Acute otitis media is different than *otitis media with effusion* (fluid in the middle ear, secretory otitis media, serous otitis, “glue ear”) and *chronic otitis media* (chronic suppurative otitis media). People usually get acute otitis media with, or after, a cold. Chronic otitis media is rare in developed countries, because in about 1930 we started treating ear infections with antibiotics. Before this, chronic otitis media was common, and often led to deafness and other complications.

**Diagnosis of Acute Otitis Media**

Acute otitis media is fluid in the middle ear combined with signs or symptoms of acute local or systemic illness. The ear may hurt, or may drain fluid; or the patient may have fever. But the specifics for diagnosis are not so clear. In 26 clinical trials, there were 18 different sets of diagnostic criteria. One survey of 165 pediatricians resulted in 147 different sets of criteria! The 2013 AAP-AAFP guideline *The Diagnosis and Management of Acute Otitis Media* provides the following advice on diagnosing otitis media, trying to standardize the diagnosis:

- Clinicians should diagnose acute otitis media (AOM) in children who present with moderate to severe bulging of the tympanic membrane (TM) or new onset of otorrhea not due to acute otitis externa.
- Clinicians may diagnose AOM in children who present with mild bulging of the TM and recent (less than 48 hours) onset of ear pain (holding, tugging, rubbing of the ear in a nonverbal child) or intense erythema of the TM.
- Clinicians should not diagnose AOM in children who do not have middle ear effusion (MEE) (based on pneumatic otoscopy and/or tympanometry).

Diagnosing a middle ear effusion is fairly easy. Do pneumatic otoscopy. That’s where you use a soft ear speculum (to get a seal with the ear canal), with an insufflation bulb attached to the otoscope, and puff air into the ear. You look at the *tympanic membrane* (eardrum, TM) for position, color, translucency, and mobility. In one study, as confirmed by myringotomy (needle aspiration of the middle ear to get fluid), pneumatic otoscopy was 93% sensitive and 58% specific for effusion, which compares favorably with *tymanometry* (see below) which was 90% sensitive and 86% specific.

A 2004 clinical guideline on *otitis media with effusion* (OME) says: Distinct redness of the TM should not be a criterion for antibiotic prescribing because it has poor predictive value for acute otitis media and is present in about 5% of ears with OME. Screaming babies always have a red TM, and removing wax often makes the TM red. A retracted TM, which hurts, is from eustachian...
tube dysfunction, and not a bacterial infection.1

A recent study recommended you diagnose acute otitis media with two or more of

- decreased or absent TM mobility,
- yellow or white discoloration of the TM,
- opacification of the TM not due to scarring, and
- visible bubbles or air-fluid levels.9

Another study correlated color, position and mobility with acute otitis media (diagnosed with myringotomy).10 A cloudy TM, and a bulging TM, and a TM with decreased mobility (all three) correlated 99% with acute otitis media (see Table 1). You might want to get your own insufflation bulb (Welch-Allyn #23804), as it adds a lot to the accuracy of your diagnosis; I did. You need soft speculum sheaths to make a good seal with the external ear canal. The ED or clinic should supply these, though most don’t. I bought a box of 80 of each size of the Welch Allyn SofSeal sheaths, 24330 (med) and 24320 (small), that fit the speculums of the Welch Allyn Macroview otoscopes in every ED and clinic in which I have worked for the past 10 years. It cost $44.50/box from schoolhealth.com.

A machine that tells you if the patient has a middle ear effusion without digging the wax out of the ear of a squirming, screaming infant sounds good. Tympanometry uses such a device to assess for middle ear effusion. Since the early 1970s, tympanometers have been found in many ENT offices and pediatric offices and a few Emergency Departments. They’re easy to use, but results are a bit hard to figure out. Basic tympanometers measure how much of a 226 Hz musical tone reflects back from the TM, as the air pressure in the external canal is varied, both above and below ambient air pressure. More modern tympanometers use a pair of musical tones. The tympanometer plots a pressure-versus-compliance curve on a graph known as a tympanogram. The interpretation of tympanograms is described in the medical literature and online but is beyond the scope of this handout.11,12 Tympanometry is no better than pneumatic otoscopy for diagnosing a middle ear effusion.

Like using an insufflation bulb, tympanometry requires an airtight seal; however, spectral gradient acoustic reflectometry (SGAR), also known as acoustic reflectometry, does not. SGAR machines emit tones from 1.8 to 4.4 kHz, and measure how much is reflected. As with tympanometry, accuracy depends on how experienced you are,13 though SGAR is easier than tympanometry.9 Neither tympanometry or SGAR is better than history, physical exam, and pneumatic otoscopy to diagnose acute otitis media.14 As Combs writes: “No technology can replace the careful history and otoscopic examination by an experienced physician.”15

Physicians can’t diagnose acute otitis media by symptoms alone. But parents can. Their sensitivity is 71% and their specificity is 80%.16

**Antibiotics for acute otitis media?**

Back in the 1980s, when I was a resident, I was taught that “any child with an earache has an acute amoxicillin deficiency until proven otherwise.” In the USA, parents bringing an infant or child to you with an earache usually expect antibiotics. In Europe, though, they seldom get antibiotics.17,18 In the USA 95% of kids with acute otitis media get antibiotics; in the Netherlands, it’s only 31-56%.19-21

Having acute otitis media before you’re 6 months old means you’re more likely to get recurrent acute otitis media later in life. But family history of allergy, breast-feeding, day
care, gender, and home environment make no difference in how likely you are to get acute otitis media. Recurrent acute otitis media tends to resolve as children grow older. There is some evidence that, for children with recurrent episodes of acute otitis media, that prophylactic antibiotics, either throughout the cold season, or with onset of a viral upper respiratory infection, may help prevent acute otitis media. But the 2013 AAP-AAFP guidelines state: Clinicians should not prescribe prophylactic antibiotics to reduce the frequency of episodes of AOM in children with recurrent AOM.

I was taught to prescribe antibiotics for acute otitis media to decrease the incidence of deafness. However, permanent deafness comes primarily from chronic otitis media (2 or more weeks of otitis media with discharge) which is quite rare in North America; acute otitis media does not cause permanent deafness, but it’s common to have a bit of temporary deafness from left-over fluid in the middle ear. Worse complications, such as permanent deafness or death from brain infection, are rare outside the developing world.

If we prescribe lots of antibiotics for red tympanic membranes, do we create resistant bacteria? Yes. Do we help or hurt the patient? We may be hurting the patient. An immediate antibiotic decreases crying during the day and provides better sleep the first day. It decreases pain, but only slightly, and only on the second day of antibiotics, when symptoms are already improving. This small benefit may not outweigh complications such as diarrhea and creating resistant bacteria.

It’s now OK to give a “safety-net antibiotic prescription” and tell parents not to fill it unless the ear pain goes on for a couple of days. A lot of the time, parents don’t fill the prescription. Parents are happy and you’re creating fewer resistant bugs. Telling the parents to call back for a prescription in a couple of days has the same satisfaction rate, but seems to me as though it would work better for offices than EDs. Nobody has (yet) studied delayed antibiotics for adults.

The American Academy of Pediatrics and American Academy of Family Physicians 2013 joint clinical practice guideline says:

- The clinician should prescribe antibiotic therapy for AOM (bilateral or unilateral) in children 6 months and older with severe signs or symptoms (i.e., moderate or severe otalgia or otalgia for at least 48 hours or temperature 39°C [102.2°F] or higher).
- The clinician should prescribe antibiotic therapy for bilateral AOM in children 6 months through 23 months of age without severe signs or symptoms (i.e., mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]).
- The clinician should either prescribe antibiotic therapy or offer observation with close follow-up based on joint decision making with the parent(s)/caregiver for unilateral AOM in children 6 months to 23 months of age without severe signs or symptoms (i.e., mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]). When observation is used, a mechanism must be in place to ensure follow-up and begin antibiotic therapy if the child worsens or fails to improve within 48 to 72 hours of onset of symptoms.
- The clinician should either prescribe antibiotic therapy or offer observation with close follow-up based on joint decision-making with the parent(s)/caregiver for AOM (bilateral or unilateral) in children 24 months or older without severe signs or symptoms (i.e., mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]). When observation is used, a mechanism must be in place to ensure follow-up and begin antibiotic therapy if the child worsens or fails to improve within 48 to 72 hours of onset of symptoms.

This may be summarized as: Treat with antibiotics if severe acute otitis media, or if nonsevere bilateral acute otitis media in young children. Treat with antibiotics or “observe” (no antibiotics and have patient call back if not improving or provide a “safety net prescription”) if nonsevere unilateral acute otitis media in young children, or if nonsevere acute otitis media in older children.

But there is a review of antibiotics for acute otitis media in children from the Cochrane Collaboration. Unlike the US-only AAP-AAFP guideline, it represents worldwide experts. It notes that antibiotics decrease pain only slightly and only for a couple of days, and, they don’t decrease temporary deafness, rupture of the TM, or mastoiditis. And, 37% of those who get antibiotics get vomiting, diarrhea or rash. So, the Cochrane Review says that you should
prescribe antibiotics only if:
- there is bilateral acute otitis media, or
- there is acute otitis media with otorrhea (discharge from the ear).

So what do you do? I treat acute otitis media only if I’m absolutely sure it’s there and it looks bad, otherwise I just treat for eustachian tube dysfunction, with oxymetazoline (AFRIN) nasal spray, as described below.

Bacteria that cause acute otitis media are often resistant to amoxicillin (particularly pneumococcus: *Streptococcus pneumoniae*). But amoxicillin is still the first-line antibiotic; it’s as good as other antibiotics, because the amoxicillin concentrates in middle ear fluid, enough to overcome the resistance. That is, if, instead of standard-dose amoxicillin (25-50 mg/kg/day divided BID or TID; maximum 30 mg/kg/day if child is < 3 months old) you prescribe high-dose (80-90 mg/kg/day divided BID, though a Cochran Review says once a day is as good), for a full 7-10 days. A single shot of IM ceftriaxone, or 5 days of oral azithromycin, are good alternatives.

The 2013 AAP-AAFP guidelines succinctly but confusingly states: Clinicians should prescribe amoxicillin for acute otitis media when a decision to treat with antibiotics has been made and the child has not received amoxicillin in the past 30 days or the child does not have concurrent purulent conjunctivitis or the child is not allergic to penicillin. When I’m not playing doctor I play computer nerd and think in Boolean logic, so I would reword it thusly: prescribe amoxicillin unless ((the child has had amoxicillin in the past 30 days) OR (the child has otitis-conjunctivitis syndrome) OR (the child is allergic to penicillins)).

If, after three days of an antibiotic, the patient still has, fever, ear pain, a red, bulging TM, or discharge from the ear, what do you do? High-dose amoxicillin-clavulanate (AUGMENTIN), or cefuroxime axetil (CEFTIN), or intramuscular ceftriaxone (ROCEPHIN) for three days. And if you see a patient with this in the ED, emphasize the need for primary-care follow-up!

Repeat episodes of acute otitis media (more than a month after the first time) is almost always (>90%) from a new virus or bacterium. Amoxicillin-clavulanate (AUGMENTIN) is probably appropriate at this point.

When a mother (it always seems to be the mother, not the father) says “amoxicillin never works for his/her ear infections!” I believe the mother. Some kids are probably colonized with highly amoxicillin-resistant bacteria. Our scientific studies are not good enough yet to tease out these outliers. So I prescribe something else, and call it the art of medicine.

Finally, since we’ve mentioned amoxicillin so much, we should discuss whether you should prescribe “normal” dose or “high” dose (though “high” dose has been normal for the past couple of decades). Because in the US kids almost all get immunized against most strains of pneumococcus, otitis media has decreased (though there is much entertaining scholarly debate about how much it has decreased) and is likely no longer mostly caused by pneumococcus. Therefore, some are recommending that we go back from the “high” dosage (90 mg/kg/day) to “normal” dosage, but with amoxicillin-clavulanate (AUGMENTIN) rather than plain amoxicillin.

**Other Treatments for acute otitis media**

Oral decongestants and antihistamines might help just slightly, but cause so many problems that the cure is worse than the disease. And taking them during a cold doesn’t prevent acute otitis media. A decongestant nasal spray such as oxymetazoline (AFRIN) helps a bit: ~19% residual effusion at one month as opposed to 27% residual effusion for oral decongestants, antihistamines, and untreated controls. I recommend seven days of oxymetazoline (AFRIN) nasal spray – never more than seven – to avoid rhinitis medicamentosa, which I describe as “being addicted to nasal spray so you have to use it to breathe through your nose the rest of your life; the bottle says only three days but seven days is safe.” I tell them to spray into both nostrils, then lie flat on their backs for a few minutes, so that they can taste the spray getting back to where the Eustachian tubes drain out in the back of the nose/throat.

Antipyrine and benzocaine ear drops (commonly known as AURALGAN), may help the pain a bit, but the FDA said that the
manufacturer never proved that the drops were safe and effective, so they are no longer sold in the US.47,48

Otitis-Conjunctivitis Syndrome

Conjunctivitis and otitis media are sometimes occur together, and the combination is highly likely to be caused by *H. influenzae*;49 *H. flu* tends to be resistant to amoxicillin and azithromycin (ZITHROMAX). So, when treating otitis media, look for conjunctivitis; if you see it, consider amoxicillin-clavulanate (AUGMENTIN), cefuroxime (CEFTIN) or cefdinir (OMNICEF).50-54

For the same reason, if you see a child with purulent conjunctivitis, take a look at the ears; roughly 2/3 will also have otitis media.55 Treat with an oral antibiotic, but you don’t need to prescribe eye drops. The tears have enough of the oral antibiotic to work as antibiotic eye drops.56

Otitis Media with Effusion (OME; “Glue Ear”; Serous Otitis; Middle Ear Effusion)

Sometimes people come to the ED with decreased hearing, sometimes sudden-onset. The most common cause is earwax impaction. But if you look in the ear, and rather than a cerumen impaction, you might see a clear effusion fluid behind the tympanic membrane. Or, you might find the same on a routine ear exam.

Middle ear effusions are common after acute otitis media. Two weeks after they have otitis media, about ¾ of kids will have a persistent effusion; a month after, half will; and three months later, maybe ¼ will. Antibiotics don’t help.53,58

Serous otitis may also come from eustachian tube dysfunction (ETD) from other causes: chronic eustachian tube deformity, allergies,19 tobacco smoking and esophageal reflux.60 Less common causes include chronic sinus disease (particularly of the ethmoids), adenoidal hyperplasia, and rarely head and neck tumors.61 People with serous otitis may complain of a feeling of “water in the ear,” mild pain or decreased hearing. Serous otitis is defined as fluid in the middle ear without signs or symptoms of ear infection. Like otitis media, it’s more common in kids.7 Serous otitis is not a big deal in the ED, but it’s a big deal for pediatricians and family doctors, as decreased hearing causes problems in class.62

If you see a cloudy tympanic membrane, or a visible effusion with an air-fluid level, or bubbles behind the tympanic membrane, without symptoms of acute infection, you’ve diagnosed serous otitis. Refer the patient to a primary care doctor for follow-up. It’s optional in the ED, but decreased mobility with insufflation confirms your diagnosis.55

Unfortunately, there is almost nothing we can do. Antibiotics, antihistamines, oral decongestants, oral steroids, mucolytics like guaifenesin (e.g., ROBITUSSIN, MUCINEX) and autoinflation with a Politzer device (don’t ask) are all useless.64-68 Some think that many cases of adult serous otitis are from allergies.69 Especially in adults with obvious nasal allergies, a nonsedating antihistamine and a steroid nasal spray might help. Since it may help acute otitis media, a short course of oxymetazoline (AFRIN) nasal spray less than seven days to avoid rhinitis medicamentosa – might help, due to high concentrations in the middle ear that will kill even resistant organisms, is still the drug of choice for acute otitis media.

Although nasal-spray decongestants may help acute otitis media, oral decongestant and antihistamines are not recommended (don’t help much or at all, lots of side effects).

Otitis-Conjunctivitis Syndrome is usually from *H influenzae*; prescribe Augmentin rather than amoxicillin.

For otitis media with effusion (serous otitis), no acute treatments work, except maybe decongestant nasal spray, or if allergic, steroid nasal spray. It is simply observed for months for resolution.

For acute otitis media with tympanostomy tubes or a ruptured tympanic membrane, treat not with oral antibiotics, but with non-ototoxic ear drops such as ofloxacin or ciprofloxacin.

Mastoiditis and petrositis (Gradenigo’s Syndrome) are quite rare in the developed world, and while CT or MRI may help a bit, you have to make the initial diagnosis clinically.

Key Points

- Chronic suppurative otitis media, which causes serious long-term problems, occurs almost entirely in the developing world.
- You should diagnose acute otitis media by: signs and symptoms of acute otitis media (fever, earache); and evidence of a middle ear effusion.
- You should diagnose a middle ear effusion when you see: fluid behind the tympanic membrane, or decreased mobility with insufflation, or opacity or discoloration of tympanic membrane (not counting scarring), or evidence from tympanometry or spectral gradient acoustic reflectometry.
- Do not diagnose acute otitis media when you just see redness of the tympanic membrane.
- Should you treat acute otitis media with antibiotics? Maybe. There are dueling recommendations.
- You can, for certain kids with acute otitis media, give a prescription for an antibiotic but tell the parents not to fill it unless the ear is still hurting in a couple of days.
- High-dose amoxicillin,
Acute otitis media with tubes or ruptured TM

Tympanostomy tubes (myringotomy tubes, ventilation tubes, “grommets”) are sometimes surgically inserted in the tympanic membranes of children with recurrent acute otitis media or, particularly in children > 3 years old, chronic otitis media with effusion (serous otitis). The tubes are expected to drain fluid for days or weeks after insertion. About 5% of children with tubes develop chronic otitis media (drainage from the ear), usually due to skin flora such as Pseudomonas aeruginosa and Staphylococcus aureus.

You may be unsure if a patient has a hole in the tympanic membrane or not. A patient may have had tympanostomy tubes in the past, and you can’t tell if they are still there. And, sometimes, the pressure from acute otitis media will cause the tympanic membrane to rupture; this may fill the ear canal enough that it’s hard to tell if you’re dealing with otitis media with perforation or otitis externa.

Two clues to a perforated tympanic membrane are: (1) people who can taste the drops after putting ear drops in their ear, and (2) people who can blow air out their ear when blowing their noses.

You may see an infant or child with known tympanostomy tubes complaining of acute (sudden onset, severe) otitis media. This occurs in roughly half of children with tubes. From the drainage, the external ear canal may look eczematous. The patient may have a low-grade temperature or fatigue, but due to the tubes, not much pain.

About a third of kids with acute otitis media have a spontaneous rupture of the tympanic membrane during one of their episodes of otitis media, more likely if they’ve had prior otitis media. Usually the pain gets a lot better when the tympanic membrane ruptures. Ninety-four percent of the perforations were spontaneously healed within a month. Children who have had a perforation are twice as likely to have recurrent acute otitis media.

The bacteria in ear drainage in those under age 3 is the same as that in acute otitis media: a mixture of viruses and airway-derived bacteria. In older children, it will usually be skin flora including Pseudomonas aeruginosa and Staphylococcus aureus.

There are many treatments for such ear drainage, from doing nothing (“observation”), through ear drops, to oral antibiotics. In children younger than 3 years old with acute tube-associated drainage, ear drops are as good as oral antibiotics; ofloxacin ear drops (FLOXIN) are as good as oral amoxicillin-clavulanate (AUGMENTIN). Given that ear drops are effective for tube-associated and perforation-associated ear drainage in all ages, it seems prudent to use ear drops as the initial treatment, unless there is severe ear pain or high fever, in which case you should probably prescribe both ear drops (to cover skin bacteria) and one of the usual otitis media oral antibiotics.

Prescribe only non-otoxic eardrops when there might be a tube or perforation, as some of the ear drops may get into the middle ear. Neomycin and polymyxin B and hydrocortisone otic suspension (CORTISPORIN) contains both an ototoxic aminoglycoside (neomycin) as well as ototoxic propylene glycol; acetic acid ear drops (VOSOL, ACETASOL; VOSOL-HC, ACETASOL-HC) also contain ototoxic propylene glycol, as well as being acidic enough to make the middle ear hurt, so don’t prescribe them if there might be a tube or perforation, unless the benefits outweigh the risks.

Oflaxacin (FLOXIN) and ciprofloxacin (CIPRODEX) drops are non-otoxic. Including a steroid with an antibiotic may make ear drops slightly more effective, but generic ofloxacin (FLOXIN) drops are both cheap and effective.

If you see a child with tubes with discharge not improving with appropriate antibiotics, culture the drainage, but don’t change treatment. Refer for primary care physician follow-up and the physician may use culture results to guide treatment. If there is new ear pain or fever, and the patient is on just ear drops, start oral antibiotics.
**Mastoiditis and Petrositis**

In the early 1900s, a fifth of those with acute otitis media got mastoiditis or petrositis. But since antibiotics became available in the 1930s, they became rare (<1%), especially in the US and other developed nations.83

Mastoiditis is a symptomatic infection of the air cells in the bony mastoid process behind the ear, most commonly in infants.84 Classic mastoiditis shows swelling and perhaps warmth or redness over the mastoid, with the pinna (auricle) pushed down and forwards. But soon after the first use of antibiotics for otitis media, in 1941, there were reports of “masked mastoiditis”: patients with further complications of mastoiditis, such as brain abscess, without classic signs and symptoms.85,86 Now, the most common findings are only seen with an otoscope: an abnormal appearing tympanic membrane, and sagging of the posterior wall of the external ear canal.2 Although the ear may not be visible displace, but sometimes the postauricular fold – the crease behind the pinna (auricle) of the ear – is gone; compare with the unaffected side.87

Trying to confirm a clinical suspicion of mastoiditis is hard, as there are no accepted diagnostic criteria.88 And, as with fluid in the sinuses on CT that occurs with most any cold,89-91 fluid in the mastoid air cells on CT scan doesn’t diagnose mastoiditis, as it’s found in many cases of otitis media.92 If you do a high-resolution CT or MRI and find bony resorption in the mastoid (the bony septae between the mastoid air cells are being destroyed) then you can diagnose “coalescent” mastoiditis, but CT or MRI won’t help you diagnose earlier stages of mastoiditis.88,93,94

Patients with mastoiditis are generally admitted for further workup and treatment. Myringotomy is usually performed and tympanostomy tubes are generally placed. If there is neither subperiosteal abscess nor CNS involvement, a period of 48 hours of observation and broad-spectrum IV antibiotics is recommended prior to considering mastoidectomy.95 Subperiosteal abscesses are surgically drained.

The triad of deep facial pain, otitis media, and ipsilateral abducens nerve paralysis (inability to look to the affected side) are the classic signs of petrositis (infection of the petrous portion of the temporal bone; Gradenigo’s Syndrome)96 However, as with mastoiditis, such classic presentations are now rare. If you see someone who presents with deep facial pain and signs or symptoms of infection, and a history of chronic otitis media or surgery for mastoiditis, you should suspect petrositis.97 Get a CT or MRI scan, and consider admitting the patient for further workup and treatment. A CT scan showing bony changes in the petrous part of the temporal bone clinches the diagnosis.97

Mastoidectomy is a common inpatient treatment, but conservative management with just antibiotics is reasonable as well.98-100

**Bullous Myringitis**

I was taught that bullous myringitis – tiny blisters on the tympanic membrane – clinches the diagnosis mycoplasma-induced otitis media.101 But the bacteria in ears with bullous myringitis are basically the same as in any case of acute otitis media,102 though bullous myringitis hurts worse than other types of acute otitis media.102 As one review put it, bullous myringitis is just acute otitis media with blisters on the eardrum.101
67. Griffin G, Flynn CA. Antihistamines and/or decongestants for otitis media with effusion (OME) in children. Cochrane database of systematic reviews (Online) 2011;CD004423.