



## **The Bacteriology of Discharging Ear (Otitis Media) Amongst Children in Owerri, Imo State, South East Nigeria**

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### **Authors' contributions**

*This work was carried out with the collaboration between all authors. Authors NUN and INSD designed this study and wrote the protocol. Authors NUN, ECC and INN were involved in the collection of the ear swab samples and the isolation and identification the bacterial Isolates.*

*Authors NNO and NUN performed antibiotics susceptibility tests on bacterial Isolates and wrote the first draft of the manuscript. Authors ECC and INN managed the literature searches but all authors read and approved the final manuscript.*

**Original Research Article**

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### **ABSTRACT**

The prevalence of causative agents of acute otitis media amongst children in some parts of Owerri, Imo State - Nigeria was investigated, between the months of September and December, 2012 using standard microbiological methods. One hundred and fifty two swabs from ear discharge were collected from children under 12 years of age. The results revealed that 128 (84.2%) were positive for bacterial growth while 24 (15.8%) had no growth. The predominant organisms isolated included *Pseudomonas aeruginosa* (37.5%), *Staphylococcus aureus* (23.4%), *Proteus* species (12.5%), *Klebsiella pneumoniae* (7.8%), *Escherichia coli* (7.8%) and *Streptococcus pneumoniae* (7.8%). Antibiotic susceptibility tests revealed that all the isolates were multiresistant to six or more of the tested antibiotics while the most prevalent organisms were susceptible to gentamycin, chloramphenicol and cotrimoxazole. *Pseudomonas aeruginosa* and *Proteus mirabilis* were susceptible to ofloxacin and ciprofloxacin. All the isolates were resistant to amoxicilline/clavulanate spectinomycin and ofloxacin (except *Staphylococcus aureus*). Therefore, chloramphenicol, gentamycin, cotrimoxazole ciprofloxacin and ofloxacin, are

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suggested as topical treatment in the management of acute otitis media and good personal hygiene is also encouraged.

*Keywords: Acute otitis media; predominant organism; susceptibility patterns; infection management.*

## 1. INTRODUCTION

Acute otitis media is a purulent infection of the middle ear caused by the entrance of bacteria through the eustachian tube [1] and it is one of the commonest diseases of infants and young children. In children, its incidence is still greater than in adults because of the child's lower level of immunity and greater predisposition to infection [2].

The major epidemiological factors for otitis media are age, gender, race, socio-economic and cultural conditions, genetic and environmental factors, nutrition and poor hygiene [3], while symptoms of acute otitis media include severe unbearable pains, fever and redness of the external ear, however, complications like the rupturing of the ear drum followed by release of yellowish or whitish discharge may manifest later.

[4] Reported that the major pathogens responsible for acute otitis media include *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa*, *Proteus* species, *Haemophilus influenzae* and *Escherichia coli* and several antibiotics have been reported to be used in the treatment of otitis media such as amoxicillin, ampicillin, erythromycin and Cotrimoxazole [5].

Despite the use of these antibiotics, acute otitis media is still a relatively common condition in children and an important cause of functional disability. Sometimes complications of the disease persist into adult years, affecting the productivity of these adults.

This work was therefore carried out to study the prevalence of this condition amongst children in some parts of Imo State, Nigeria, the microorganisms involved as well as their susceptibility pattern to antimicrobial agents.

## 2. MATERIALS AND METHODS

### 2.1 Sample Collection

Samples were collected from patients admitted in some hospitals and those referred to some laboratories within Owerri Municipality. The hospitals included Federal Medical Centre, Owerri, General Hospital Owerri, Amanda Hospital, Ikenegbu Hospital, Avigram Diagnostic Laboratory and St. John's Laboratories Ikenegbu, Owerri, Imo State - Nigeria. A sterile swab was used to collect some of ear discharge from patients who had experienced symptoms of acute otitis media and ear discharges for at least 15 days and had not received any antibiotics for the previous five days. This was done before washing and cleaning of patients' ears and before treatment.

## 2.2 Isolation and Identification of Bacteria

The specimens were cultured on blood agar, nutrient agar, macConkey agar and chocolate agar plate and incubated aerobically for 24 hours at 37°C, except chocolate agar plates which were incubated anaerobically, for 24 hours at 37°C. A gram stain of the isolates was done to identify the gram reaction of each isolate and isolates were identified based on morphological, cultural and biochemical characteristics as described by [6,7,8]. These characteristics are mentioned in Table 1.

## 2.3 Antimicrobial susceptibility test

Antimicrobial susceptibility tests were performed using Kirby- Bauer disc diffusion method [9]. Antimicrobial discs used for the tests were gentamicin (10 µg), ofloxacin (10 µg), cotrimoxazole (30 µg), ampicillin (30 µg), amoxicilline/clavulanate (30 µg) and ciprofloxacin (10 µg). Others included chloramphenicol (20 µg), spectinomycin (50 µg), erythromycin (30 µg), ampicillin and cloxacillin (30 µg), rifampicin (10 µg), norfloxacin (30 µg), pefloxacin (10 µg), streptomycin (30 µg) and cephalixin (10 µg).

## 3. RESULTS

### 3.1 Biochemical Characterization of the Isolates

Results revealed that 33.3% of the isolates were gram positive and 66.7% gram negative. Bacterial isolates included *Staphylococcus aureus*, *Proteus spp*, *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Streptococcus pneumoniae* Table 1.

### 3.2 Prevalence of Isolated Bacteria

Out of the 152 samples investigated, 128 (84.2%) yielded bacterial growth, while the other 24 (15.8%) cases yielded no growth.

The isolated bacterial species included *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Proteus* species, *Escherichia coli*, *Klebsiella pneumoniae* and *Streptococcus pneumoniae* Table 2. The most prevalent organism was *Pseudomonas aeruginosa* (37.5%) followed by *Staphylococcus aureus* (23.4%). Other species are shown in Table 2. The gender-related distribution showed that more males (60.9%) were infected than females (39.1%)

### 3.3 Drug Susceptibility Test

The drug susceptibility test revealed that all the tested isolates were susceptible to ofloxacin, except *Staphylococcus aureus*, that was susceptible to chloramphenicol, cotrimoxazole, erythromycin, norfloxacin and rifampicin. Also the gram - negative bacteria isolated in this study were sensitive to ciprofloxacin. The organisms were all resistant to amoxicilline/clavulanate(30 µg) and Spectinomycin(50 µg) Table 3.

Table 1. Cultural and Biochemical Characterization of the Isolates

| Probable Bacterial species      | Characteristic of the selected colonies  | Gram Reaction | MOT | CAT | COA | CIT | OX | M-R | V-P | GLU | LAC | IND | UR | BIL |
|---------------------------------|--|---------------|-----|-----|-----|-----|----|-----|-----|-----|-----|-----|----|-----|
| <i>Staphylococcus aureus</i>    | Yellow-cream shiny colonies on nutrient agar and slight lysis on blood agar.     | +             | -   | +   | +   | -   | -  | -   | -   | A/G | A/G | ND  | ND | -   |
| <i>Proteus</i> species          | Large mucoid swarming growth on nutrient agar                                    | -             | +   | -   | -   | +   | ND | -   | -   | A/G | A   | +   | +  | ND  |
| <i>Klebsiella pneumoniae</i>    | Rose-pink colonies on MacConkey's agar and mucoid cream on nutrient agar         | -             | -   | +   | -   | +   | -  | ND  | ND  | A/G | A/G | -   | +  | +   |
| <i>Escherichia coli</i>         | Small shiny colonies on nutrient agar and rose-pink colonies on MacConkey's agar | -             | +   | +   | -   | -   | -  | -   | +   | A/G | A/G | +   | +  | -   |
| <i>Pseudomonas aeruginosa</i>   | Yellow-green pyocyanin pigmentation on nutrient agar                             | -             | +   | +   | -   | +   | +  | -   | -   | A   | A/G | -   | +  | ND  |
| <i>Streptococcus pneumoniae</i> | Grey $\alpha$ - haemolytic colonies on blood agar                                | +             | -   | -   | -   | -   | -  | +   | +   | A/G | A   | -   | -  | +   |

MOT–Motility, CAT-Catalase, COA-Coagulase, CIT-Citrate Utilization Test, OX-Oxidase, M-R - Methyl Red, V-P -Voges Proskauer, GLU-Glucose, LAC-Lactose, IND-Indole, UR-Urease, BIL-Bile solubility, A/G-Acid and Gas production, A-Acid production only, += Positive result, -= Negative result, ND – Test not done

Table 2. Microorganisms Isolated from the Cases of Otitis Media

| Pathogens isolated              | No. of Organisms Recovered | Male              | Female            |
|---------------------------------|----------------------------|-------------------|-------------------|
| <i>Pseudomonas aeruginosa</i>   | 48 (37.5%)                 | 32 (66.71%)       | 16 (33.3%)        |
| <i>Staphylococcus aureus</i>    | 30 (23.4%)                 | 22 (73.3%)        | 8 (26.7%)         |
| <i>Proteus mirabilis</i>        | 16 (12.5%)                 | 2 (12.5%)         | 14 (87.5%)        |
| <i>Proteus vulgaris</i>         | 4 (3.13%)                  | 4 (100%)          | 0 (0%)            |
| <i>Klebsiella pneumoniae</i>    | 10 (7.8%)                  | 6 (60%)           | 4 (40%)           |
| <i>Escherichia coli</i>         | 10 (7.8%)                  | 10 (71.4%)        | 4 (28.6%)         |
| <i>Streptococcus pneumoniae</i> | 10 (7.8%)                  | 2 (33.3%)         | 4 (66.4%)         |
| <b>Total</b>                    | <b>128 (84.2%)</b>         | <b>78 (60.9%)</b> | <b>50 (39.1%)</b> |

Table 3. Antibiotic Susceptibility Pattern of Isolates

| Anti-microbial agent | Disc potency ( $\mu\text{g}$ ) | <i>Staphylococcus aureus</i> | <i>Proteus</i> species | Diameter of zone(mm)<br><i>Escherichia coli</i> | <i>Klebsiella pneumoniae</i> | <i>Pseudomonas aeruginosa</i> | <i>Streptococcus pneumoniae</i> |
|----------------------|--------------------------------|------------------------------|------------------------|---|------------------------------|-------------------------------|---------------------------------|
| CN                   | 10                             | 9                            | 20                     | 30  | 22                           | 15                            | 27                              |
| AU                   | 30                             | R-                           | R-                     | R-  | R-                           | R-                            | R-                              |
| CPX                  | 10                             | R-                           | 30                     | 24  | 28                           | 30                            | R-                              |
| SXT                  | 30                             | 26                           | 15                     | 16  | R-                           | 5                             | R-                              |
| CEP                  | 10                             | R-                           | 11                     | R-  | 7                            | 10                            | R-                              |
| S                    | 30                             | R-                           | 14                     | 7   | 15                           | 22                            | 26                              |
| PN                   | 30                             | 12                           | 15                     | 15  | 10                           | R-                            | 25                              |
| OFX                  | 10                             | R-                           | 20                     | 27  | 21                           | 28                            | 17                              |
| PEF                  | 10                             | R-                           | 24                     | 17  | 28                           | R-                            | R-                              |
| CH                   | 20                             | 22                           | 19                     | 21  | 20                           | 26                            | R-                              |
| E                    | 30                             | 29                           | R-                     | R-  | 6                            | R-                            | 29                              |
| APX                  | 30                             | 11                           | R-                     | R-  | R-                           | R-                            | 6                               |
| RD                   | 10                             | 25                           | R-                     | R-  | R-                           | 4                             | 21                              |
| TG                   | 50                             | R-                           | R-                     | R-  | R-                           | R-                            | R-                              |
| NB                   | 30                             | 21                           | R-                     | R-  | R-                           | R-                            | 30                              |

CN-Gentamycin, E-Erythromycin, AU-Amoxicilline/clavulanate, CPX-Ciprofloxacin, CH-Chloramphenicol, SXT-Cotrimoxazole, APX-Ampicillin and cloxacillin, CEP - Cephalexin, RD-Rifampicin, S-Streptomycin, TG-Spectinomycin, PN-Ampicillin, NB-Norfloxacin, OFX-Ofloxacin, PEF-Pefloxacin, R- = Resistant.

#### 4. DISCUSSION

Our findings show that acute otitis media is still a prevalent health problem. *Pseudomonas aeruginosa* (37.5%) was the most predominant isolate causing acutely discharging ear and in both gender. This is in agreement with studies in Nigeria [10] but differs from studies in developed countries where *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxilla catarrhalis* were predominant [11]. Geographical locations have been reported as one of the factors that determine bacterial agents of otitis media [12,4] had earlier isolated *Staphylococcus aureus* (44%) and *Pseudomonas aeruginosa* (19.6%) from ear discharge samples. The presence of *Streptococcus pneumoniae* had been reported by [13] and later by [14], while [2] reported *Pseudomonas aeruginosa* and *Proteus* species as being the most encountered organisms from their study on otitis media. [12] In a similar study in Benin-Nigeria, had reported *Pseudomonas aeruginosa*, *Proteus sp.* and *Staphylococcus aureus* as the most prevalent microorganisms [15]. Found that most of the studies carried out in Southern Nigeria showed a higher prevalence rate of the infection when compared to the Eastern part of Nigeria. This may be explained by the high humidity conditions of the southern states that might have favored the colonization and increased the incidence of otitis media.

It was noted that more than 70% of the recovered organisms in our study were from children less than 12 years of both sexes. It is possible to postulate that the relatively high prevalence in children may be due to their poor personal hygiene in addition to other environmental factors [3].

The management of acutely discharging ear in patients varies widely among clinicians and points of disagreement occur with respect to choice of treatment. Some clinicians have prescribed use of penicillin coupled with sulfonamides while some have used herbal treatment like garlic oil [16,17]. From our study, gentamycin, chloramphenicol and cotrimoxazole were effective against the most prevalent organisms namely *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Proteus* species while ciprofloxacin and ofloxacin were effective against *Pseudomonas aeruginosa* and *Proteus* species except *Staphylococcus aureus* which was resistant to both. These antibiotics are therefore recommended for the topical treatment of discharging ear in cases of otitis media while considering the prescribing strategy for children [18]. Systematic treatment should involve a broad spectrum antibiotic, according to the respective susceptibility either given orally or administered intravenously. However, ampicillin, chloramphenicol, erythromycin, rifampicin and norfloxacin were also active against *Staphylococcus* species isolated in this study. All isolated pathogens showed multiresistance to six or more of the tested antibiotics

#### 5. CONCLUSION

The prevalence of acute otitis media is evident amongst children with higher infection rates in males than in females. Infections might be affected by several factors including humidity and poor personal hygiene.

From this study, the most prevalent microorganisms isolated are *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Proteus species*. Antibiotic sensitivity testing revealed that gentamycin, chloramphenicol, cotrimoxazole, ciprofloxacin and ofloxacin could be used for topical treatment of acute otitis media. Therefore, it is recommended that children should be

given adequate attention in terms of their hygiene to minimize their risk of infection with acute otitis media and provided treatment early in infection.

## **COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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