“Revisiting Otitis Media: Pharmacy Considerations” Nov/Dec 2013

Otitis media is an inflammation of the middle ear that can be caused by bacterial or viral infections. Our goals are to revisit this important topic & review treatment options. This lesson provides 2.50 hours (0.25 CEUs) of credit, and is intended for pharmacists in all practice settings.

The objectives of this lesson are such that upon completion the participant will be able to:

1. List causes of OM.
2. Describe the anatomy of the ear.
3. List symptoms of AOM, OME & COME.
4. Describe signs & symptoms that are used to diagnose OM.
5. List medication options that are used for treating OM.

This is a subscription program. To get continuing education credit, you must subscribe to the program, or pay fee for individual lessons.
2013 DEADLINE.
FOR CREDITS TO APPLY FOR CALENDAR 2013, WE MUST RECEIVE THEM NO LATER THAN DECEMBER 31, 2013. ALLOW 10 BUSINESS DAYS FOR CREDITS TO APPEAR IN YOUR NABP ePROFILE (CPE MONITOR) ACCOUNT.

CREDIT STATEMENTS.
Check your CE activity or print a statement from your NABP eProfile (CPE Monitor) Account. To login, go to www.nabp.net. Enter your user name (your email address) & your password. Click on "CE Activity" to view your history & to print a CE report.

WHEN YOU SEND IN QUIZZES, ALWAYS KEEP A COPY. YOU MAY EMAIL OR FAX THEM. FAX # IS 847-945-5037. OR SEND A CONVENTIONAL EMAIL WITH YOUR ANSWERS TO CEINFO@WFPROFESSIONAL.COM

This lesson provides 2.50 hours (0.25 CEUs) of credit, and is intended for pharmacists in all practice settings. The program ID # for this lesson is 707-000-13-011-H01-P. Pharmacists completing this lesson by October 31, 2016 may receive full credit.

To obtain continuing education credit for this lesson, you must answer the questions on the quiz (70% correct required), and return the quiz. Should you score less than 70%, you will be asked to repeat the quiz. Computerized records are maintained for each participant.

If you have any comments, suggestions or questions, contact us at the above address, or call 1-847-945-8050. Please write your NABP eProfile (CPE Monitor) ID Number & birthdate (MM/DD) & your CE PRN ID Number (the number that is on the top of the mailing label) in the indicated space on the quiz page (for continuous participants only).
INTRODUCTION

Otitis media is an inflammation of the middle ear that can be caused by bacterial or viral infections. Although it can affect people of all ages, it is primarily a common childhood disease. In 2006 it was reported that about 9 million children up to 17 years of age suffered from otitis media. Furthermore, eight million of these visited a physician and received prescription medications for treatment. Current estimates indicate that about 16 million physician visits annually are due to otitis media. A review of the anatomy and physiology of the ear is provided to assist in understanding the development, symptoms, diagnosis, complications and treatment of otitis media.

ANATOMY AND PHYSIOLOGY OF THE EAR

The ear is divided into three major parts: the external ear, middle ear and the inner ear.

1. The external ear consists of the following parts:

   • **Auricles** are the portions of the ear that are seen on the right and left sides of the head. Their main function is to receive and direct the sound waves coming from the outside into the ear canal and then to the eardrum. They are cartilaginous structures covered with skin.

   • **Ear Auditory canal** is about 1.25 inches long and 0.7 cm in diameter. It extends inward and downward from the auricle to the eardrum. Like the auricle, the canal is covered with skin that contains modified sebaceous glands and secretes earwax (cerumen) which lubricates the skin of the ear canal and the outer side of the eardrum. The skin also contains hair follicles located at the opening of the canal. The hair and the earwax serve to trap foreign particles and insects. The earwax is composed of cholesterol derivatives, fatty acids, and electrolytes. When fresh, cerumen is yellowish in color and has a soft consistency. However, it dries up to a brownish semi-solid wax if it is not removed regularly. The dry wax may adhere to the sides of the ear canal and the eardrum causing a condition known as impacted cerumen which causes pain, itching, hearing impairment, headache, and vertigo.

   • **The eardrum (tympanic membrane)** is a divider between the external ear and the middle ear. It is a gray-pink membrane which is about 1.0 cm in diameter and 0.1 mm in thickness. It is made of three layers: an external layer which is continuous with the skin tissue of the auditory canal, a middle layer of an elastic fibrous tissue that keeps the eardrum firm, and an internal layer of mucous membrane which is continuous with the middle ear. The eardrum plays an essential role in conducting the sound waves that enter the ear canal, causing vibrations that are transmitted to the delicate bones in the middle ear.

2. The middle ear is a cavity located in the mastoid process of the temporal bone and is lined with mucous membrane. It is about two cubic centimeters in volume and extends from the eardrum to the inner ear. The middle ear consists of the following parts:

   • **The inner side of the eardrum** which is covered by mucous membrane.

   • **Eustachian tube** which is a 1.4 inches long canal that connects the nasopharynx with the middle ear. Its main function is to equalize air pressure. Normally, the Eustachian...
tube is closed but opens to allow small amounts of air through it to equalize pressure between the middle ear and the atmosphere as during chewing, yawning or swallowing. When air pressure is equalized sound transmission is optimal. To the contrary, when air pressure between the external ear and middle ear is unequal, the eardrum tends to move inward or outward causing transient hearing difficulties, pain and discomfort. The Eustachian tube also serves as a passageway for draining discharges from the middle ear into the nasopharynx.

• **Auricle ossicles** are three tiny bones called the malleus (hammer), incus (anvil) and stapes (stirrup) located in the middle ear. Their function is to transmit and amplify sound signals from the eardrum to the inner ear.

3. **The inner ear** (*labyrinth*) is a liquid-filled area that contains the sensory organ of hearing (*cochlea*) which resembles the shell of a snail; the vestibule, which is responsible for maintaining balance; and the semicircular canals, which transmit impulses to the brain.

**OTITIS MEDIA (OM)**

There are three types of otitis media that are based on etiology, duration and symptoms: **acute otitis media (AOM)**, **otitis media with effusion (OME, serous otitis media)**, and **chronic otitis media with effusion (COME)**. Otitis media is the second most encountered childhood disease after upper respiratory tract infections (URTI). The most common predisposing factors include: URTI, congestion of the nasopharynx, obstruction of the Eustachian tube, allergic rhinitis, adenoid lymphadenopathy, eustachitis, sinusitis, pharyngitis, laryngitis, tonsillitis and adenoiditis. Even though viruses rarely cause otitis media, viral infections of the upper respiratory tract may allow the virus to reach the middle ear and to trigger otitis media which may become complicated with bacterial infection. The usual microorganisms responsible for otitis media are: *Streptococcus pneumonia*, *Haemophilus influenza* and *Streptococcus pyogenes* (group A).

Regardless of the cause, when the Eustachian tube is blocked, the air within the middle ear space is trapped and gradually some of the oxygen is absorbed, leading to a vacuum. Fluids from the surrounding tissue, as well as exudate from the infected nasopharynx and the Eustachian tube are attracted to the middle ear to fill the vacuum, resulting in otitis media. Nose blowing, coughing, and sneezing may exacerbate the infection by forcing infected fluids to enter the middle ear.

1. **Acute otitis media (AOM) or purulent otitis media**: It is the most common type of the three infections. It occurs mostly during winter and is usually associated with URTI, particularly the common cold. AOM is recurrent, particularly if the predisposing factors are not corrected. It has been estimated that 33% of children face 6 or more bouts of AOM by age 7. The infection causes swelling of the middle ear and accumulation of fluid within its space placing pressure against the eardrum causing abrupt symptoms such as sharp pain, feeling of fullness in the ear and hearing impairment. Systemic symptoms such as fever, which may reach 104 degrees F, vertigo, nausea and vomiting, may occur. Children may rub the affected ear in an attempt to relieve pain. They may experience irritability and difficulty in sleeping. If left untreated, the fluid becomes purulent with a foul smell. It may create enough pressure in the middle ear to rupture or perforate the eardrum, releasing fluid into the auditory canal. The flow of the purulent fluid to the outside tends to relieve pressure and reduce pain. Delayed treatment may lead to
chronicity of the case and the development of complications such as mastoiditis, which is an inflammation of the mastoid air cells in the temporal bone. This condition can be dangerous due to its proximity to the middle and posterior cranial fossa and related structures.

Babies are more vulnerable to AOM than older children or adults because the Eustachian tubes are shorter, more horizontal and straighter, allowing bacteria to have an easy access to the tube. Furthermore, the opening of the baby’s Eustachian tube is much smaller than that of adults and thus can be easily obstructed.

2. Otitis Media with Effusion (OME) (secretory otitis media, glue ear) is an accumulation of fluid (effusion) behind the eardrum without a sign of infection. It may occur prior to or after the infection has disappeared. If left untreated, the fluid may become thick, sticky and glue-like. The result is impairment of sound conduction (plugged up) due to interference with eardrum vibrations. However, OME may be asymptomatic with no obvious symptoms. A patient may have the tendency to talk loudly and may fail to respond to verbal commands.

3. Chronic Otitis Media with Effusion (COME) is a chronic persistent inflammation and accumulation of fluid (effusion) in the middle ear. It occurs as a result of improper or delayed treatment of AOM. Usually COME develops within weeks of an episode of AOM. If left undrained, the fluid may cause damage to the middle ear. If the fluid becomes thick, liquid indicates inflammation of the lining of the middle ear. Accumulation of large quantities of fluid may result in perforation of the eardrum. In some cases the amount of fluid is minimal and can only be seen upon examination. COME has no clearly defined symptoms and the child does not appear to be ill. There may be no pain involved. The most common complaint is feeling of fullness in the ear and some hearing loss. OME and COME are often discovered during a regular pediatric visit. The appearance of swelling, tenderness, and redness behind the ear may indicate involvement of the mastoid bone (mastoiditis) which needs to be treated promptly. Another complication which may occur due to COME is cholesteatoma which is a keratinous squamous epithelium cyst behind the eardrum. If left untreated, this growth will enlarge causing damage to the surrounding bones as well as hearing loss that may become permanent.

**DIAGNOSIS**

To assist in the diagnosis of AOM, confirmation of the acute onset, signs of middle ear fluid (effusion) and evaluation of the presence of signs and symptoms of inflammation in the middle ear are helpful. Middle ear fluid usually contains Streptococcus pneumoniae, Haemophilus influenza, and/or Moraxella catarrhalis. It should be kept in mind that symptoms of AOM in children, which include irritability, pulling of the ear, excessive crying episodes, and fever, may be encountered in cases of upper respiratory infections. Detection of effusion may be achieved by using a pneumatic otoscope which enables the user to look in the ear and confirm the presence and the approximate amount of fluid behind the eardrum. During the examination, the instrument may be activated producing gentle puffs of air against the eardrum. If the eardrum remained motionless, this indicates the presence of fluid in the middle ear that prevents the movement of the eardrum. Visualization of the eardrum is done by using the otoscope. Dark appearance and/or bulging of the eardrum are indicative of the presence of effusion.
TREATMENT

In February 2013 the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP) updated an evidence-based clinical practice guideline that deals with the treatment of uncomplicated AOM in children from 2 months old through 12 years of age. The guidelines provide achieving pain relief, the use of antibacterials, and choice of specific drugs, as well as preventive measures. The guidelines are not the only criteria to be followed in the treatment of AOM. Their purpose is to serve as a framework for clinical decision-making by primary care clinicians. The use of antibacterials in the treatment of AOM has been a routine while in some European countries treatment begins with symptomatic therapy and antibacterials are used only if such approaches fail to combat AOM. The reluctance to begin treatment with antibacterials is due to increased antibacterial resistance. The selection of the antibacterials is essential due to resistance among many pathogens that cause AOM. Resistance is mainly caused by aggressive and frequent use. It should be remembered that uncomplicated ear infections often clear-up spontaneously. As a result, treatment may begin with pain relievers and monitoring the patient’s progress or lack of it. If the infection fails to subside, then the use of specific antibacterials may be warranted. Treatment of AOM should be distinguished from OME. While the use of antibacterials in treating AOM is a common practice, initial antibacterial therapy is not indicated in treating OME.

Duration of treatment is important in minimizing recurrences and to assist in achieving a full recovery. Patients younger than 2 years should be treated with a 10 day course of antibacterials, while children older than 2 years should take antibacterials for 5-7 days. Other patients with severe recurrences or complicated AOM should take antibacterials for at least 10 days. A recurrent AOM is one that occurred 3 or more times in the prior 6 months or 4 or more times in the preceding 12 months.

Most cases of AOM improve spontaneously. However, many cases require the use of systemic antibiotics and analgesics. Some patients may benefit from the use of antihistamines and decongestants. It is essential that attempts be made to identify the predisposing factors and how to minimize or eliminate them. Selection of the antibacterial plays an important role in eradicating the infection in the shortest time. The drug should be effective against the causative organisms and must be able to reach the infected mucosa of the middle ear in adequate concentration. There is no evidence as to the efficacy of ear drops in the treatment of AOM. The antibacterials used in treating AOM include: amoxicillin with or without clavulanic acid or its derivatives, ceftriaxone, cefuroxime, erythromycin, azithromycin, clarithromycin, sulfasoxazole with or without trimethoprim, and trimethoprim. Ibuprofen is used to relieve pain and fever.

Amoxicillin is p-hydroxyampicillin which is an aminopenicillin with broader activity than penicillinase-resistant and natural penicillin. It is the drug of choice for initial treatment of uncomplicated AOM. However, if the infection is due to β-lactamase producing bacteria resistant to the drug, then amoxicillin should be administered along with clavulanate potassium. The advantages of the use of amoxicillin are: high efficacy, well distributed into the middle ear fluid, well tolerated, and relatively inexpensive costs. Clavulanate potassium is a β-lactamase inhibitor that possesses a weak antibacterial activity when used alone. However, when administered in combination with certain penicillins and cefalosporins, a synergistic effect takes place resulting in the expansion of spectrum of antibacterial activity to include many strains of β-lactamase-producing bacteria. The enzyme β-lactamase is produced by certain organisms and can inactivate the β-lactamase antibiotics.
Amoxicillin is not significantly affected by acidic gastric fluid. It is well absorbed after oral administration; 74-92% of an oral dose is absorbed and can be taken on a full or empty stomach. The main adverse reactions to amoxicillin include hypersensitivity reactions mostly in the form of rash, exfoliative dermatitis, nausea, vomiting, diarrhea, and epigastric distress. Anaphylaxis following oral use has been reported rarely. Hypersensitivity reactions occur mostly in patients who are sensitive to penicillin, and in asthmatics. Amoxicillin is available in capsules, powder for suspension, chewable tablets, tablets, and film-coated tablets.

**Ceftriaxone Sodium** is a semisynthetic member of the third generation of cephalosporin β-lactamase antibiotics. It was first isolated in 1948 from a fungus growing in a sewer in Sardinia. The drug is a bacteriocidal, which like other cephalosporins, exerts its activity by inhibiting micropeptide synthesis in the bacterial cell wall. It is active against many gram-negative bacteria. Ceftriaxone is not well-absorbed from the GI tract, and is given parenterally. It is used for treating AOM caused by Streptococcus pneumonia, Haemophilus influenza or Moraxella catarrhalis. A single IM dose gives clinical response equal to that of a 7-10 day regimen of oral amoxicillin. A 3-day regimen (50 mg/kg IM once daily) has been effective in treating persistent or relapsing AOM. The adverse reactions to the drug include headache, tenderness and pain at the site of injection, dizziness, flushing and diarrhea.

**Cifuroxime** is a second generation cephalosporin which may be used orally as tablets or as a suspension liquid. Its side effects include diarrhea, nausea, vomiting, skin rash, itching, vaginal itching and excessive discharge, and wheezing.

**Erythromycin** is a macrolide antibiotic that possesses antibacterial activity similar to or slightly wider than that of penicillin. It is well absorbed from the duodenum, and the stability of the drug in gastric acidity depends on the derivatives of erythromycin used. Erythromycin base and erythromycin stearate are highly susceptible to gastric acid which causes inactivation of the drug. Erythromycin base tablets are either enterically coated or buffered. The main adverse effects of erythromycin include nausea, vomiting, diarrhea, abdominal cramps, hepatic dysfunction and mild skin reactions. It, along with its derivatives, is the alternate drug of choice for persons who are allergic to penicillin.

**Azithromycin** is a subclass of macrolide antibiotics that are derived from erythromycin and used to treat AOM infections caused by gram-positive and gram-negative bacteria. The most common adverse effects include GI disturbances such as diarrhea, nausea, vomiting and abdominal cramps, and less frequently hepatitis, headache, heartburn, and delirium. In March 2013 the FDA issued a warning that the drug may cause abnormal activity in the electrical activity of the heart that could lead to a potentially fatal irregular heart rhythm. It is available in tablets, extended release suspensions, and a suspension that can be taken on an empty stomach at least 1 hour before or 2 hours after a meal.

**Clarithromycin** has antibacterial activity similar to erythromycin and is available as a tablet, extended release tablets and suspension. It can be taken with or without food. It has side effects similar to those of erythromycin.

**Sulfasoxazole** is an antibacterial sulfonamide which is short-acting and rapidly absorbed from the GI tract. About 85% of the drug is bound to plasma protein. It has a broad-spectrum of activity that includes gram-positive bacteria and certain gram-negative organisms. Adverse effects include headache, nausea, vomiting, hematologic effects, functional hepatic changes, crystalluria which may result in oliguria, hematuria, and impaired renal function. The
risk of crystalluria may be reduced by adequate fluid intake. Sulfasoxazole may be taken with erythromycin as well as with trimethoprim.

**Trimethoprim** is an anti-infective agent which is effective against gram-positive aerobic bacteria and gram-negative bacteria including many penicillin-resistant strains. Adverse effects include sensitivity reactions such as skin rash and photosensitivity, nausea, vomiting, glossitis and hematologic effects.

**Ibuprofen** is a nonsteroidal anti-inflammatory drug (NSAID) used to reduce pain and fever. It also possesses antplatelet effects. Common side effects include nausea, GI bleeding, raised liver enzymes, diarrhea, constipation, headache and rash.

**The use of antihistamines and decongestants** may be helpful in reducing congestion of the Eustachian tube.

**SUMMARY**

Otitis media is an inflammation of the middle ear and is usually due to a bacterial infection. It is a very common condition in children and exists in the following subtypes: acute otitis media (AOM), otitis media with effusion (OME) and chronic otitis media with effusion (COME). The majority of patients with AOM improve spontaneously. However, cases that require treatment usually respond positively to the use of antibiotics such as amoxicillin, cephalosporins, erythromycin and its derivatives and sulfasoxazole with or without trimethoprim.

**References**


**2013 DEADLINE.**

FOR CREDITS TO APPLY FOR CALENDAR 2013, WE MUST RECEIVE THEM NO LATER THAN DECEMBER 31, 2013. ALLOW 10 BUSINESS DAYS FOR CREDITS TO APPEAR IN YOUR NABP ePROFILE (CPE MONITOR) ACCOUNT. DON’T FORGET TO GIVE US YOUR NABP, ePROFILE # & YOUR BIRTH DATA (MM/DD), WE DO NOT NEED YEAR.

**LICENSED IN FLORIDA?**

YOU MUST TELL US & YOU MUST GIVE US YOUR FLORIDA LICENSE #.
Fill in the information below, answer questions and return Quiz Only for certification of participation to:
CE PRN®, 400 Lake Cook Road, Suite 207, Deerfield, IL 60015.
NAME ____________________________________________________________________________
ADDRESS __________________________________________________________________________
CITY __________________________ STATE _________ ZIP ____________
CE PRN I.D. # __________________________
CPEMonitor ID ______________
Birthdate (MM/DD) ______________
ARE YOU LICENSED IN FLORIDA? IF YES, FL LIC # __________________________
EMAIL Address (we need this) __________________________________________________________

LEsson evaluation
Please fill out this section as a means of evaluating this lesson. The information will aid us in improving future efforts. Either circle the appropriate evaluation answer, or rate the item from 1 to 7 (1 is the lowest rating; 7 is the highest).
1. Does the program meet the learning objectives?
   List causes of OM YES NO
   Describe the anatomy of the ear. YES NO
   List symptoms of AOM, OME & COME YES NO
   Describe signs & symptoms that are used to diagnose OM YES NO
   List medication options that are used for treating OM YES NO

2. Was the program independent & non-commercial YES NO
   Low Relevance 1 2 3 4 5 6 7 Very Relevant

3. Relevance of topic

4. What did you like most about this lesson? _______________________________________________________
5. What did you like least about this lesson? _______________________________________________________

Please Mark the Correct Answer(s)

1. Which statement about the external ear is INCORRECT?
   A. Covered with a mucus membrane
   B. Contains sebaceous glands
   C. Contains hair follicles
   D. Directs sound waves to the ear drum

2. Cerumen:
   A. Drains from the ear following infection
   B. Is another term for “eardrum”
   C. Is composed of cholesterol, fatty acids & electrolytes
   D. Spontaneously sloughs off from the ear

3. Initial aggressive treatment of choice for AOM & OME should be high dose antibiotics.
   A. True B. False

4. Cholesteatoma is the formation of a keratinous epithelium cyst behind the eardrum.
   A. True B. False

5. Which statement is INCORRECT about azithromycin?
   A. A subclass of macrolide antibiotics
   B. May cause abnormal activity in electrical activity of the heart
   C. An alternate drug of choice for patients who are allergic to penicillin
   D. Must be taken immediately “pc”

6. A complication of AOM is:
   A. Speech impairment
   B. Loss of balance
   C. Tinnitus
   D. Mastoiditis

7. Which of these is the drug of choice for initial treatment of uncomplicated AOM?
   A. Sulfasoxazole B. Amoxicillin
   C. Ceftriaxone D. Clarithromycin

8. Which of the following is NOT an advantage of amoxicillin use?
   A. High efficacy
   B. Well distributed into middle ear fluid
   C. No side effects
   D. Well tolerated

9. Which statement is INCORRECT about ceftriaxone sodium?
   A. Must be administered parenterally
   B. A 3rd generation cephalosporin
   C. A bactericidal agent
   D. Well absorbed from GI tract

10. Detection of effusion in the middle ear is diagnosed by:
    A. Patient pulling the ear auricle
    B. Use of pneumatic otoscope
    C. Apply pressure behind the ear
    D. Inserting a syringe through the eardrum
Contributing Author
Farid Sadik, Dean Emeritus
University of South Carolina
College of Pharmacy
Columbia, SC
College of Pharmacy

Fax 847-945-5037

Program ID #707-000-13-011-H01-P.
CE Provider Tracking # with CEBroker.com is 50-3170.

CE PRN® is a publication of W-F Professional Associates, Inc.
W-F Professional Associates, Inc. is accredited by the Accreditation Council for
Pharmacy Education (ACPE) as a provider of continuing pharmaceutical
education. Providers who are accredited by ACPE are recognized by All
States for fulfilling CE requirements. Pharmacists completing this course by
September 30, 2016 may receive full credit. This lesson furnishes 2.50 hours (0.25
CEUs) of credit.

ALL PHARMACISTS---READ THIS! CREDIT STATEMENTS & HISTORY!
Check your CE activity or print a statement from your NABP eProfile (CPE Monitor)
Account.

FLORIDA PHARMACISTS---READ THIS!
We don’t know you’re Florida licensed unless you tell us. Place your Florida
license # on EVERY quiz.