AOM**

Recommended Therapy and Dose (Maximum dose should not exceed adult dose)	Duration	Comments
<u>Standard Dose</u> <b>Amoxicillin</b> 40 mg/kg/day PO div tid or <u>High Dose</u> <b>Amoxicillin</b> 90 mg/kg/day PO div bid or tid	5 days*  5 days*	<ul style="list-style-type: none"> <li>Amoxicillin retains best coverage of oral <math>\beta</math>-lactam agents against <i>S.pneumoniae</i> (including intermediate strains).</li> <li>Higher dose (90 mg/kg/day) recommended if:                             <ul style="list-style-type: none"> <li>recent (&lt;3 months) antibiotic exposure <b>and/or</b> daycare centre attendance.</li> </ul> </li> </ul> <p><u>or</u></p> <ul style="list-style-type: none"> <li>recurrent AOM: 6 weeks to 3 months apart. Note: less than 6 weeks is considered failure of therapy.</li> </ul>
<u><math>\beta</math>-lactam allergy</u> <b>Azithromycin</b> 10 mg/kg PO 1st day then 5 mg/kg PO daily or <b>Clarithromycin</b> 15 mg/kg/day PO div bid	1st day then 4 days  5 days*	
<u>Non Type I beta-lactam allergy/anaphylaxis</u> <b>Cefuroxime axetil</b> 30 mg/kg/day PO div bid or <b>Cefprozil</b> 30 mg/kg/day PO div bid	5 days*  5 days*	<ul style="list-style-type: none"> <li>Compared to cefuroxime, cefprozil has a better taste but inferior coverage of <i>Haemophilus spp</i> and penicillin intermediate <i>S. pneumoniae</i>.</li> </ul>
<p>* <b>Note on Duration</b>                      Use 10 days if: &lt;24 months old; perforated eardrum; recurrent AOM</p>		

**Table 2: 2nd Line Agents in the Treatment of AOM**

Recommended Therapy and Dose	Duration	Comments
<u>Failure of Amoxicillin</u> <b>Amoxicillin - clavulanate</b> 90mg/kg/day PO div bid (based on amoxicillin)  or  <b>Cefuroxime axetil</b> 30mg/kg/day PO div bid  or  <b>Cefprozil</b> 30 mg/kg/day PO div bid	10 days  10 days  10 days	<p><u>Rationale</u></p> <ul style="list-style-type: none"> <li>Amoxicillin - clavulanate will provide coverage for penicillin intermediate <i>S. pneumoniae</i> and <math>\beta</math>-lactamase producing organisms</li> <li>Use amoxicillin-clavualante 7:1 formulation</li> <li>Provides best coverage of all oral cephalosporins against penicillin intermediate strains of <i>S. pneumoniae</i> and provides good coverage of <i>Haemophilus/Moraxella/S. aureus</i>.</li> <li>Due to poor taste of suspension recommend tablets if possible (can crush tablets and put in palatable fluid).</li> <li>Compared to cefuroxime, cefprozil has a better taste but inferior coverage of <i>Haemophilus spp</i> and penicillin intermediate <i>S. pneumoniae</i>.</li> </ul>
<u><math>\beta</math>-lactam allergy</u> <b>Azithromycin</b> 10 mg/kg PO then 5 mg/kg PO daily or <b>Clarithromycin</b> 15 mg/kg/day PO div bid	1st day then 4 days  10 days	<ul style="list-style-type: none"> <li>Macrolides have been shown to be less efficacious than amoxicillin-clavulanate.<sup>9,10</sup></li> </ul>

The most frequent causative agent of AOM is *Streptococcus pneumoniae* (40%), followed by nontypeable *Haemophilus influenzae* (25%), *Moraxella catarrhalis* (10%), Group A *Streptococcus* (2%) and *Staphylococcus aureus* (2%).<sup>13</sup> Up to 15% of middle ear fluid cultures reveal 2 organisms and findings from the left and right ear may differ. About 20-30% have no bacterial pathogens identified and presumably are viral in etiology.

The emergence of bacterial strains that are increasingly resistant to antimicrobial agents is a growing concern in Canada and worldwide.<sup>14-16</sup> Inappropriate use of antibiotics for viral upper respiratory tract infections<sup>17</sup> has been a major contributor to antimicrobial resistance. Currently, 25% of *Haemophilus influenzae* and 90% of *Moraxella catarrhalis* produce  $\beta$ -lactamase enzymes which will inactivate penicillin and amino penicillins. Recently, there has been a dramatic increase of multiple antibiotic resistant *Streptococcus pneumoniae*. Currently, approximately 8% of *Streptococcus pneumoniae* isolates in Alberta demonstrate in vitro resistance to penicillin, with 1.4% of these isolates exhibiting high level resistance (MIC  $\geq 2$  mg/mL). In Alberta, resistance to macrolides for *S. pneumoniae* is approximately 9%.

## Diagnosis

The diagnosis of AOM requires the presence of inflammation and pus in the middle ear, and acute onset of symptoms and signs of ear infection, i.e., earache, fever, irritability, poor feeding or vomiting, often associated with cough and rhinitis.<sup>18</sup> This differentiates AOM from:

- ◆ Myringitis - inflammation of the tympanic membrane. This is usually associated with viral infections of the upper respiratory tract and may also be seen temporarily in the crying child.
- ◆ OME - fluid in the middle ear without signs or symptoms of acute inflammation of the eardrum.
- ◆ Chronic suppurative otitis media - persistent inflammatory process associated with perforated tympanic membrane and draining exudate for more than 6 weeks. Many cases actually represent Otitis Externa that has been inappropriately treated. It is difficult to see a perforation in a chronically draining ear, especially if the external canals are inflamed. In these cases, mastoid x-rays and perhaps even a CT scan of the external canal, middle ear, and mastoid cells, becomes quite important for diagnosis.

## PRACTICE POINT

Bullous myringitis (rare) - bullae or tympanic membrane may be hemorrhagic. It is caused by *Mycoplasma pneumoniae* and has a 90% spontaneous resolution rate.

Earache is a significant symptom predicting AOM but may also be a symptom of teething, wax in the ear canal, and migraine. A small number of children will have AOM without earache, but will generally have purulent rhinitis, irritability, night restlessness and sometimes fever.<sup>19,20</sup>

The diagnosis of AOM is made by history and direct visualization of the tympanic membrane (the wax may have to be removed). On direct otoscopy, the only specific sign is a bulging eardrum. In the absence of a bulging eardrum but with clinical suspicion of AOM, pneumatic otoscopy is necessary to differentiate AOM from myringitis. In children where this is difficult, corroboration with clinical symptoms is essential.<sup>21</sup> Younger children usually need to be restrained. Visualization of the tympanic membrane may still be difficult because of the narrow diameter of the ear canal which may also be tortuous.

Early AOM may be diagnosed by inflammation which is seen along the handle of malleus, and in the superior pole of the tympanic membrane. At this stage, the rest of the tympanic membrane usually still has good mobility with insufflation by the pneumatic otoscope. With these findings, the child should be followed closely.<sup>22</sup>

Other less common diagnostic methods include tympanometry and acoustic reflectometry. These methods must still be used in conjunction with compatible history.<sup>23</sup>

Diagnosis may be difficult in a younger child but it is important to accurately do so. A first episode of AOM before 6 months of age is likely to lead to recurrence of AOM, and subsequently, significant periods of OME with diminished hearing, leading to delayed speech development and impaired cognitive functioning.<sup>24</sup>

In the child who is younger than 2 months of age, there is a significant risk of bacteremia associated with AOM.<sup>22</sup>

## Management of AOM

Antibiotic therapy is recommended for AOM in children under 24 months.<sup>25</sup> Some studies have suggested that routine use of antibiotics, especially in children 2 years and older, is not indicated because of the high rate of spontaneous resolution.<sup>26-28</sup> A meta-analysis of 5400 children with AOM indicated that antibiotic therapy enhanced acute symptom relief by 13.7% despite a spontaneous recovery in 81% of cases.<sup>28</sup> Spontaneous resolution is organism specific: *S. pneumoniae* 10%; *H. influenzae* 50%; *M. catarrhalis* 75%.<sup>29,30</sup> A randomized trial in the United Kingdom in 2001 compared providing immediate antibacterial therapy with delaying antibacterial agents for 72 hours in children aged 6 months to 10 years. Seventy six percent of children in the delayed group never required antibiotics and 70% were symptomatically better at 72 hours. This compared to an 86% “symptom improved” rate in the treatment group. Immediate use of antibiotics was associated with one day shorter illness but no difference in school absence or pain scores.<sup>31</sup> Some experts recommend watchful waiting for 48 to 72 hours before initiating antibiotic therapy if symptoms are manageable with analgesics. This approach is appropriate in patients over 2 years of age if good follow-up can be assured. Some groups recommend against this approach if the child presents with bilateral AOM.<sup>32</sup> Regardless of whether or not antibiotics are given, the management of pain, especially during the first 24 hours, should be addressed. Acetaminophen and ibuprofen provide effective analgesia for mild to moderate pain, are readily available, and are recommended as the mainstay of pain management for acute otitis media.<sup>18</sup>

The goals of antibiotic treatment of AOM are to:

- ◆ Produce a clinical cure.
- ◆ Prevent complications.
- ◆ Eradicate bacteria from the middle ear.

All of these goals can be achieved in most children. The most important factor is not to prescribe antibiotics for inappropriate diagnosis of AOM. Since *S. pneumoniae* has the lowest spontaneous resolution rate and is associated with more serious complications, it is essential to ensure optimal coverage for this organism.

Amoxicillin at doses of 40 mg/kg/day given TID should be considered as the first line oral therapy for low risk children (no previous exposure to antibiotics in the last 3 months and not attending daycare centres).<sup>18,33</sup>

Amoxicillin at doses of 90 mg/kg/day divided BID or TID should be considered as the first line oral therapy for AOM in high risk children (those who have received antibiotics in the past 3 months and/or who are attending daycare centres).

Amoxicillin is the current antibiotic of choice for AOM<sup>34</sup> for the following reasons:

- ◆ Adequate coverage for organisms involved in AOM.
- ◆ Best activity of all oral  $\beta$ -lactam agents against penicillin intermediate *S. pneumoniae*.
- ◆ Excellent middle ear concentrations.
- ◆ Relatively few adverse effects.
- ◆ Lower potential to induce resistance.
- ◆ No other antibiotic agent has been proven superior to amoxicillin in clinical trials.

The choice of an agent remains uncertain in cases where amoxicillin treatment fails. There are many reasons why diagnosis, poor compliance, inadequate antibiotic dosage or frequency, persistence of pus in an undrained middle ear, viral infection or presence of resistant bacteria. If the patient fails standard dose amoxicillin therapy, potential pathogens include viruses,  $\beta$ -lactamase producing organisms (*Haemophilus*, *Moraxella*) or penicillin resistant *S. pneumoniae*. In these cases it is recommended to use high dose amoxicillin-clavulanate (90mg/kg/day divided BID using the 7:1 formulation) to provide coverage for these bacterial pathogens (see Table 2).<sup>31,35</sup> If the child is not responding or is deteriorating on the recommended regimens, consultation with a specialist and consideration of tympanocentesis for culture and susceptibility is recommended to rule out high level resistant *S. pneumoniae*.

In penicillin allergic patients, trimethoprim/sulfamethoxazole (TMP/SMX) and erythromycin-sulfisoxazole have been recommended as alternatives to amoxicillin. However, because of increased resistance, these agents are no longer recommended<sup>36,37</sup> The newer macrolides can be used (NB: erythromycin is not adequate for the management of AOM as it has poor activity against *Haemophilus spp* and *Moraxella catarrhalis*), or a second-generation cephalosporin (cefuroxime axetil, cefprozil) can be used in those patients who are not allergic to cephalosporins nor anaphylactic to penicillins. Resistance to macrolides continues to increase and the routine use of these agents in AOM in patients who are not  $\beta$ -lactam allergic is not recommended.<sup>9,36</sup>

The standard duration of antibiotic therapy for AOM has been 10 days. A number of well designed, randomized studies have compared shorter courses of antibiotic therapy (3 to 7 days) with traditional 10 day courses. Based on these studies,<sup>29</sup> reduced duration of therapy from 10 days to 5 days appears to have equivalent efficacy for uncomplicated AOM. Reduced duration of therapy has several advantages including reduced potential to promote antibacterial resistance, reduced adverse effects, increased compliance, and reduced cost. Longer courses of antibiotics have been associated with resistant *S. pneumoniae*.<sup>38</sup> The results favouring 10-day therapy have been most significant in children less than 2 years old. Thus children less than 2 years of age or those who present with perforation of the tympanic membrane should receive 10 days of antibiotic therapy.<sup>39</sup>

Steroids are not recommended for the treatment of otitis media with effusion because of limited scientific evidence that this treatment is effective. Tonsillectomy has not been found to be effective in the management of otitis media with effusion. Adenoidectomy, however, may be useful in chronic/recurrent otitis media.

Treatment of AOM with antihistamines or decongestants is not recommended. A Cochrane review of 2569 cases found that there was no benefit in outcome in patients taking antihistamines or decongestants alone and that there was an increase in adverse effects associated with these drugs.<sup>40</sup>

### Follow-up

Normally the symptoms of AOM should resolve within 72 hours of initiating antibiotic treatment. However, middle ear effusion may persist for up to 1 month in 50% of patients and up to 3 months in 10% of patients despite bacteriological cure. **Therefore, persistence of middle ear fluid after a full course of antibiotic therapy for AOM is not an indication for continued therapy or institution of treatment with a second line antibiotic.**<sup>18</sup>

### Recurrence

Recurrent otitis media is defined as 3 or more episodes of acute otitis media over the preceding 6 months, or four or more episodes in the last year. Under these circumstances, prevention of further attacks is desirable. Modification of risk factors, when possible, may be of benefit.

Elimination of smoking from the environment and avoidance of pacifiers have been shown to help reduce recurrence of otitis media.<sup>5</sup> As the child grows older, the incidence of recurrence declines. If recurrences persist, consultation with a specialist is recommended.

### Antibiotic Prophylaxis

Antibiotic prophylaxis has only minimal effects on recurrent otitis media, decreasing recurrences by approximately one episode per year.<sup>40</sup> Given the high risk of developing antibiotic resistance associated with prolonged use of antibiotics, antibiotic prophylaxis is no longer recommended in the management of recurrent otitis media.

### Referral

Referral to ENT for consideration of myringotomy and tympanostomy tubes is recommended if:

- OME for  $\geq 3$  months with bilateral hearing loss  $\geq 20$  dB.
- $\geq 3$  episodes in 6 months
- $\geq 4$  episodes in 12 months
- Retracted tympanic membrane (need to rule out significant pathology such as cholesteatoma)<sup>40</sup>.
- Cleft palate or craniofacial malformations

### FUTURE DIRECTIONS

Vaccines have been highly successful in preventing many childhood diseases but until now have not been helpful in preventing AOM. The currently licensed 23 valent polysaccharide pneumococcal vaccine is not immunogenic in young children. A new conjugated pneumococcal vaccine is now available and may have a role in the prevention of AOM in the future.

### Primary References

1. Teele D, Klein J, Rosner B, et al. Epidemiology of otitis media during the first seven years of life in children of greater Boston: A prospective cohort study. *Journal of Infectious Diseases*, 1989; 160: 83-94.
2. Ross A, Croft P, Collins M. Incidence of acute otitis media in infants in a general practice. *Journal of the Royal College of General Practitioners*, 1988; 38(307): 70-72.
3. Pelton S. New concepts in the pathophysiology and management of middle ear disease in childhood. *Drugs*, 1996; 52 (Suppl 2): 62-67.



4. Adair-Bischoff C, Sauve R. Environmental tobacco smoke and middle ear disease in pre-school age children. *Archives of Pediatrics and Adolescent Medicine*, February 1998; 152(2): 127-133.
5. SIGN (2003) Diagnosis and management of childhood otitis media in primary care. Report No. 66. Scottish Intercollegiate Guidelines Network. [www.sign.ac.uk](http://www.sign.ac.uk)
6. Klein J. Otitis media. *Clinical Infectious Diseases*, 1994; 19: 823-833.
7. Klein J, Teele D, Pelton S. New concepts in otitis media: results of investigations of the greater Boston otitis media study group. *Advanced Pediatrics*, 1992; 39: 127-156.
8. Curns A, Holman R, Shay D, et al. Outpatient and hospital visits associated with otitis media among American Indian and Alaska Native children younger than 5 years. *Pediatrics*. 2002; 109(3). [www.pediatrics.org/cgi/content/full/109/3/e41](http://www.pediatrics.org/cgi/content/full/109/3/e41)
9. Dagan R, et al. Bacteriologic and clinical efficacy of amoxicillin-clavulanate vs azithromycin in acute otitis media. *Pediatric Infectious Disease Journal*, 2000; 19: 95-104.
10. Hoberman A, Dagan R, Leibovitz E, et al. Large dosage amoxicillin/clavulanate, compared with azithromycin, for the treatment of bacterial acute otitis media in children. *Pediatric Infectious Disease Journal*, 2005;24(6):525-532.
11. Bluestone C. Update on middle ear infections. *Infect Disease Clin Pract*, 1995; 4(suppl): S206-215.
12. Giebink G. The microbiology of otitis media. *Pediatric Infectious Disease Journal*, 1989; 8:S18-S20.
13. Stephenson J, Martin D, Kardatzke D, et al. Prevalence of bacteria in middle ear effusions for the 1980s. Reprinted Bluestone C, Stephenson J, Martin L. Ten year review of otitis media pathogens. *Pediatric Infectious Disease Journal*, 1992; 11: S7-S11.
14. Doern GV, Brueggemann A, Holley HP, et al. Antimicrobial resistance of *Streptococcus pneumoniae* recovered from outpatients in the United States during the winter months of 1994 to 1995: results of a 30-center national surveillance study. *Antimicrobial Agents Chemotherapy* 1996;40:1208-13.
15. Blondel-Hill E, Fryters S. *Bugs and Drugs 2006*. Capital Health, Edmonton AB.
16. Simor AE, Louie M, The Canadian Bacterial Surveillance Network, and Low DE. Canadian national survey of prevalence of antimicrobial resistance among clinical isolates of *Streptococcus pneumoniae*. *Antimicrobial Agents Chemotherapy* 1996;40:2190-3.
17. Mainous A, Hueston WJ, Clark JR. Antibiotics and upper respiratory infection: do some folks think there is a cure for the common cold. *Journal of Family Practice*. 1992; 42(4): 357-61.
18. American Academy of Pediatrics, American Academy of Family physicians. *Diagnosis and Management of Acute Otitis Media*. *Pediatrics* 2004;113(5):1451-65.
19. Hiekkinen T, Ruuskamen O. Signs and symptoms predicting acute otitis media [see comments]. *Archives of Pediatric and Adolescent Medicine*, 1995; 149: 26-29.
20. Marchant CD, McMillan PM, Shurin PA, et al. Objective diagnosis of otitis media in early infancy by tympanometry and ipsilateral acoustic reflex thresholds. *Journal of Pediatrics*, 1986; 109: 590-595.
21. Uhari M, Niemela M, Hietala J. Prediction of acute otitis media with symptoms and signs. *Acta Paediatrica*, 1995; 84: 90-92.
22. Roark R, Berman S. Continuous twice daily or once daily amoxicillin prophylaxis compared with placebo for children with recurrent acute otitis media. *Pediatric Infectious Disease Journal*, 1997 April; 16(4): 376-81.
23. Brookhauser PE. Use of tympanometry in office practice for diagnosis of otitis media. *Pediatric Infectious Disease Journal*, 1998; 17: 5-51.
24. Teele DW, Klein JO, Chase C, et al. Otitis media in infancy and intellectual ability, school achievement, speech, and language at age 7 years. Greater Boston Otitis Media Study Group. *Journal of Infectious Diseases*. 1990 Sep; 162(3): 685-94.
25. Paradise JL. Short-course antimicrobial treatment for acute otitis media: not best for infants and young children. *JAMA*, 1997 Nov; 278(20): 1640-2.
26. van Buchem FL, Dunk JH, van't Hof MA. Therapy of acute otitis media: myringotomy, antibiotics, or neither? A double-blind study in children. *Lancet*, 1981 Oct; 2(8252): 883-7.
27. Browning GG. Childhood otalgia: acute otitis media. Antibiotics not necessary in most cases *BMJ*, 1990 Apr; 300(6730) :1005-6.
28. Froom J, Culpepper L, Jacobs M, et al. Antimicrobials for acute otitis media? A review from the International Primary Care Network. *BMJ*, 1997 Jul; 315(7100): 98-102.
29. Klein JO. Microbiologic efficacy of antibacterial drugs for acute otitis media. *Pediatric Infectious Disease Journal* 1993;12:973-5.
30. Steele R. Management of otitis media. *Infections in Medicine*, 1998; 15(3): 174-178, 203
31. Little P, Gould C, Williamson I, et al. Pragmatic randomized controlled trial of two prescribing strategies for childhood acute otitis media. *BMJ*, 2001; 322: 336-342.
32. [www.prodigy.nhs.uk/guidance.asp?gt=Otitis%20media%20-%20acute](http://www.prodigy.nhs.uk/guidance.asp?gt=Otitis%20media%20-%20acute)
33. Kozyrskyj AL, Hildes-Ripstein GE, Longstaffe SE, et al. Treatment of acute otitis media with a shortened course of antibiotics: a meta-analysis. *JAMA*, 1998 Jun; 279(21): 1736-42.
34. Lister P, Pong A, Chartrand S, Sanders C. Rationale behind high dose amoxicillin therapy for acute otitis media due to penicillin non-susceptible pneumococci: support from in-vitro pharmaco-dynamics. *Antimicrobial Agents and Chemotherapy*, 1997 Sept; 41(9): 1926-1932.

35. Hedrick JA, Sher LD, Schwartz RH, et al. Cefprozil versus high-dose amoxicillin-clavulante in children with acute otitis media. *Clinical Therapeutics*, 2001;23(2):193-204.
37. Leiberman A, Leibovitz E, Piglansky L, et al. Bacteriologic and clinical efficacy of trimethoprim-sulfamethoxazole for treatment of acute otitis media. *Pediatr Infect Dis J*, 2001; 20(3): 260-264.
38. Dowell S, Butler J, Giebink S, et al. Acute otitis media: management and surveillance in an era of pneumococcal resistance – a report from the Drug-resistant *Streptococcus pneumoniae* Therapeutic Working Group. *Pediatr Infect Dis J*. 1999; 18: 1-9.
39. Flynn C, Griffin G, Tudiver F. Decongestants and antihistamines for acute otitis media in children. *Cochrane Review*, 2003. The Cochrane Library (Issue 2). Oxford: Update Software
40. Casselbrant ML, Kaleida PH, Rockette HE, et al. Efficacy of antimicrobial prophylaxis and of tympanostomy tube insertion for prevention of recurrent acute otitis media: results of a randomized clinical trial. *Pediatric Infectious Disease Journal* 1992;11:278-86.
10. Glasziou PP, Del Mar CB, Sanders SL, et al. Antibiotics for acute otitis media in children (Cochrane Review). In: *The Cochrane Library*, Issue 3, 2004. Chichester, UK: John Wiley & Sons, Ltd.
11. Little P, Gould C, Moore M, et al. Predictors of poor outcome and benefits from antibiotics in children with acute otitis media; Pragmatic randomized trial. *BMJ*, 2002;325:22-5.
12. Le Saux N, Gaboury I, Baird M, et al. A randomized, double-blind, placebo-controlled noninferiority trial of amoxicillin for clinically diagnosed acute otitis media in children 6 months to 5 years of age. *CMAJ* 2005;172:335-41.

## SELECTED READINGS

1. Boucher FD. The new macrolide antibiotics: use them carefully. *Paediatric Child Health* 1997; 2: 385-6.
2. Craig WA, Andes D. Pharmacokinetics and pharmacodynamics of antibiotics in otitis media. *Pediatric Infectious Disease Journal* 1996;15:944-8.
3. Dowell SF, Butler JC, Giebink GS, et al. Acute otitis media: management and surveillance in an era of pneumococcal resistance – a report from the Drug-resistant *Streptococcus pneumoniae* Therapeutic Working Group. *Pediatric Infectious Disease Journal* 1999;18:1-9.
4. Dowell SF, Marcy MS, Phillips WR, et al. Otitis media - principles of judicious use of antimicrobial agents. *Pediatrics* 1998;101(suppl): 165-71.
5. Harrison CJ. Using antibiotic concentrations in middle ear fluid to predict potential clinical efficacy. *Pediatric Infectious Disease Journal* 1997;16:S12-6.
6. Schloss MD. Otitis media: to treat or not to treat? *Canadian Respiratory Journal* 1999;6(suppl A): 51-3A.
7. Uhari M, Mantysaari K, Niemela M. A meta-analytic review of the risk factors for acute otitis media. *Clinical Infectious Diseases* 1996; 22: 1079-83.
8. Le Saux N, Cabourney I, Baird M, et al. A randomized, double-blind, placebo controlled, noninferiority trial of amoxicillin for clinically diagnosed acute otitis media in children 6 months to 5 years of age. *CMAJ*, 2005; 172(3): 335-341.
9. Dagan R, Abramson O, Leibovitz E, et al.. Impaired bacteriologic response to oral cephalosporins in acute otitis media caused by pneumococci with intermediate resistance to penicillin. *Pediatric Infectious Disease Journal*, 1996;15(9):980-985.

## Toward Optimized Practice (TOP) Program

Arising out of the 2003 Master Agreement, TOP succeeds the former Alberta Clinical Practice Guidelines program, and maintains and distributes Alberta CPGs. TOP is a health quality improvement initiative that fits within the broader health system focus on quality and complements other strategies such as Primary Care Initiative and the Physician Office System Program.

The TOP program supports physician practices, and the teams they work with, by fostering the use of evidence-based best practices and quality initiatives in medical care in Alberta. The program offers a variety of tools and out-reach services to help physicians and their colleagues meet the challenge of keeping practices current in an environment of continually emerging evidence.

### TO Provide Feedback

The Alberta CPG Working Group for Antibiotics is a multi-disciplinary team composed of family physicians, infectious diseases specialists, internal medicine specialists, pediatricians, microbiologist, hospital and community pharmacists, epidemiologists, public health professionals, consumers, and an Alberta Health and Wellness representative. The team encourages your feedback. If you have difficulty applying this guideline, if you find the recommendations problematic, or if you need more information on this guideline, please contact:

Clinical Practice Guidelines Manager  
 TOP Program  
 12230 - 106 Avenue NW  
 Edmonton AB T5N 3Z1  
 Phone: 780.482.0319  
 or toll free 1.866.505.3302  
 Fax: 780.482.5445  
 Email: [cpg@topalbertadoctors.org](mailto:cpg@topalbertadoctors.org)  
 Website: [www.topalbertadoctors.org](http://www.topalbertadoctors.org)

*Acute Otitis Media - July 1999  
 Revised – January 2008*