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Prevalence of Ear Infections in First Year Children of Primary Schools in A Western Ugandan Community

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Abstract

Ear infections in the United Kingdom were reported at a prevalence of 90% in children aged 0–6 years peaking at six years, the commonest age for Ugandan children to start primary school. This study was done to determine prevalence of ear infections in primary one children in Mbarara district, identify commonest ear infections, the causative pathogens isolated and their antibiograms and comparing the prevalence of ear infection in urban and rural schools. A cross sectional study was carried out among three urban day schools and three rural day schools randomly chosen in Mbarara district. History was taken using a data collection form and examinations were done using an otoscope. All pus swabs from infected ears were inoculated on Blood agar, Chocolate agar, MacConkey Agar plates before smears for Gram staining were made. Identification of the pathogen was through biochemical tests and API system. Sensitivity tests to antibiotics were set on Mueller Hinton Agar using the disc diffusion technique of Kirby-Bauer. Otoscopy was done on 600 children, 8.0 %(48) showed signs of ear infections. The commonest ear infection was otitis externa. Staphylococcus aureus species showed the highest prevalence with 75% (6). Staphylococcus aureus species showed 100% sensitivity to gentamicin, 80% sensitivity to ciproflaxin. Serratia marcencens also showed 100% sensitivity to ciproflaxin, The prevalence of ear infection was 8.0% among children in primary one in Mbarara district in a cross sectional study.

Keywords

Ear infections; Primary school children; Antibiograms; South-west Uganda

INTRODUCTION

Globally, an estimated 278 million people live with disabling hearing impairment resulting from ear infection. Childhood hearing Impairment, even if transient, can have long-term adverse effects on behavior, speech and language development, academic performance and future employment. (Robert et al, 2011).

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Ear infections are so prevalent that about 50% of children in the United Kingdom are reported to have been infected with Otitis Media (ear infection) within the first year of their birth. This percentage shockingly rises to as much as 90% for children aged up to six years which is the commonest age bracket for primary one children in Ugandan primary schools and primary school in Mbarara as a district. (sinuswars, 2002) There are three types of ear infections. Each type is defined according to where they occur in the ear canal. An ear infection may take place in the inner (otitis interna) , middle (otitis media (OM), or outer ear (otitis externa (OE)) (Shiel, 2016).

Otitis externa (OE) can take acute or chronic forms. The acute form is primarily of bacterial origin and annually affects four in 1,000 persons in the United States. The chronic form is commonly of a fungal or allergic origin or is the manifestation of dermatitis. It affects 3 to 5 percent of the population. Manifestations include pruritus, pain, and erythema, but as the disease progresses, other problems such as edema, otorrhea, and conductive hearing loss may develop. Disease can range from mild inflammation, which occurs in approximately 50 percent of cases, to life-threatening temporal bone infections in less than 0.5 percent. (David, 2006)

Otitis Interna mainly presents mainly with loss of balance and sensory neural hearing impairment. All these presentations are dependent on severity of infection. There are various predisposing factors which may include swimming, history of ear infection in early childhood, anatomical abnormalities, immunosuppression, trauma, allergic reactions. (Peter et al, 2009).

The causative organisms can be viruses, bacteria, fungi. For OM, most commonly the cause is a viral infection and this can be complicated by a secondary bacterial infection which is indicated by a persistent symptomatic disease. The most common viral causes include respiratory syncytial virus, influenza, adeno virus, rhino virus, corona virus, entero virus, parainfluenza and metapneumo virus. Bacterial causes include streptococcus pneumoniae, Haemophilusinfluenzae, Moraxella catarrhalis and Streptococcus pyogenes. Other common bacterial species include Staphylococcus, Pseudomonas aeruginosa, Escherichia coli, S. aureus, Proteus mirabilis, Klebsiella species, Bacteroides, Peptostreptococcus, Proprionibacterium cause OM. Among these bacterial species, P. aeruginosa has been particularly blamed for the deep-seated and progressive destruction of middle ear and mastoid structures through its toxins and enzymes. (Peter et al, 2009).

OM has a range of clinical presentations including AOM, which is characterised by the rapid onset of local and systemic symptoms, including otalgia, fever, vomiting and accumulation of fluid in the middle ear cavity and OME, where the child experiences middle ear fluid accumulation without the systemic symptoms. Both of these presentations may occur recurrently or chronically. Globally, more than 700 million cases of AOM are diagnosed each year, with 50% of affected children being under five years of age. Recurrent AOM is commonly observed in up to 65% of children by 5 years of age. OME typically resolves spontaneously within 3 months however, 30–40% of children experience persistent or chronic fluid in the middle ear for more than 3 months. (chinh, 2016)

Ear infections are common infections in children for which antibacterial agents are prescribed, for example Acute Otitis Media (AOM) in children in the United States. Hence, the diagnosis and management of ear infections has a significant impact on the health of children, the cost of providing care, and overall use of antibacterial agents. These infections also generate a significant social burden and indirect cost due to time lost from school. For the clinician, the choice of a specific antibacterial agent is an important aspect of management. Concerns about the rising rates of antibacterial resistance and the growing costs of antibacterial prescriptions have focused the attention of the medical community and the general public on the need for sensible use of antibacterial agents (Peter et al, 2009).

In routine practice, obtaining etiological culture-confirmed diagnosis is uncommon, thus the need for regular studies to identify susceptibility patterns. (Bardachet al, 2011). Poorly treated ear infections can lead to a number of complications ultimately leading to hearing impairment.

Ear infection was an area that has been neglected in Uganda. There was lack of enough information about the prevalence of ear infection among primary one children in schools in Mbarara district. This study will provide an estimate of the population-based data on the occurrence rate, the nature and type of ear infection in primary one children in primary schools in Mbarara. This information is particularly needed to measure the burden of ear infection in children in Mbarara.

The susceptibility patterns identified will update antibiograms hence influence the antibiotics chosen for management of ear infections. Early identification, timely assessment, support and intervention will prevent the complications that may result from ear infection like hearing impairment which will probably improve speech development, listening and reading skills and academic performance of the primary one children with ear infections.

The aim of this study was to determine the prevalence of ear infections in the first year children in primary schools in Mbarara district of Uganda, with specific objectives of identifying the common types of ear infection, establishing the antibiogram of the pathogens isolated from ear discharge and comparing the prevalence of ear infection in urban and rural populations (schools) hence make recommendations to clinicians, including pediatricians and otolaryngologists.

MATERIALS AND METHODS

Study design:

The study was a cross section study design, carried out in Mbarara district in western Uganda (Coordinates 00 36S 30 36E). Six day schools were chosen randomly. The study was carried out from 5th May 2012 to 5th may 2013. It was carried out among children of primary one in three urban (Mbarara army primary school, Mbarara parents primary school, Mbarara municipal school) and three rural (Bugashe primary school, Ndeija primary school, Kagongi primary school) day primary schools in Mbarara district. The study had variables which included sex, age, antibiograms, bacterial isolates, type of ear infection.

Inclusion and Exclusion Criteria:

All pupils in primary one day schools whose parents had consented to participate in the study were enrolled into the study and those whose parents did not consent were not enrolled. Data was collected using data collection form.

Sample Size.:

The sample size was calculated using the standard formula (Dahiru *et al*, 2006) for prevalence studies. During the substitution of value in the formula, we got a sample size of 138 primary one children, however in order to establish a reliable prevalence rate, we examined a total of 100 children per school giving a total of 600 children. The sampling was randomly done both for the schools and the children who participated in the study.

Data Collection Procedure and Analysis:

The children that took part in the study were assessed by three medical students in year IV who had already rotated in Ear Nose and Throat clinic. Clinical examinations were done using an otoscope with specific interest to ear infections. History was guided by a data collection form and where a discharge was found, before a sample was collected, the external ear was cleansed with sterile cotton swabs moistened with sterile physiological saline and then an ear swab was taken for laboratory examination.

All samples were inoculated on Blood Agar (BA), Chocolate Agar (CA) and MacConkey Agar (MCA) plates before smears for gram staining were made on clean microscope slides. The BA and MCA plates were incubated aerobically at 37oc for 24hr while the CA plates were incubated under 5% CO2 at 37oc for 24hr.

The growths were examined macroscopically and biochemically (API system) to identify the isolates as recommended by Cowan and Steel. Antibiotic sensitivity was performed on the identified organisms by the disc diffusion method using Diagnostic Sensitivity Test (DST) agar (or Mueller Hinton Agar) as described by Stokes and Ridway. Control organisms used was staphylococcus aureus (NCTC 6571) and E. coli (NCTC 10418).

Data Analysis:

The results obtained from the data collection forms, clinical examinations using otoscopes and laboratory examination of the samples provided the required data. The collected data was entered into the computer using statistical packaging for social scientists (STATA) and analysed accordingly. For further illustration of the results, bar graphs and pie charts were used.

Ethical considerations:

The study only begun after the Faculty Research and Ethics Committee and Faculty of Medicine at Mbarara University had approved the proposal. Permission was obtained from the district education officer and Head teachers of the schools since they acted as gate keepers. The children who are eligible and whose parents/guardians had consented were included and briefed about the study. All information gathered from the study was coded for cases of privacy and security. Examination was carried out in a closed room, one student at a

time. The child found infected were referred to the nearest health centers. Those with complications were referred to Mbarara regional referral hospital.

RESULTS

The prevalence of ear infections in rural and urban areas is shown in Table 1. From the 600 children clinically examined using an otoscope, 552 (92.0%) showed no signs of ear infections while 48(8.0%) showed signs of ear infections. Out of the 48(8.0) infected children, 6 children showed ear discharge and 2 showed post auricular ear infection which all yielded bacterial growth after culture (8 species of organisms).

Using the fishers exact test, the p-valve was 0.773 greater than the conventionally accepted significance of 0.005 (i.e. $p>0.05$). In other words there is no statistically significance difference in the proportion of otitis media and otitis externa in the study.

More males, 26 children representing 4.33% were infected than females, 22 children representing 3.67%. 100% of the children who were infected were in the age range of 5–7 years. Other findings included children who had wax impaction and foreign bodies in their ears, 110 children had wax impaction representing 0.18%, 50 girls and 60 boys in both rural and urban (i.e. 51children in rural areas, 59 children in urban areas) Foreign bodies, 20 children representing 3.33%, 13 girls and 7 boys in both rural and urban. (i.e. 6 children in urban areas, 14 in rural areas). A total of 14 (2.33%) males and 15(2.50%) females were infected in urban schools.12 (2%) males and 7(1.17%) female were infected in rural schools. In urban schools, a total of 144 male and 156 female students were examined. In rural schools, 155 males and 145 female students were examined. Urban areas showed a higher prevalence of ear infections of 29 pupils representing 4.83% while the rural areas showed a prevalence of 19 pupils representing 3.17%

As shown in figure 1, Otitis externa affected more urban school (20 children) than rural school (7 children). Otitis media with effusion affected more rural school (4 children) than urban school (2 children). Acute Otitis media affected more children in rural school (6 children) than in urban school (3). Suppurative otitis media affected rural and urban schools equally (3 children). The commonest type of ear infection was otitis externa because it showed the highest prevalence in both urban and rural primary schools.

Figure 3 shows that Gentamicin, tetracycline and ceftazidine-clavulunic acid gave the highest sensitivity of 100% while Ciproflaxin, chloramphenicol, erythromycin showed the highest resistance of 10%. As shown in Figure 4, Ciproflaxin, gentamicin and chloramphenicol showed the highest sensitivity of 100%

DISCUSSION

Most of the pupils seen in this study had the various forms of ear infection ranging from acute Otitis Media, chronic suppurative Otitis Media, and Otitis Media with effusion to Otitis Externa.

The prevalence of ear infection was 8.0% among pupils in primary one in Mbarara district between 5th may 2012 to 5th may 2013. Urban primary schools showed a higher prevalence of 4.83% while rural primary schools showed a prevalence of 3.17%. The high prevalence of ear infection in urban primary schools results from upper respiratory infections due to high levels of air pollution in urban schools. The high level of air pollution causes bacteria to invade the nasopharynx weakening the immature immune system resulting in an inadequate antibody response leading to middle ear infection. (Burns, 2013).

The commonest type of ear infection in both urban and rural schools was Otitis Externa. The causes of otitis externa included foreign bodies, immune mediated reaction i.e. drug reaction, fungal infection (aspergillosis), parasite infection, bacterial infections. The ratio of male to female was 26:22 with more males affected than females. This was comparable to the findings of Bashir et al, 2008 who recorded more males than females in a ratio of 2.5:1. However this was in contrast to Adeyemi et al, 2007 who reported more females 49 (52.7%) than males 44 (47.3%). The male preponderance in this study cannot be explained as no knowledge of anatomical difference between the ear structures of male and female children has been reported, Nwokoye et al, 2012. However, Akinpelu and Amusa (2007) argued that the high incidence of male patients presenting with ear infections especially Otitis Media could be because of the active and adventurous nature of the boys that predispose them to traumatic conditions. Gram positive bacteria, 7(87.5%) were the commonest bacterial isolates detected children infected with Otitis Media with discharge, followed by Gram negative bacteria, 1(12.5%). These results were comparable with those by Bashir et al, 2008 who reported thatGram positive bacteria (49.8%) were greater than Gram negative bacteria (46.5%) in incidence. However this was in contrast to the findings of Adeyemi et al, 2007 who reported a high prevalence in Gram negative organism of 72 (68.2%) than Gram positives 32(30.8%).

Gram positive bacteria included Staphylococcus aureus species 6(75%), Dephtheroids 1(12.5%)and Gram negative bacteria included Serratia marcencens species 1(12.5%). This finding was however in contrast to the findings of Nwokoye et al, 2002 at Nigerian institute of Medical Research Yaba who reported M. Catarrhalis (19.0), Bacteroides ureolyticus (14.9%) and Micheal et al, 2002 who recorded Haemophilus inflennza in their studies.

In line with this study Staphylococcus aureus presented in 75% and it was the most frequent microorganism, Adegbite et al, 2004 reported Staphylococcus aureus as the most commonly recovered organism from the chronically draining ear while other researchers have also recorded high prevalence of Staphylococcus aureus 40%, 30.8%, Bashir et al, 2008 and Adeyemi et al, 2007 respectively. This was in contrast to Nwokoye et al, who reported Streptococcus pneumonia (38.1%) as the most predominant microorganism.

Brobby, 1992 reported that the aetiologic of organism in Otitis Media vary from continent to continent i.e. locality to locality. This variation can be attributed to the emergence of increasing antimicrobial resistance, difference in social cultural practices, nutrition and socio-economic factors among others. The diverse nature of bacterial aetiology of Otitis Media reported in this study therefore confirms previous studies.

Since all the children were found at school, it is assumed that the infection was community acquired. Poor hygiene and unorthodox approach to treatment which include introduction of unconventional ear drops and concoctions such as oil and local herbs into the middle ear may have initiated the proliferation of pathogens (that have gained access to the ear) leading to blockage of the eustachian tube or development of a post auricular ear infection.

Staphylococcus aureus species showed 100% sensitivity to gentamicin, tetracycline and ceftazidine-clavulunic acid, 80% sensitivity to ciproflaxin. Serratia marcencens also showed 100% sensitivity to ciproflaxin, gentamicin, and chloranphenicol. This was in contrast to Bashir et al, 2008 who reported that ofloxacin was the most sensitive drug. It showed 98% sensitivity to Pseudomonas species and 96% sensitivity to Staphylococcus aureus.

The limitations in this study were mainly encountered during the process of history taking since most of the children were too young.

In conclusion, the ratio of male to female was 26:22 with more males affected than females. This showed no significant statistical difference. The prevalence of ear infection was 8.0% among pupils in primary one in primary school in Mbarara district between 5th may 2012 to 5th may 2013. Urban primary schools showed a higher prevalence of ear infections in primary one children than rural primary schools. Staphylococcus aureus species accounted for most of the ear infections. The overall percentage sensitivity of the organism was to gentamicin and ciproflaxin.

The use of eardrops containing ciproflaxin and gentamicin should be encouraged. It has been proved to be an effective first-line topical antibiotic in the treatment of chronic suppurative Otitis Media. Further studies about infections are encouraged. Increased health sensitization of children and the community on the possible risk factors of ear infection as a preventive strategy that might reduce disease occurrence should be encouraged.

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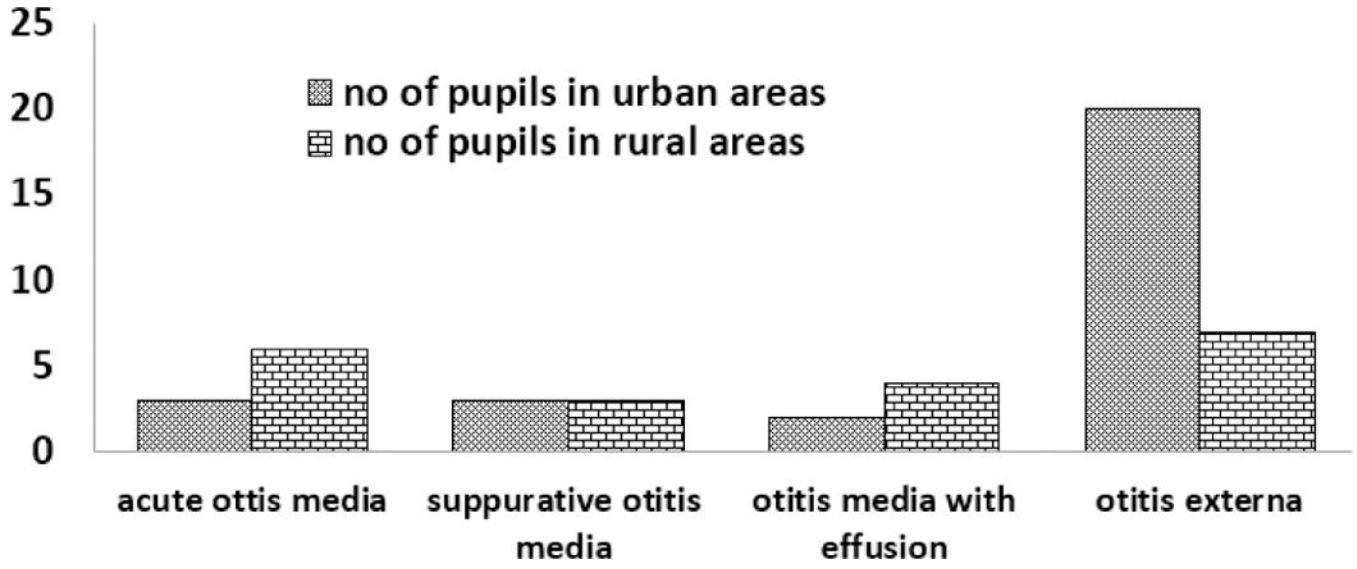

Figure 1:
Types of Ear Infections in first year primary school students in Mbarara district of Uganda

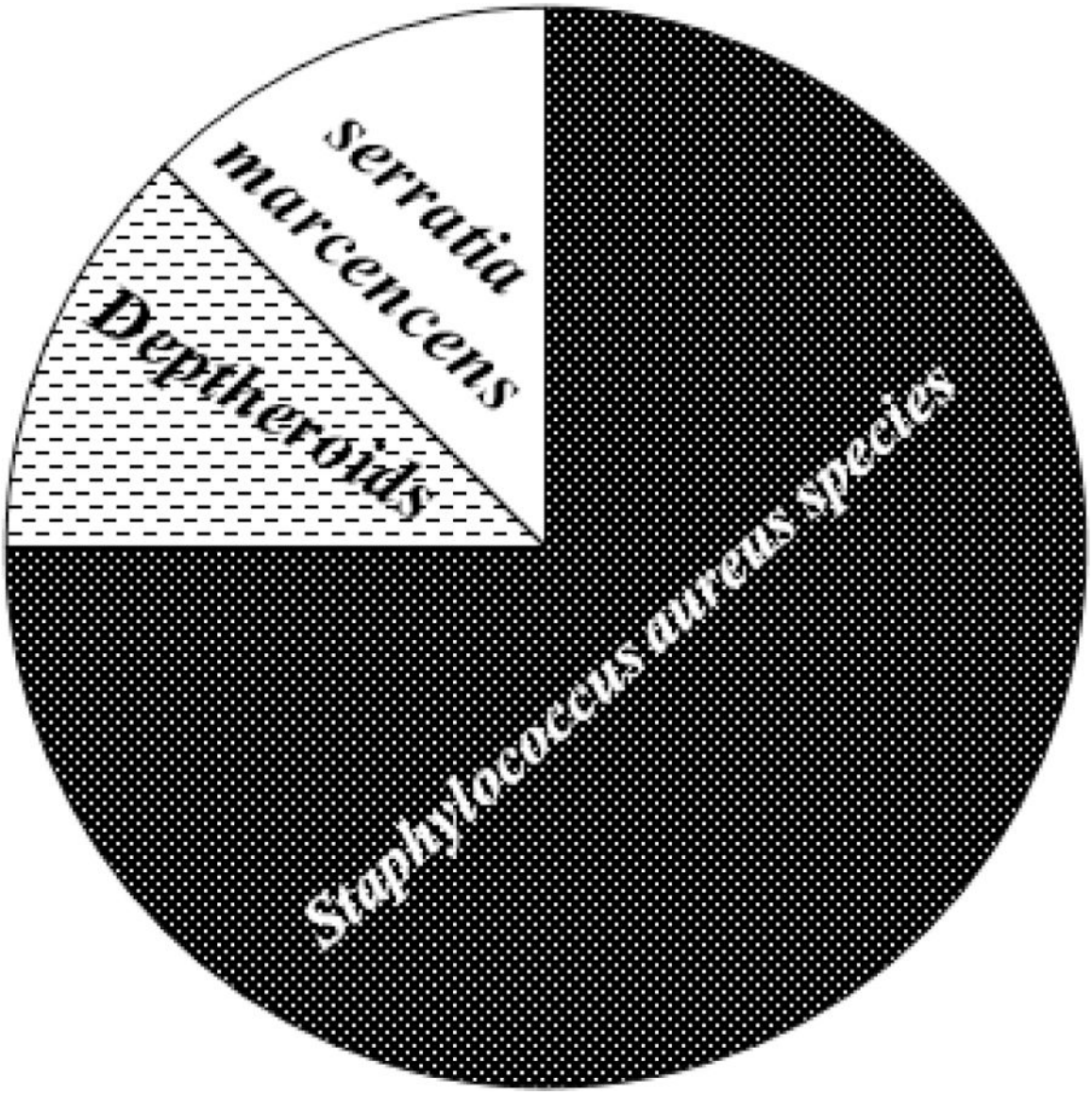

Figure 2:
Shows Distribution Of Common Bacterial Isolates In Ear Infections

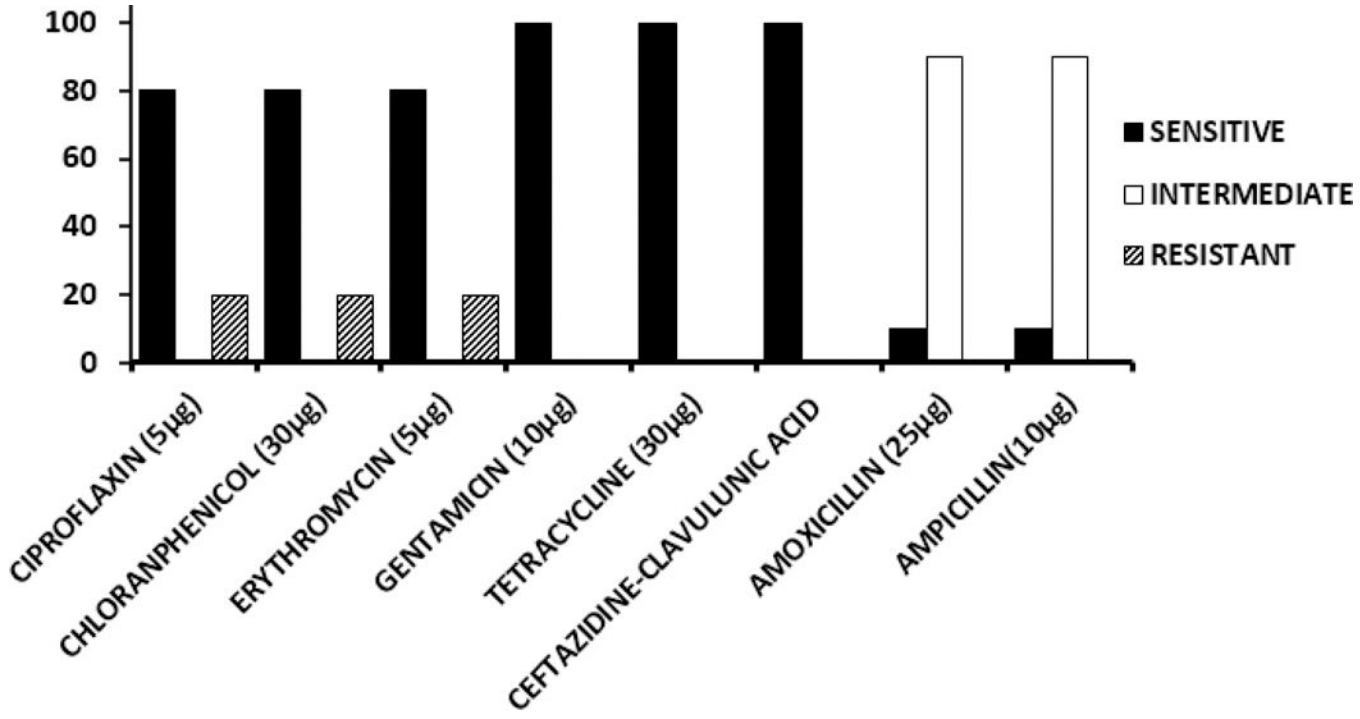

Figure 3:
Staphylococcus Aureus Antibiogram Pattern (N=6)

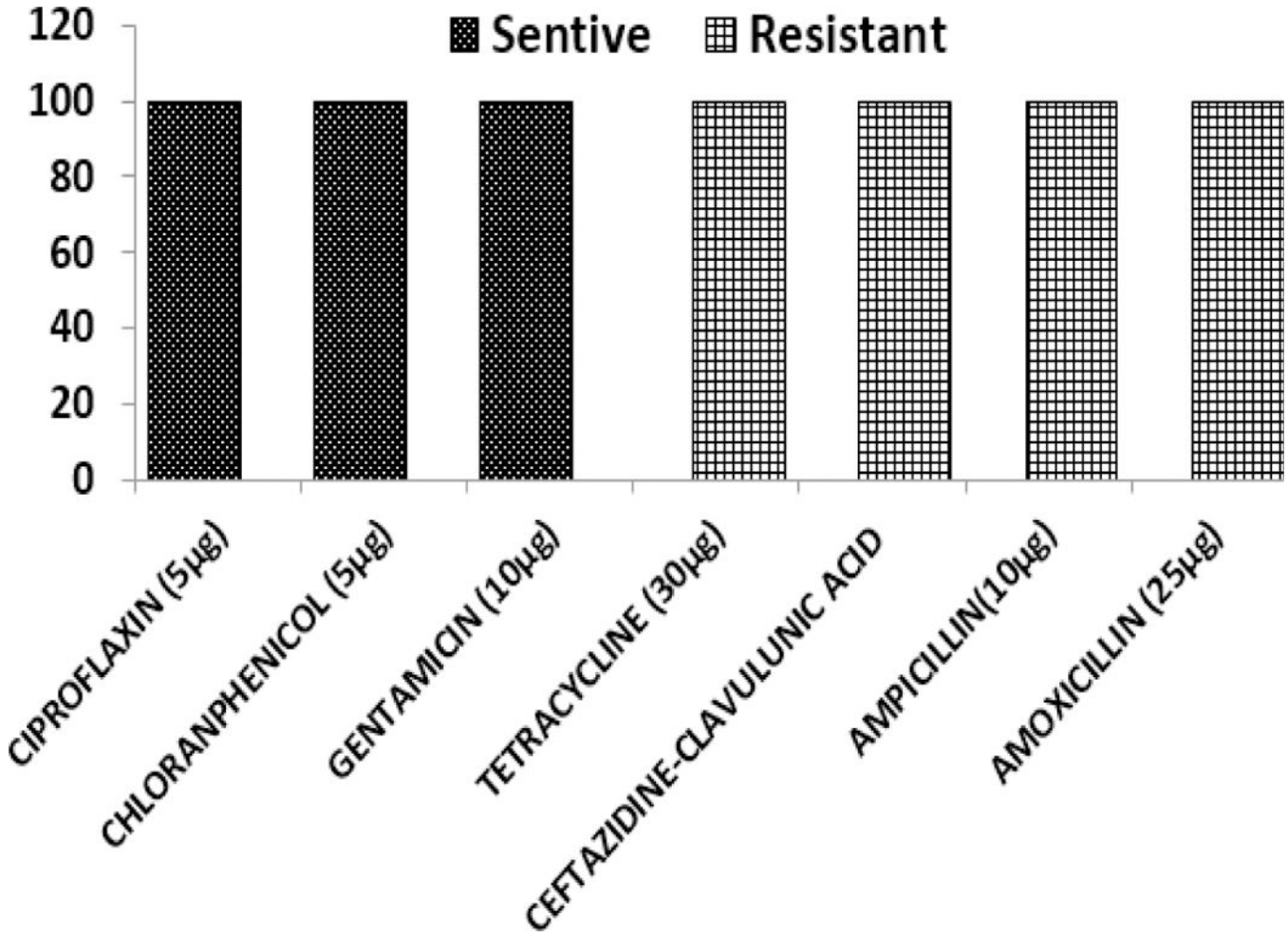

Figure 4:
Serratia mercencens antibiogram pattern

Table 1:

Prevalence of ear infections in rural and urban areas

	Male	Female	Male	Female
Number of infected pupils	12	**7**	14	15
Total number of pupils examined	155	145	144	156
Total number of infected pupils	19		29	
Prevalence of ear infection.	3.17%		4.83%	