

## Acute Otitis Media: Identification of Causative Pathogens with Antimicrobial Comparative Efficacy

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### Abstract

The otitis media is the most common type of ear infection while the most important cause of ear infections in humans is bacterial. *Pseudomonas aeruginosa* is the most common pathogen causing ear infection in pediatrics. Proper diagnoses and proper treatment is really required in case of ear infection because it may leads to deafness. Study aimed to evaluate the major pathogens causing ear infection. For the purpose of this study surveillance considerations was done by collecting the retrospective data from public healthcare sector of patients with immune-compromised so that we come to know about the major pathogens causing ear infection and their treatment options. Nearly the otitis media is the most common type of ear infection (50%). The bacterial pathogens are the major cause of infection (85%) mainly includes *Pseudomonas* species (21%). The (27%) of pathogens are resistant to antibiotic therapy while (38%) of the pathogens are sensitive towards various antibiotics. The untreated ear infection may leads to deafness so proper efficacious treatment is required in that case. After careful considerations about the pathogens causing ear infection. It was concluded that the bacterial, viral or fungal are the possible causes of ear infection. Proper diagnosis and proper treatment is required in these cases especially for pediatrics because they are more susceptible to those infections.

**Keywords:** Ear infection; Pathogens; Resistance pattern; Sensitivity pattern; Antimicrobial treatment

### Introduction

An ear infection (acute otitis media) is most often a bacterial or viral infection that influence the middle ear, behind the eardrum air filled in space that accommodate the tiny vibrating bones of the ear. Otitis media are of three types mainly: The first type is Otitis externa that intricate the outer ear and ear canal. In external otitis, the ear seems to be painful when touch and tugging. It's also called swimmers ear. Otitis media is the second type in otitis media; the ear is contaminating with fluid behind the ear drum, in the habitually air-filled in space of middle ear. The infection of middle ear is very common in childhood sometimes requires a surgical procedure called *myringotomy* and tube insertion. The third one is Otitis interna it involves the inner ear includes sensory organs. When the inner ear is inflamed common symptom is vertigo, also called as labyrinthitis [1-5].

Adults often suffer this form of the ear infection. In the infection of ear canal, the ear canal skin is inflamed. Ear infection caused by either viruses (influenza and respiratory syncytial virus is most common) and bacteria's most commonly including *Streptococcus pneumoniae* and *Pneumococcus* species. A fondness of stuffiness in the ears without any infection and characterized by inflammation and fluid, this is known as otitis media with effusion. This mainly happen due to chronic presence of fluid in ear or ear drum this chronic otitis media with effusion can create hearing problem for patients as well make them immuno-compromised. Symptoms of ear infection appears mostly after 2 to 7 days of infection the main symptom is feeling of pain in ear other symptoms include loss of appetite, fever, vomiting, fluid draining by ear, fussiness, clumsiness and scandal of ringing in ear [6-8]. There are various risk factors that makes person more credulous to ear infection which intricate mainly the age factor because children's ages 3 years or younger because Eustachian tube in children's much smaller than adults and so that they are more prone to ear infections another factors including congenital problems that makes person acquiescent to ear infection it was also seen that the immuno compromised individuals are also at high risk of ear infection problems [9,10].

There are many ways to diagnose the ear infection which include different testing the most commonly preferential test include pneumatic otoscope (the air passed to the ear by otoscope in order to see the movement of ear drum) other diagnostic tools including hearing test, tympanometry and blood tests [11-13]. Blood test for diagnosis only prefer when the immuno deficiency is a major cause of infection in ear. Some defensive steps could be taken in order to prevent from ear infection which includes immunization, proper child care, avoid smoking and maintenance of hygiene conditions in ear. In order to treat ear infection antibiotics used broadly which includes amoxicillin, rather than it antihistamines and decongestant could also administer. The most common examples include acetaminophen, phenylpropranolamine (PPA) and tylenol, etc. the most common side effects of these antibiotics include sedation, dry mouth, dizziness, headache and high blood pressure problems if use chronically [14-18].

Otitis media is a polymicrobial multifactorial disease the viruses which are playing a key role in causing ear infections are adenovirus, influenza virus and types A and B both types, respiratory syncytial virus (RSV), enterovirus, rhinovirus and coronavirus also the Para influenza virus. The most common viruses that cause upper respiratory infection and eventually initiates a chain that spread to throat and ear infection in complicated cases. It was perceive that viruses cause inflammation the middle ear and leads to acute otitis externa. In order to prevent from viral infections different vaccines are available for different viruses these vaccinations could absolutely help to prevent from ear infections

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and other infections caused by viruses. Particular antiviral antibiotics may also be very implicit to treat ear infection cause by viral pathogens. E.g. cebosch, etc. saliva virus is present in normal bacterial flora in oral cavity and it is proved to be non-pathogenic but also prevent from a variety of pathogenic organisms. It was also observed that saliva virus due to the formation of BLIS could prevent the growth of bacteria related to throat pain [19-24].

Where viruses are a main causative pathogens causing otitis media bacteria are also the major pathogens provoke ear infection. The three most common bacteria affiliated with otitis media are Pneumonia, Strepto., Catharlis and Influenza to cause any infection bacteria firstly enter into host body and it needs to colonization which is a dynamic process. It was reported that *Haemophilus influenza* show synergism effect if *Streptococcus pneumoniae* also attack that same individual having influenza virus species. These two species also block each other effects in some cases. Different agents used against a variety of pathogen like neomycin is only effective against *Staphylococcus aureus* and *Proteus* species while it is less effective against aeruginosa and anaerobes so polymyxin B used as a contrary to that specific species. Other than it chloramphenicol is effectual against a variety of organisms. Fluoroquinolones including ciprofloxacin is very common antibiotic to treat otitis media. Aminoglycosides e.g. gentamycin and amikacin are frequently used against gram negative bacteria by topical application to ears. Hence amoxicillin antibiotic is adequate against all gram positive bacteria's. Frequently upper respiratory infection, sore throat or pharyngitis can leads to ear infection [25-31]. Fungi can also cause otitis externa. In that case the ear should be clean through or it can be wash by 1% acetic acid in alcohol prescribed by a doctor. A variety of antifungal creams are also using now days to treat ear infection. Clotrimazole is very sufficient against *Candida* and *Aspergillus* species of fungi. The infection cause by fungi is very unusually occur [32-36].

The objective of the study is to evaluate pathogens causing ear infection (acute otitis media) isolated from severely ill patients in search of effective antimicrobial treatment option by finding sensitivity and resistance pattern.

## Methodology

Study designed basically based on retrospective evaluation of antibiograms from public healthcare centers of Pakistan especially from Abbasi Shaheed hospital of previously Ill and immuno-compromised patients. For that purpose susceptiveness and intrasignance pattern of most invasive pathogen *Pseudomonas aeruginosa*, *Streptococcus* species, etc. were assemble in-docurams of hospitals. After congregate there ruminative studies data were detach very exactly and which is related to the studies. The crude data then exploit to move on continuing studies on pathogens which are the extensive anticipant of ear infection. Obtained antibiograms were interpreted by CLSI reference standard protocol of susceptibility and resistance pattern [37].

## Results

According to observational studies of the data, the very most common pathogen causing ear infection is *Pseudomonas aeruginosa* (13%), other *Pseudomonas* species (7%), *Staphylococcus aureus* (5%), *Aspergillus* species (3%), *Streptococcus pneumonia*, *Proteus miabilis* and *Klebshiella pneumonia* (2%) while it was also observed that the very unusual pathogens that may cause ear infections include *Candida albicans*, *E. coli* and other gram positive cocci in pairs (1%). Through careful consideration it was seen that *Pseudomonas aerogenosa* is the very most common pathogen which is highly sensitive (93%) to a wide variety of antibiotics. As shown in Figure 1.

The susceptibility of ear infection in different age groups is as follows which seems to be that children's are more prone to ear infection because the Eustachian tube size is smaller as compared to adults one and also children's immunity is not fully developed Figure 2.

Middle ear infection or otitis media is the most frequent type of ear infection. The ratio of otitis media, otitis externa and otitis interna susceptibility in isolates is Figure 3:

The incidence of ear problems or stages of ear infectious problems in patients is characterized by chronic ear infection then deafness and which leads to ear hematoma. But it occurs in very unusual cases.as shown in Figure 4.

Ear infection caused by bacteria, virus and fungi. Bacteria accounts 85% of the ear infections cases and most unusually ear infections caused by fungi. Antibiotic susceptibility of *Pseudomonas aeruginosa* in isolates is described in Figure 5-7 (Table1).

## Discussion

The ear infection is the most common infections of pediatrics. The general physicians and ear specialist mostly handle the cases of middle ear infection worldwide. *Pseudomonas aeruginosa* is the very most common pathogen causing ear infections. Antibiotic therapy is required to treat ear infection if not then condition may become worse or may leads to deafness. However, when ear infection patient comes to physicians must consider the wide variety of pathogens including bacteria, viruses and fungi then treated with respect to the pathogen causing infection. Inappropriate antibiotic therapy may cause severe illness or resistance to drug. Our study is based on the ruminative studies of past two years of ICU patients. We have considered the incidence of otitis media in individuals. *Pseudomonas aeruginosa* is very sensitive to cephalosporins, penicillinS, and aminoglycosides, while less sensitive to glycolipids, carbapenems, macrolides and tetracycline's [38]. *Pseudomonas aeruginosa* could cause very severe illness for immune-compromised patients and may be it becomes life threatening if not treated on time properly. According to the studies other pathogens *Streptococcus pneumonia* and coagulase negative *Staphylococcus* is highly sensitive to penicillin's, *Proteus miabilis*, *Staphylococcus aureus*, *Klebsiella pneumonia* and *P. aeruginosa* is highly sensitive to cephalosporins. *Pseudomonas* species are highly sensitive to aminoglycosides; *Proteus vulgaris* is highly sensitive to carbapenems.

Combination therapy is the most efficacious therapy and could treat otitis media more early and properly with less chances of development of resistance. It could also treat with single antibiotic therapy like

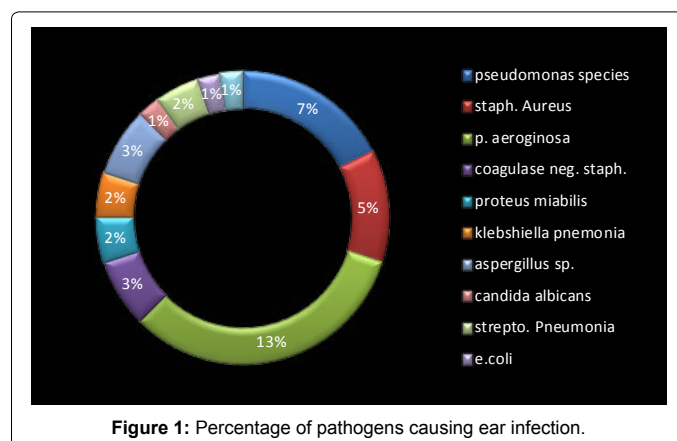
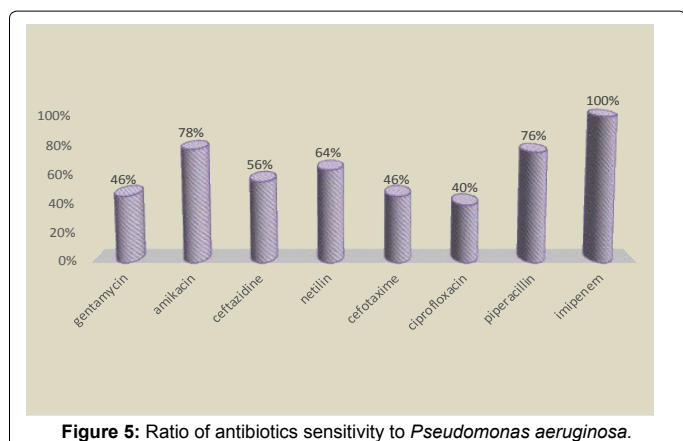
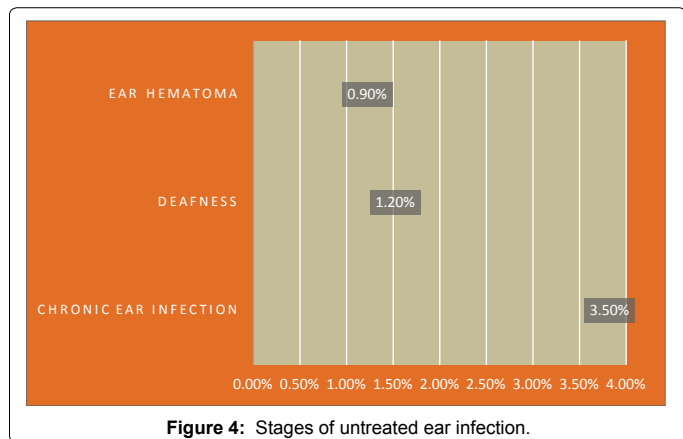
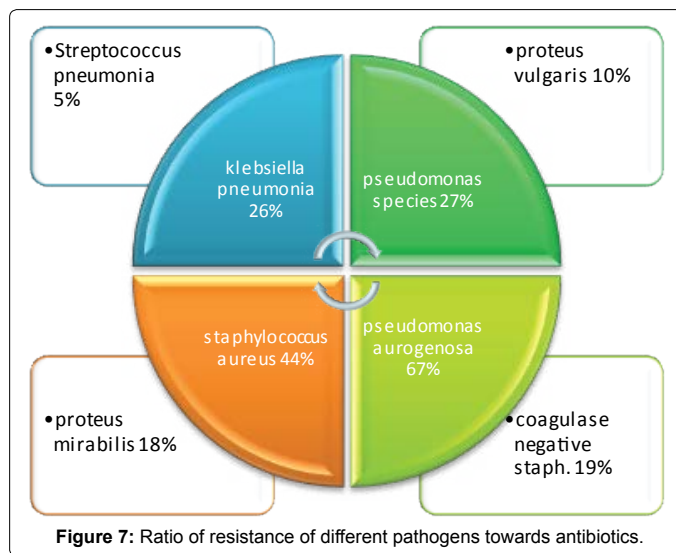
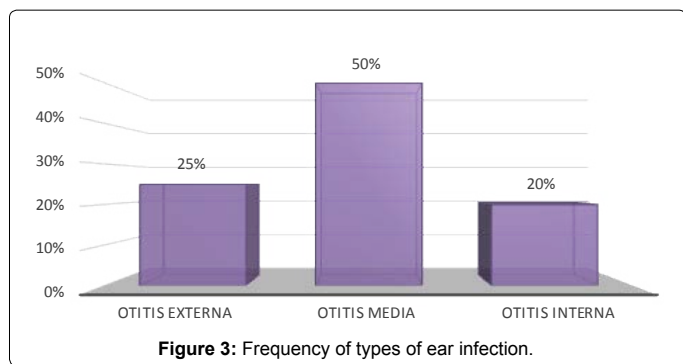
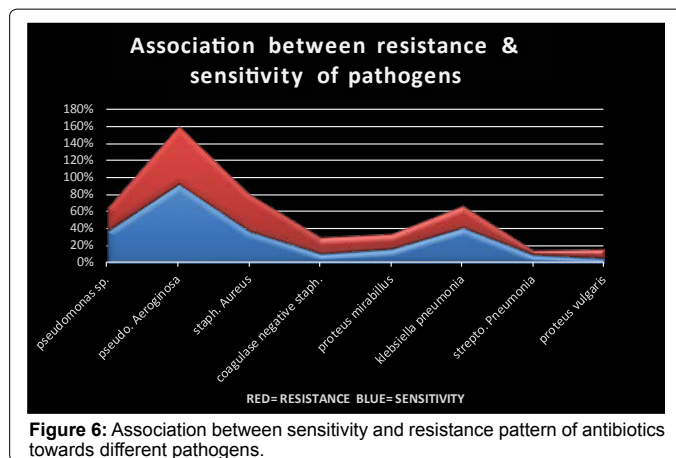
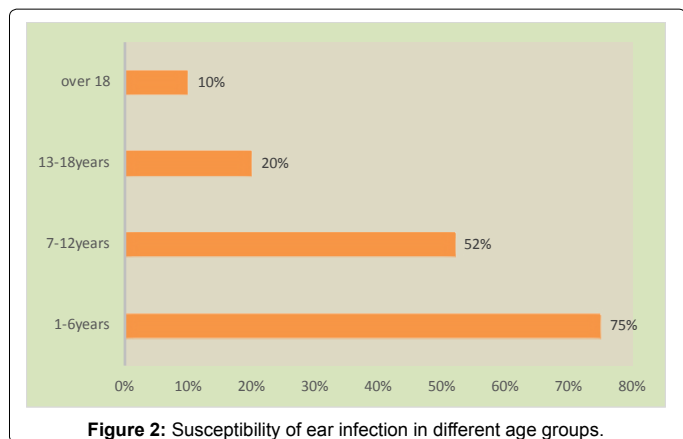


Figure 1: Percentage of pathogens causing ear infection.



cephalosporins are very widely used to treat ear infections but that infections caused by *Pseudomonas* species couldn't efficaciously treat by cephalosporins only it require combination of antibiotic therapy. Empirical treatment of ear infection by cephalosporin antibiotic is very most commonly use but it may be a major tool to cause resistance rather than to treat infection. Hence this could be control by proper diagnoses of ear infection by different diagnostic tools like otoscope, tympanectomy, etc. Studies shows that chronic ear infection could lead to deafness then ear hematoma. Otitis media is the most common type of ear infection. Pediatrics are more sensitive to infections specially ear infection so children's are mostly suffers from otitis media as due to small size of Eustachian tube and incomplete development of immune system.

From the above retrospective studies in public health care sectors of Pakistan it was observed that ear infection is not cause by a single pathogen instead there are a variety of pathogens that could cause ear infection either that are bacterial viral or fungal. The treatment options are basically depends upon the cause of infection [39,40]. The empiric use of antibiotic to treat ear infection may leads to a resistance hence further experimental and observational studies are require to treat ear infection in a first attempt without causing any type of resistance.

Drugs	<i>S. pneumonia</i>	<i>P. miabilis</i>	<i>P. species</i>	<i>P. vulgaris</i>	<i>S. aureus</i>	<i>P. aeruginosa</i>	<i>Coagulase negative staph.</i>	<i>Klebsiella pneumonia</i>
Resistance	R	R	R	R	R	R	R	R
Penicillins	1%	1%	3 %	1%	8%	8%	3%	2%
Cephalosporins	1%	6%	11%	3%	3%	25%	2%	4%
Glycopeptides	1%	1%	1%	1%	2%	3%	2%	1%
Carbapenems	-	3%	3%	-	4%	7%	2%	-
Aminoglycosides	2%	2%	2%	-	4%	1%	3%	3%
Tetracyclines	-	-	-	-	-	-	2%	-
Macrolides	1%	-	-	-	-	1%	-	--
Lincosamides	-	-	-	-	-	-	-	-
Quinolones	-	1%	1%	1%	4%	6%	2%	1%
others	1%	3%	3%	1%	1%	4%	2%	2%
Drugs	<i>S. pneumonia</i>	<i>P. miabilis</i>	<i>P. species</i>	<i>P. vulgaris</i>	<i>S. aureus</i>	<i>P. aeruginosa</i>	<i>Coagulase negative staph.</i>	<i>Klebsiella pneumonia</i>
Sensitivity	S	S	S	S	S	S	S	S
Penicillins	5%	3%	1%	-	6%	19%	3%	-
Cephalosporins	1%	5%	2%	-	8%	25%	2%	9%
Glycopeptides	1%	1%	1%	-	5%	7%	2%	1%
Carbapenems	-	1%	2%	2%	3%	10%	2%	4%
Aminoglycosides	2%	4%	8%	-	1%	23%	1%	3%
Tetracyclines	-	-	-	1%	-	-	-	-
Macrolides	1%	1%	-	-	-	1%	-	--
Lincosamides	-	-	-	-	-	-	-	-
Quinolones	-	3%	3%	-	3%	10%	-	3%
others	-	-	1%	1%	2%	4%	-	-

**Table 1:** The susceptibility of sensitivity and resistance of various antibiotics towards different pathogens causing ear infection.

## Conclusion

Introductory the ear infection is of three type's otitis externa, otitis media and otitis interna. Otitis media is not the unicast disease it is a multifactorial disease cause by a wide variety of pathogens. Treatment basically done on the basis of pathogen causing ear infection. Physicians may require to costumier antibiotic therapy based on the patient's initial response after the organism is confirmed, and sensitivity test results are accessible. Reasoning cure of contagious disease design serious challenge in the society because it cause high rate of mortality and morbidity in past years. The studies show very less association between sensitivity and resistance pattern of antibiotic against pathogens. Infections which congruous with serious challenge for both hospital and community acquired disease. Which generate need for the selection of earmark pathogens to confront problem relate with multidrug resistance during the treatment of ear infection. Proper diagnosing of ear infection is also a very basic tool for the treatment which could be done by hearing test, tympanectomy, otoscope, etc.

## Conflict of Interest

There is no conflict of interest regarding this publication.

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