Acute otitis media (AOM), also called suppurative otitis media, is one of the most frequent diagnoses for children seeking acute medical care.
TERMINOLOGY

- Acute otitis media (AOM)
- Middle ear effusion (MEE)
- Otitis media with effusion (OME)
Acute otitis media (AOM): acute bacterial infection of middle ear fluid.

Middle ear effusion (MEE): fluid in the middle ear cavity. MEE occurs in both otitis media with effusion (OME) and AOM.

Otitis media with effusion (OME): middle ear fluid that is not infected.

OME is also called serous, secretory, or nonsuppurative otitis media.

OME frequently precedes the development of AOM or follows its resolution.

The distinction between OME and AOM may be difficult, since they are part of a continuous spectrum.
Anatomy of Tympanic Membrane

- The normal middle ear is aerated, and the tympanic membrane is slightly convex, translucent, mobile, and intact
Normal left tympanic membrane with pearly gray color.
In AOM: the middle ear is fluid-filled, and the tympanic membrane is usually bulging, erythematous, cloudy, and immobile.

Increased pressure in the middle ear may lead to central ischemia, necrosis, and perforation of the tympanic membrane.
Examples of the white, bulging tympanic membrane seen in acute otitis media. The "B" panel also demonstrates marked erythema along the handle of the malleus and an air-fluid level in the anterosuperior part of the tympanic membrane.
Accurate diagnosis of AOM requires systematic evaluation of the tympanic membrane for position, translucency, mobility, color, and other findings (eg, fluid level, perforation).

Systematic assessment of the tympanic membrane is facilitated by the use of the COMPLETES mnemonic:
- Color (eg, gray, white, pale yellow, amber, pink, red, blue)
- Other conditions (eg, fluid level, bubbles, perforation, otorrhea, bullae, tympanosclerosis (scars), atrophic areas, retraction pockets, cholesteatoma)
- Mobility
- Position (eg, neutral, retracted, full, or bulging)
- Lighting (a halogen light source and fully charged battery should be used)
- Entire surface (the four quadrants of the tympanic membrane should be examined)
- Translucency
- External auditory canal and auricle (eg, deformed, displaced, inflamed, foreign body)
- Seal (a good seal requires an airtight pneumatic system and a speculum that is large enough to prevent air leak)
DIAGNOSIS

- The **clinical diagnosis of AOM requires**: 

  **MEE**
  
  and
  
  acute history, signs and symptoms of middle ear inflammation

- A diagnosis of AOM also can be established if there is acute purulent otorrhea and otitis externa has been excluded.
MEE

- MEE can be confirmed by one or both of the following findings on otoscopy:
  - Bubbles or an air-fluid level
  - Two or more of the following:
    - Abnormal color (white, yellow, amber, or blue)
    - Opacity (involving part or all of the tympanic membrane) not due to scarring
    - Impairment of mobility

- MEE is necessary but not sufficient for a diagnosis of AOM; there also must be evidence of acute inflammation.

- If a child has MEE but no evidence of acute inflammation, he or she has OME.
Acute Inflammation

- Signs of acute inflammation are necessary to differentiate AOM from OME.

- Otoscopic signs:
  - *Distinct fullness or bulging* of the tympanic membrane: the best and most reproducible sign
  - Marked redness

- Non-otoscopic symptoms:
Non-otoscopic symptoms:

- Ear pain (Otalgia)
- Unaccustomed tugging or rubbing of the ear
- Otorrhea or ear discharge or swelling about the ear (which may indicate disease of the mastoid) are specific physical findings, if present.
- Nonspecific symptoms and signs include fever, irritability, headache, apathy, anorexia, vomiting, and diarrhea.
- Young children, especially infants, are more likely to present with nonspecific than specific symptoms.
Non-otoscopic symptoms must be accompanied by abnormal otoscopic findings as described above to make a diagnosis of AOM.

As an example, a child who complains of ear pain may be diagnosed with AOM if he or she also has a white or yellow tympanic membrane with marked decrease in mobility.
DIAGNOSIS...

- The diagnosis of AOM requires evidence of an acute history, signs and symptoms of middle ear inflammation (distinct erythema of the tympanic membrane or otalgia), AND

- the presence of middle ear effusion (eg, tympanic membrane bulging, decreased or absent tympanic membrane mobility, presence of an air-fluid level, or otorrhea)
DIFFERENTIAL DIAGNOSIS

- The main consideration in the differential diagnosis of AOM is OME.

- **Otitis media with effusion** — MEE, with decreased mobility and opacification or cloudiness of the tympanic membrane, occurs in both AOM and OME.

- However, careful evaluation of the position, color, and other findings of the tympanic membrane can help to distinguish AOM from OME.

- In AOM, the tympanic membrane is usually bulging; in OME, it is usually retracted or in the neutral position.

- In AOM, the tympanic membrane is typically red, white, or pale yellow; in OME, it is typically amber or blue.

- ,.....
When there is a negative pressure in the middle ear cavity, the position of the tympanic membrane will be retracted.
An air-fluid level is appreciated when the tympanic membrane appears translucent above and opaque below a line demarcating the separation.
Acute otitis media in children: Epidemiology, pathogenesis, clinical manifestations, and complications
Incidence

- Although AOM occurs at all ages, is most prevalent in infancy.

- Between 60 and 80 percent of infants have at least 1 episode of AOM by one year of age, and 80 to 90 percent by 2-3 years.

- The highest incidence of AOM occurs between 6 and 24 months of age.

- The incidence declines with age except for a limited reversal of the downward trend between five and six years of age, the time of school entry.

- AOM is infrequent in school-age children, adolescents, and adults, but the bacteriology and therapy are similar to those in infants and children.
Risk Factors

- young age,
- day care attendance,
- not having been breast fed *(Breast feeding for at least three months)*
- exposure to tobacco smoke,
- pacifier use,
- ethnicity (Native Americans and Alaskan and Canadian Eskimos)
- family history
- Others: season, underlying diseases (allergic rhinitis)
Risk Factors...

- **Age**

  The occurrence of disease early in life is probably a result of a number of factors, including *immature anatomy, physiology, and immunologic responses.*

- Some of these factors are identifiable (eg, the change in skull configuration and vectors of the eustachian tube, development of antibodies following exposure to bacterial pathogens)
PATHOGENESIS

- The patient has an antecedent event (usually an upper respiratory tract viral infection or allergy).

- The event results in congestion of the respiratory mucosa of the nose, nasopharynx and eustachian tube.

- Congestion of the mucosa in the eustachian tube obstructs the narrowest portion of the tube, the isthmus.

- Obstruction of the isthmus causes negative pressure followed by accumulation of secretions produced by the mucosa of the middle ear.

- Viruses and bacteria that colonize the upper respiratory tract can reach the middle ear via aspiration, reflux, or insufflation.

- Microbial growth in the middle ear secretions may result in suppuration with clinical signs of AOM.
Anatomy of the ear

This diagram illustrates the relationship of the middle ear to the external auditory canal and inner ear. Reproduced with permission from Bluestone, CD, Klein, JO. Otitis Media in Infants and Children. WB Saunders, Philadelphia, 2001.
Complications

I. Fluid may persist for weeks to months after the onset of signs of AOM despite treatment with appropriate antimicrobial agents.

- Whenever fluid fills the middle ear space, there is some loss of hearing that may lead to problems of development of speech, language, and cognitive abilities in the child.

II. Extension of the suppurative process to adjacent structures may lead to complications such as mastoiditis, labyrinthitis, meningitis, and lateral sinus thrombosis, cavernous sinus thrombosis, subdural empyema, and carotid artery thrombosis.
Complications

III. Tympanic membrane perforation:

- because the pressure of the middle ear abscess on the membrane leads to central ischemia, necrosis, and perforation.

- AOM caused by group A streptococci (GAS) is associated with higher rates of tympanic membrane perforation than AOM caused by other pathogens.
Persistently or fluctuating hearing loss is present in most patients with middle ear effusion.

The median loss is 25 dB, which is equivalent to putting plugs in the patient's ears.

Some studies have noted that children with prolonged time spent with middle ear effusion have lower scores on tests of speech, language, and cognitive abilities.

In addition to hearing impairment, patients with otitis media may suffer vestibular, balance, and motor dysfunctions.
Complications...

- **Children in developing areas** — Lack of access to medical care and local environmental factors lead to severe suppurative episodes of otitis media in children living in developing areas.

- The prevalence of perforated eardrums in children aged 4 to 12 months living in an aboriginal settlement in Australia was 25 percent.
Bacteria

- Three species of bacteria account for most of the bacterial isolates from middle ear fluid:
  - Streptococcus pneumoniae
  - Haemophilus influenzae
  - Moraxella catarrhalis

- The most common viral pathogens include *respiratory syncytial virus*, *rhinoviruses*, *influenza viruses*, and *adenoviruses*. 
Bacteria...

- Although the specificity of ear-related findings in the diagnosis of otitis media is poor, some clinical features do correlate with a particular organism.
Fever $\geq 38^\circ$C and earache were reported more frequently in patients with pneumococcus (44 percent with pneumococcus compared with 25 percent with H. influenzae and 26 percent with Moraxella).

Eye symptoms, primarily conjunctivitis, were identified more often in patients with H. influenzae (54 percent with H. influenzae compared with 15 percent with pneumococcus and 18 percent with Moraxella).

There was no difference in otologic findings among the three pathogens.
Acute otitis media in children: Treatment
Clinical Course

- The systemic and local signs and symptoms of AOM usually resolve in 24 to 72 hours with appropriate antimicrobial therapy, and somewhat more slowly in children who are not treated.

- However, persistence of middle ear effusion (MEE) after the resolution of acute symptoms is common.
Percent of children with otitis media with effusion (OME) persisting for up to 12 weeks after an episode of acute otitis media.

Clinical Course...

- MEE is associated with conductive hearing loss.

- Prolonged presence of middle ear fluid may lead to the mistaken diagnosis of AOM in patients with a subsequent illness resulting from other causes.
Pain remedies

Guidelines issued in 2004 by the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP) state that the management of AOM should include an assessment of pain and treatment if pain is present.

- **Ibuprofen** (10 mg/kg three times per day)
- **Acetaminophen** (10 mg/kg three times per day)
Decongestants and Antihistamines

- An oral decongestant, such as pseudoephedrine, may relieve nasal congestion, and antihistamines may help patients with known or suspected nasal allergy.

- However, the efficacy of antihistamines and decongestants in treating AOM has not been proven.
Decongestants and Antihistamines…

- In addition, treatment with antihistamines may prolong the duration of middle ear effusion.

- The American Academy of Pediatrics (AAP) recommends that over-the-counter cough and cold medications should not be given to infants and children younger than two years of age, due to the risk of life-threatening side effects.
Antibiotic Therapy

- Antibiotic Therapy VERSUS Observation
- The AAP/AAFP 2004 guideline suggests that observation without use of antibacterial therapy is an option for selected children with uncomplicated AOM based upon diagnostic certainty, age, illness severity, and assurance of follow-up
AAP/AAFP recommendations for observation versus antibiotics in the management of acute otitis media

<table>
<thead>
<tr>
<th>Age</th>
<th>Certain diagnosis*</th>
<th>Uncertain diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6 months</td>
<td>Antibacterial therapy</td>
<td>Antibacterial therapy</td>
</tr>
<tr>
<td>6 months to 2 years</td>
<td>Antibacterial therapy</td>
<td>Antibacterial therapy if severe illness*; observation optionΔ if non-severe illness</td>
</tr>
<tr>
<td>≥2 years</td>
<td>Antibacterial therapy if severe illness*; observation optionΔ if non-severe illness</td>
<td>Observation optionΔ</td>
</tr>
</tbody>
</table>

* A certain diagnosis meets all three criteria: rapid onset, signs and symptoms of middle ear inflammation, AND signs of middle ear effusion.
  • Severe illness is considered moderate to severe otalgia or fever ≥39°C; non-severe illness is considered mild otalgia and fever <39°C in the past 24 hours.
  Δ Observation is only appropriate when follow-up can be ensured and antibacterial agents started promptly if symptoms persist or worsen.

Adapted from the American Academy of Pediatrics American Academy of Family Physicians Clinical Practice Guideline on the Diagnosis and Management of Acute Otitis Media 2004. Available online at pediatrics.aappublications.org/cgi/content/full/113/5/1451.
AAP/AAFP guideline

- Antibacterial therapy should be administered to any child younger than the age of six months, regardless of the degree of diagnostic certainty.

- For children ages six months to two years, antibacterial therapy is recommended when the diagnosis of AOM is certain or if the diagnosis is uncertain but illness is severe (moderate to severe otalgia or fever ≥39°C in the previous 24 hours). Observation is an option for children in whom the diagnosis is not certain and illness is not severe.

- For children older than two years, antibacterial therapy is recommended if the diagnosis is certain and illness is severe. Observation is an option when the diagnosis is certain but illness is not severe, and in patients with an uncertain diagnosis.
The AAP/AAFP 2004 guidelines underline the difference in approach to therapy of the child younger or older than two years of age.

The older child has fewer episodes of middle ear infection and less severe disease than the infant age group.

The differences in disease incidence and severity due to age likely occur because of changes in the anatomy and physiology of the middle ear system and the increase in immune protection against middle ear pathogens.
Children older than two years who have bilateral disease or otorrhea are best managed with antimicrobial therapy.

For those who are normal hosts and who have mild symptoms and signs of unilateral AOM, the watchful waiting option with appropriate follow-up may be appropriate.
ANTIMICROBIAL THERAPY

- Clinical and microbiologic efficacy
- Acceptability (taste, texture) of the oral preparation
- Absence of side effects and toxicity
- Convenience of the dosing schedule
- Cost

Seventeen antimicrobial drugs (16 oral and one parenteral preparation) have been approved by the US Food and Drug Administration (FDA) for the treatment of AOM.

In addition, two otic preparations (eg, ofloxacin otic and ciprofloxacin-dexamethasone otic) also are available for treatment of AOM with otorrhea in children with tympanostomy tubes in place or tympanic membrane perforation.
### Antimicrobial agents approved for treatment of acute otitis media: United States 2000

<table>
<thead>
<tr>
<th>Most used drugs</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>Cephalexin</td>
</tr>
<tr>
<td>Amoxicillin-clavulanate*</td>
<td>Cefaclor</td>
</tr>
<tr>
<td>Cefuroxime axetil*</td>
<td>Loracarbef</td>
</tr>
<tr>
<td>Ceftriaxone IM*</td>
<td>Cefixime</td>
</tr>
<tr>
<td>Erythromycin + sulfisoxazole•</td>
<td>Ceftibuten</td>
</tr>
<tr>
<td>Azithromycin•</td>
<td>Cefprozil</td>
</tr>
<tr>
<td>Clarithromycin•</td>
<td>Cefpodoxime</td>
</tr>
<tr>
<td>Trimethoprim-sulfamethoxazole◊</td>
<td>Cefdinir</td>
</tr>
<tr>
<td>Ofloxacin otic*</td>
<td>Trimethoprim</td>
</tr>
</tbody>
</table>

* Usually used when amoxicillin fails.
• Choices for penicillin-allergic patients.
Δ Should be avoided if penicillin-resistant pneumococcus prevalent in the area.
◊ With tympanostomy tubes.

ANTIMICROBIAL THERAPY...

- First-line therapy
- A 2001 meta-analysis concluded there is no evidence to support any particular antibiotic regimen versus another for treatment of AOM.

- Nevertheless, **amoxicillin** remains the drug of choice because it is effective, safe, relatively inexpensive, and has a narrow microbiologic spectrum.
### Interpretive Breakpoints for *Streptococcus pneumoniae* for Selected Antibiotics

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Susceptible</th>
<th>Intermediate</th>
<th>Resistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin G (parenteral)</td>
<td>≤0.06 mcg/mL</td>
<td>--</td>
<td>≥0.12 mcg/mL</td>
</tr>
<tr>
<td>Meningitis</td>
<td>≤0.06 mcg/mL</td>
<td>--</td>
<td>≥0.12 mcg/mL</td>
</tr>
<tr>
<td>Non-meningitis*</td>
<td>≤2 mcg/mL</td>
<td>4 mcg/mL</td>
<td>≥8 mcg/mL</td>
</tr>
<tr>
<td>Penicillin V (oral)*</td>
<td>≤0.06 mcg/mL</td>
<td>0.12 to 1 mcg/mL</td>
<td>≥2 mcg/mL</td>
</tr>
<tr>
<td>Amoxicillin (non-meningitis)</td>
<td>≤2 mcg/mL</td>
<td>4 mcg/mL</td>
<td>≥8 mcg/mL</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parenteral</td>
<td>≤0.5 mcg/mL</td>
<td>1 mcg/mL</td>
<td>≥2 mcg/mL</td>
</tr>
<tr>
<td>Oral</td>
<td>≤1 mcg/mL</td>
<td>2 mcg/mL</td>
<td>≥4 mcg/mL</td>
</tr>
<tr>
<td>Cefotaxime, Ceftriaxone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td>≤0.5 mcg/mL</td>
<td>1 mcg/mL</td>
<td>≥2 mcg/mL</td>
</tr>
<tr>
<td>Non-meningitis</td>
<td>≤1 mcg/mL</td>
<td>2 mcg/mL</td>
<td>≥4 mcg/mL</td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>≤0.5 mcg/mL</td>
<td>1 mcg/mL</td>
<td>≥2 mcg/mL</td>
</tr>
<tr>
<td>Cefdinir</td>
<td>≤0.5 mcg/mL</td>
<td>1 mcg/mL</td>
<td>≥2 mcg/mL</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>≤0.25 mcg/mL</td>
<td>0.5 mcg/mL</td>
<td>≥1 mcg/mL</td>
</tr>
<tr>
<td>Rifampin</td>
<td>≤1 mcg/mL</td>
<td>2 mcg/mL</td>
<td>≥4 mcg/mL</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>≤0.5 mcg/mL</td>
<td>1 mcg/mL</td>
<td>≥2 mcg/mL</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>≤0.25 mcg/mL</td>
<td>0.5 mcg/mL</td>
<td>≥2 mcg/mL</td>
</tr>
<tr>
<td>Gemifloxacin</td>
<td>≤0.12 mcg/mL</td>
<td>0.25 mcg/mL</td>
<td>≥0.5 mcg/mL</td>
</tr>
<tr>
<td>Levofoxacin</td>
<td>≤2 mcg/mL</td>
<td>4 mcg/mL</td>
<td>≥8 mcg/mL</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>≤1 mcg/mL</td>
<td>2 mcg/mL</td>
<td>≥4 mcg/mL</td>
</tr>
</tbody>
</table>

* For non-meningitis isolates, the penicillin MIC can predict susceptibility to other beta-lactams as follows:
Penicillin MICs ≤0.06 mcg/mL indicate susceptibility to amoxicillin (oral or parenteral), ampicillin-sulbactam, cefaclor, cefdinir, cefditoren, cefpodoxime, cefprozil, ceftriaxone, cefuroxime, imipenem, loracarbef, and meropenem.
Penicillin MICs ≤2 mcg/mL indicate susceptibility to amoxicillin, amoxicillin-davulananate, cefepime, cefotaxime, ceftriaxone, and ortipenem.

The AAP/AAFP guideline recommends a dose of amoxicillin of 80 to 90 mg/kg per day.

For heavier children, we suggest a maximum dose of 3 g/day, although diarrhea is a potential adverse effect at higher doses.
Doubling the dose from 40 to 80 mg/kg per day provide activity against most intermediate strains of S. pneumoniae, including many of the resistant strains.

Only S. pneumoniae that are highly resistant to penicillin will not respond to this regimen.

As a result, more than 80 percent of children with pneumococcal AOM would respond to high-dose amoxicillin treatment.
Despite the increasing importance of H. influenzae, including beta-lactamase-producing strains, high-dose amoxicillin remains the preferred choice for initial therapy.
ANTIMICROBIAL THERAPY...

- **Amoxicillin** should not be used as first-line therapy in children who are at high risk for AOM caused by an amoxicillin-resistant otopathogen:

  1. Children who were treated with antibiotics in the previous 30 days, particularly beta-lactam antibiotics.

  2. Children with concurrent purulent conjunctivitis (otitis-conjunctivitis syndrome usually is caused by nontypeable H. influenzae, which is frequently resistant to beta-lactam antibiotics)

  3. Children receiving **amoxicillin** for chemoprophylaxis of recurrent AOM (or urinary tract infection)
ANTIMICROBIAL THERAPY…

- Children in the above categories should start therapy with an agent with activity against beta-lactamase-producing nontypeable H. influenzae, as well as S. pneumoniae, such as amoxicillin-clavulanate.
ANTIMICROBIAL THERAPY...

- **Penicillin allergy** — Acceptable alternatives to penicillin in patients with allergy to penicillin depend upon the type of the previous hypersensitivity reaction

  - Non-type 1 reactions — In patients who report penicillin allergy but who did not experience a type 1 hypersensitivity reaction (urticaria or anaphylaxis), we suggest one of the following:
    - **Cefdinir** (14 mg/kg per day in 1 or 2 doses; maximum dose 600 mg/day)
    - **Cefpodoxime** (10 mg/kg per day once daily; maximum dose 800 mg/day)
    - **Cefuroxime** *(cefuroxime* axetil suspension: 30 mg/kg per day in two divided doses, maximum dose 1 g/day; *cefuroxime* tablets: 250 mg every 12 hours)

However, these oral agents do not achieve sufficient concentration in the middle ear to eradicate penicillin-resistant *S. pneumoniae*. 
ANTIMICROBIAL THERAPY...

- A single intramuscular dose of ceftriaxone (50 mg/kg) provides high concentrations in the middle ear for more than 48 hours and may be considered an alternative for children with AOM and history of non-type 1 penicillin allergy.
- If clinical signs improve within 48 hours following administration of ceftriaxone, no further therapy is necessary.
- If clinical signs persist, a second dose is administered and, if necessary, a third dose.
Type 1 reactions

Macrolide antibiotics can be used for patients who have had a type 1 hypersensitivity reaction to amoxicillin or other beta-lactam antimicrobial agents.

However, macrolide resistance is common (approximately 35 percent) among isolates of S. pneumoniae (lack of activity against approximately one-third of pneumococcal isolates)

Macrolides lack of activity against most Haemophilus influenzae isolates.
Available macrolide drugs approved for AOM include:

- Erythromycin plus sulfisoxazole,
- Clarithromycin
- Azithromycin

Erythromycin plus sulfisoxazole (50 to 150 mg/kg per day of the erythromycin component divided into 4 doses; maximum dose 2g erythromycin or 6 g sulfisoxazole/day) may be the most effective of these regimens but is rejected often by patients based upon taste and frequency of dosing
ANTIMICROBIAL THERAPY...

- Five days of **azithromycin** (10 mg/kg per day [maximum dose 500 mg/day] as a single dose on day one and 5 mg/kg per day [maximum dose 250 mg/day] for days two through five) or

- **clarithromycin** (15 mg/kg per day divided into 2 doses; maximum dose 1 g/day) can be used,

- but resistant pneumococcal isolates cannot be overcome by increasing the dose of macrolides, unlike the scenario with beta-lactam drugs.
Trimethoprim-sulfamethoxazole (TMP-SMX) should be used with caution because of:

1) The presence of resistant pneumococci and may be useful only in regions where pneumococcal resistance to this combination is not a concern.

2) In addition, TMP-SMX should not be used if group A streptococcus (GAS, S. pyogenes) is suspected (eg, when there is an associated tympanic membrane perforation.
ANTIMICROBIAL THERAPY...

- Duration of therapy

- Children younger than two years be treated for 10 days
- those two years and older without a history of recurrent AOM be treated for 5-7 days.

- AAP/AAFP guideline:
- a 5-7 days course of antibiotics for children six years and older who have mild to moderate AOM.

- 2-5 years: 10 days
ANTIMICROBIAL THERAPY...

- Treatment failure
- Recurrent AOM
- Tympanic membrane perforation
- FOLLOW-UP
Treatment Failure

- Treatment failure is defined by lack of symptomatic improvement 48 to 72 hours after initiation of antimicrobial therapy.

- Patients who fail first-line therapy be treated with amoxicillin-clavulanate

- Alternatives include cefdinir, cefpodoxime, and cefuroxime.

- Children younger than two years and children older than two years who have language or learning problems require follow-up at 8 to 12 weeks to monitor the resolution of MEE. Children older than two years who do not have language or learning problems should be followed up at their next health maintenance visit, or sooner if there are concerns regarding persistent hearing loss.
Follow-Up

- Require follow-up at 8 to 12 weeks to monitor the resolution of MEE:
  - Children ≤ 2 yrs
  - Children > 2 yrs who have language or learning problems
  - Children older than two years who do not have language or learning problems should be followed up at their next health maintenance visit, or sooner if there are concerns regarding persistent hearing loss.