

Acute Otitis Media

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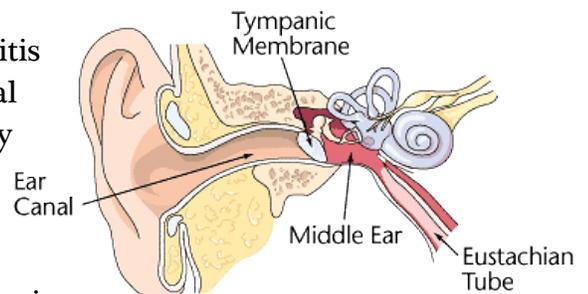
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What is acute otitis media?

Acute otitis media is an infection of the middle ear, generally caused by bacteria. In acute otitis media (i.e., an ear infection or an infection of the middle ear), pus and infected fluid accumulate in the middle ear space.

The tympanic membrane (eardrum) appears inflamed, reddened, and often protrudes outward. Usually, an ear infection begins after the eustachian tube (a small tube connecting the back of the nose to the middle ear space) has become swollen, congested, and closed, most commonly resulting from an ongoing viral respiratory infection.

Acute otitis media should not be confused with: 1) external otitis ("swimmer's ear")-a painful bacterial infection of the superficial skin of the ear canal, or 2) otitis media with effusion (secretory otitis or "fluid ears")-an accumulation of non-inflamed fluid behind the eardrum. Otitis media with effusion is not considered infected, and most doctors do not treat it with antibiotics. This uninfected fluid in the middle ear is a remnant in 50% to 60% of resolved ear infections. It is frequently a mild complication of colds, respiratory illnesses, or nasal allergies.



What causes acute otitis media?

Acute otitis media usually is caused by one of four bacteria:

1. *Streptococcus pneumoniae* (pneumococcus) in 30% to 45% of cases.
2. *Haemophilus influenzae* (*Haemophilus*-but not the *Haemophilus* strain in the HIB or meningitis vaccine) in 20% to 30% of cases.
3. *Moraxella catarrhalis* (*Moraxella*; sometimes called *Branhamella catarrhalis*) in approximately 10% of cases.
4. Group A *Streptococcus* (like the strep bacteria of strep throat) in 5% of the cases.

The pneumococcus bacteria is now the most difficult to treat. Some strains have become very resistant to antibiotics by using their unique ability to transform their genes and cell wall into a bacterial form, which is resistant to most of the antibiotics that commonly are used to treat ear infections. These resistant strains frequently are cultured from children who do not respond to several courses of antibiotics. When a child has an ear infection that does not respond to antibiotics, resistant pneumococcus bacteria may cause it.

Pneumococcus has 90 different types, which are all genetically related; however, 7 types account for the majority of ear infections in childhood and nearly all of the antibiotic resistant strains. In addition,

pneumococcus is the leading cause of meningitis, bloodstream infections, and serious pneumonia in children, sometimes as a result of a preceding ear infection.

Up to half of Haemophilus and nearly all Moraxella bacteria produce an enzyme (beta-lactamase), which makes these bacteria resistant to some of the commonly used antibiotics. This enzyme may destroy many antibiotics when they come in contact with the bacteria. Nonetheless, several available antibiotics are still quite effective against these strains.

Viruses play a critical role in the development of acute otitis media by enabling the bacteria to travel into the middle ear (see below). By themselves, though, viruses account for only 6% to 10% of ear infections.

How does it cause disease?

As long as air entering from the back of the nose is able to reach the middle ear space via the eustachian tube, the middle ear rarely becomes infected. The eustachian tube in younger children is flimsy and easily collapses. As the child grows, the cartilage tissue surrounding the eustachian tube becomes stiffer, longer, and more angulated inside the skull.

Pneumococcus, Haemophilus, and Moraxella commonly reside in the back of the nose, and do not infect the child. Once a child becomes infected with a respiratory virus, it not only causes congestion of the nose and the lungs, but also of the eustachian tube. When this tube becomes clogged, the cells in the middle ear space produce a fluid-like substance, which allows bacteria to grow and infect the middle ear space. A virus infection precedes up to 90% of cases of acute otitis media.

Respiratory virus infections also trigger ear infections by upsetting the body's normal defenses in the nose and the eustachian tube, and allowing certain normal bacteria that reside in the nose to "stick" better to the lining of the nose and the eustachian tube. Certain viruses, such as the flu (influenza) and RSV (a respiratory syncytial virus, or the "bronchiolitis bug"), are more frequently associated with ear infections. Occasionally, the child's nose becomes colonized by a new aggressive strain of bacteria, which rapidly invades the middle ear. Unfortunately, more exposures (e.g., via daycare attendance) to viruses and new strains of bacteria increase the likelihood of ear infections.

How common is acute otitis media?

Acute otitis media is predominantly an infection of young children, primarily occurring in the first three years of life. Children in the 1990s experience 30% more episodes of acute otitis media as compared with children in the 1970s, probably as a consequence of high rates of day care. Currently, acute otitis media accounts for one-fourth of all pediatric office visits in the first three years.

Nearly 94% of children will experience at least one ear infection in the first three years of life, with an average of about three episodes in the first and second years, and one and one-half episodes in the third year. As many as 5% to 8% of children will undergo the placement of ventilating tubes in their first 24 months of life. Much of this is related to the high rate of daycare attendance in the United States, with increased exposure to infectious agents.

Who gets an ear infection?

At the highest risk for ear infections include those children who:

- are male;
- are of the white, American Indian, or Eskimo races;
- attend daycare;
- have Downs syndrome;
- are immunocompromised;
- have a strong family history of otitis media;
- were not breastfed during the first 12 months of life; and/or
- reside in a smoking household.

Children with a cleft palate or HIV have particularly severe problems with recurrent ear infections.

Age affects the rate of acute otitis media, with a dramatic decline in frequency in children older than three years. However, some children with a history of ventilating tubes or frequent recurrent otitis media, severe allergies, or large adenoids may still be plagued with ear problems.

Is an ear infection contagious?

To some degree, the bacteria that cause ear infections are contagious because they may colonize, or set up residence, in the nose of children or close contacts. However, only a small proportion of children colonized with a new strain of bacteria will develop an ear infection. For example, in the case of pneumococcus, only about 15% of children colonized in the nose with a new strain of it will develop an ear infection, and usually only within the first month. Also, some bacterial strains appear more aggressive than others and will directly invade the middle ear.

What may be even more important than new bacterial colonization is the spread of respiratory viruses, particularly among children in daycare and pre-schools. Respiratory viruses are very contagious in close quarters. They frequently make a child more susceptible to an ear infection by upsetting the normal balance between the child's local nose immunity and the co-inhabitant bacteria. When the child's defenses are down, or the eustachian tube becomes clogged, the bacteria tend to infect the middle ear.

How do you know if your child has an ear infection?

Children with an ear infection display a wide range of symptoms, from none at all, to a high fever, to a screaming earache. Many infants and toddlers with an ear infection show less obvious symptoms, such as sleeplessness, irritability, decreased feeding, or a fever. Ear pain and ear tugging are helpful clues, but are fairly unreliable. Even in older children with a respiratory illness, mild to moderate ear complaints and earaches frequently occur in children with normal ears. In these children, a sore throat often causes the ear complaints. Fever occurs in only one-fourth of ear infections, and it does not signify an ear infection.

One of the more reliable indicators of an ear infection in younger children is when a child, who has had a cold and a runny nose for three to seven days, suddenly develops sleeplessness and

inconsolability during the night, along with increasing fussiness throughout the day. Children with a persistent ear infection who have recently received antibiotics often show few symptoms.

Antibiotics should not be prescribed over the phone for a presumed ear infection, without an examination by a physician. Only a careful examination of the eardrum by a doctor can determine whether the ear is truly infected. Often, when the child is brought into the office in the early phase of a cold or a mild respiratory infection, the eardrum will be normal, only to become infected several days after the office visit. If the child has only a mild cough and a runny nose, it is best to wait at least five to seven days into the illness before making an office visit.

The new EarCheck™ (acoustic reflectometry instrument) may help parents to determine whether a young child is getting an ear infection. If a previously healthy child, who now has an illness, develops an abnormal reading on the instrument, parents can assume a 70% chance of fluid behind the eardrum. It will not distinguish between infected or uninfected fluid. More importantly, if the readings are normal and the child's symptoms are mild, parents can assume that it is very unlikely that the child has an ear infection, and an office visit may be avoided.

What does the eardrum look like when it is infected?

When a doctor examines the eardrum through the otoscope instrument, the eardrum normally appears as a thin gray, translucent membrane (like wax paper). When infected, it will look opacified (cloudy), very reddened, and yellowish. Sometimes, it shows a small layer of pus-like material. During an infection, the eardrum usually becomes rigid because of the accumulation of fluid, and it will not wiggle when the doctor puffs a small amount of air against the eardrum with an otoscope. Use of tympanometry or acoustic reflectometry (i.e., the EarCheck instrument) may help to determine if there is fluid behind the eardrum. Neither instrument distinguishes between infected or uninfected fluid.

From the appearance of the eardrum, the doctor cannot determine the type of bacteria, or whether bacteria or viruses are causing the infection. The eardrum in children with otitis media with effusion appears as an orangish or dull, straw-colored fluid, and it also does not move when air is applied to it.

How is an ear infection treated?

The intense ear pain of acute otitis media can be partially relieved by adequate doses of ibuprofen or acetaminophen. For more severe earaches, some doctors may prescribe codeine. Numbing eardrops provide minimal relief, and only for a short time. A warm washcloth or sweet oil (olive oil) directly instilled in the ear canal may temporarily distract from the child's ear pain.

Nearly all doctors in the United States believe that acute otitis media should be treated with antibiotics by mouth, particularly if the child has symptoms. Antibiotics generally provide prompt and dramatic relief of the ear pain. Oral antibiotics for acute otitis media are safe and effective, with exceedingly rare serious side effects.

In a few European countries, ear infections are not treated in children older than two years, unless symptoms persist for more than 48 hours. A few U.S. physicians recommend this same tactic.

Most experts in the United States are concerned about the tendency for pneumococcus in an ear infection to cause more serious infections. When pneumococcus causes an ear infection, if left untreated, it will persist in the ear of 80% of children for up to a week. However, most episodes of acute otitis media will resolve on their own from 3 to 10 days. Yet, non-treatment may be dangerous, not only because of the risk of serious pneumococcus infections, but also because of the possibility of other serious complications. Furthermore, few parents are willing to watch a child suffer with an earache, a fever, and crying for several days.

Amoxicillin (the "pink ink") is the drug of choice for initial ear infections, except in the penicillin allergic child. In an attempt to enhance the effectiveness of this inexpensive and safe antibiotic, many doctors are now prescribing amoxicillin twice a day and in double the daily standard dose. Effectiveness for initial therapy with most antibiotics approaches 70% to 80%. There are other antibiotics to treat children who do not respond to amoxicillin or who never seem to respond to initial amoxicillin therapy.

Children who do not respond after two or more standard courses of antibiotics can be expected to respond to another antibiotic only about 50% to 60% of the time. Most children who fail antibiotic therapy are younger than 24 months, have poor eustachian tube function, and tend to be infected with more resistant bacteria. At this point, the easy-to-treat bacteria usually have been eliminated. The persistent bacteria are the most resistant strains of the three most common ear bacteria. The emergence of more resistant strains is outpacing the development of new effective drugs. A child's doctor should be relied upon to select the most effective second-line antibiotic choices.

The new "one-shot" (ceftriaxone) for acute otitis media also is effective for simple cases of acute otitis media. However, "the shot" should only be used in select children, such as those with vomiting and diarrhea, very cantankerous toddlers, or children with an associated moderately serious illness. Three daily doses of ceftriaxone also may be very effective in children who have failed three to four consecutive courses of antibiotics, and are destined for tube placement.

The Centers for Disease Control (CDC) has convincingly pointed out that antibiotic overuse is one of the major culprits for the increasing antibiotic resistance problem. Parents should not insist on an antibiotic prescription for fevers, minor colds, and respiratory illnesses.

Physicians almost never know which bacteria they are treating. Thus, the CDC and other otitis experts advocate the use of tympanocentesis (lancing the ear or ear tap) for children who have failed antibiotic therapy.

Tympanocentesis:

relieves instantly the pain of the child with a crying earache; enables the physician to culture the bacteria and to select the best antibiotic for the infection; and allows the ear infection (like an abscess) to drain, which may improve the healing process.

The procedure can be performed nearly pain free. Only physicians who have been trained in the procedure perform it.

No medication is currently available to treat viruses that precipitate ear infections, either before or during the illness. An exception is the flu virus. Anti-flu medications and the flu vaccine could help prevent some wintertime ear infections, but only for the small number of children with ear infections related to the flu.

What are the complications?

The most serious complications secondary to ear infections are mastoiditis (infection of the skull bone behind the ear) and meningitis (infection of the lining of the brain). Both are extremely rare.

Chronic draining ears and chronic perforations (holes in the eardrum) are uncommon, but occur more frequently as a result of resistant pneumococcus. However, these complications are commonly seen in developing countries where antibiotics are not readily available. Permanent hearing loss from very severe recurrent infections is a major concern, but is still rarely observed with effective antibiotic therapy. Children with an ear infection (even ones that rupture and drain) suffer only some temporary, low grade hearing loss. As the fluid resolves, which may take months, the hearing returns to baseline levels.

Your child's doctor may work with an ear-nose-and-throat doctor to help treat the more severely afflicted child, or one who has suspected chronic hearing loss. Children with chronic fluid persisting for more than four months, or with more than five or six ear infections in a year, may require the insertion of "tubes." This is most important during the first two years of life when hearing is critical for speech and language development. Chronic ear infections may aggravate learning and later school problems, but cause and effect on this issue remains speculative.

Severe complications from ear infections nearly have been eliminated, and there is an array of antibiotics to treat them; however, the rate of highly resistant bacteria infecting children has increased. Physicians cannot continue to wastefully prescribe antibiotics, and parents should not demand them to treat everyday colds and viral infections. Although the new Prevnar vaccine may prevent many strains of highly resistant pneumococcus, with continual antibiotic misuse, microbiologic history will repeat itself in other pneumococcal strains or in other bacteria.

How can an ear infection be prevented?

The simplest preventive measures include the following:

- Breastfeed an infant during the first 12 months of life
- For bottle-fed infants, never prop the bottle and wean off the bottle by 12 months
- Do not smoke around the baby, particularly in the household or the car
- Do not smoke during pregnancy
- Consider a private sitter or a smaller daycare, instead of a high volume daycare
- Avoid the introduction of solid foods in the first four months of life
- Administer the flu vaccine annually after six months of age
- Consider allergen avoidance and allergy shots in older children (over three years) with chronic fluid
- Administer Prevnar vaccine to infants less than 24 months of age

More controversial preventive measures include the following:

- Avoid the pacifier
- Give the pneumococcal vaccine (Prevnar) to infants and children older than 24 months who are unvaccinated with Prevnar and still getting recurrent ear infections

Ineffective measures include the following:

- Covering a child's head with a hat during the winter
- Using decongestants and antihistamines to "prevent" ear infections
- Chiropractic manipulation
- Herbal remedies

What research is being done?

The most important recent development to potentially reduce the frequency of ear infections is a new pneumococcal conjugate vaccine. A study from Northern California suggests that this vaccine could prevent about 7% of overall episodes of ear infections, and up to 23% of recurrent ear infections.

The new pneumococcal vaccine contains 7 of 90 types of pneumococcus, which are the most common and the most resistant bacteria. Elimination of these resistant types could have an impact on the number of antibiotic failures in children. This also could mean a reduction in the placement of tubes, possibly by one-fourth, as observed in the California study.

This vaccine is administered to infants at 2, 4, 6, and 12 months of age. Side effects have been minimal, and it has been a very safe vaccine. It uses the same technology as the universally administered HIB vaccine.

Some new antibiotics are about to undergo testing in children with acute otitis media. In preliminary testing, these drugs appear to work against the resistant pneumococcus.

In the future, there may be alternate ways of treating or preventing ear infections. A new antibiotic may be able to penetrate the eardrum directly by instilling eardrops. A nasal spray squirted in the nose of infants a few times a day may prevent the common bacteria of acute otitis media from gaining access to the nose. Some Scandinavian investigators have shown slight reduction in the number of ear infections in children who regularly used an experimental sugar called xylitol.