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Original Article

Microbiology Section

Clinico-epidemiological Characteristics and Risk Factors Associated with Multidrug-resistant Bacterial Ear Infections at a Tertiary Care Centre in Northern India: A Retrospective Analytical Study

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ABSTRACT

Introduction: A total of 360 million people worldwide have been reported to suffer from hearing loss. The most common cause of ear infection is otitis media, which can be attributed to bacterial pathogens such as *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Streptococcus pneumoniae*.

Aim: To identify the incidence and risk factors associated with multidrug-resistant bacteria causing ear infections at a tertiary care centre in India.

Materials and Methods: A retrospective analytical study was conducted in the Bacteriology section of the Department of Microbiology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India, from January 2021 to January 2023, and analysed in February 2023. A total of 83 ear discharge samples sent to the laboratory were included in the duration of the study and all clinical and laboratory data were extracted from the hospital information system and the laboratory register, respectively. All pathogens were identified using routine biochemicals and Matrix-assisted Laser Desorption/Ionisation- Time of Flight-Mass Spectrometry (MALDI-TOF-MS) assay, and their antibiotic susceptibility testing was performed using the Kirby Bauer Disc Diffusion method. Statistical analysis was performed using International Business Machines (IBM) Statistical Package for Social Sciences (SPSS) software version 20.0 (SPSS Inc.). The Chi-square test was used for all categorical variables, and the comparison of two means was performed using GraphPad Prism version 9.5.1 (GraphPad Software Inc.), with p-value <0.05 considered statistically significant.

Results: The mean age of the participants in the present study was 35.39±20.93 years and majority, 56 (67.47%) participants were males. Among total 83 samples, 69 (83.13%) patients with suppurative bacterial ear infections. Postoperative conditions in 40 (48.19%) samples and respiratory allergies in 36 (43.37%) samples were the most common risk factors associated with ear infections. Postoperative conditions (p-value=0.005) and Diabetes Mellitus (DM) (p-value=0.026) were statistically significant risk factors for developing ear infections. *Pseudomonas aeruginosa* was recognised as the most common pathogen in 22 acute cases and 10 chronic cases of otitis media. For all the antimicrobial agents tested, the highest resistance was observed towards fluoroquinolones in 51/67 (76.11%) samples, followed by extended-spectrum beta-lactams in 43/67 (64.18%) samples.

Conclusion: The current study describes the incidence and risk factors associated with multidrug-resistant ear infections, the spectrum of pathogenic microbial isolates and their drug susceptibility, aiming to prevent morbidity and complications leading to the loss of auditory function.

Keywords: Antibiotic susceptibility testing, Matrix-assisted laser desorption/ionisation-time of flight-mass spectrometry, Otitis media, *Pseudomonas aeruginosa*

INTRODUCTION

A total of 360 million people worldwide are reported to suffer from hearing loss, and 60% of these cases are preventable. Furthermore, 40% of all preventable hearing loss cases are attributed to ear infections [1-3]. Hearing loss in children can lead to difficulties in language development, speech and other cognitive functions, which can impact their education and future employment opportunities [4-6]. The prevalence of hearing loss in India has been observed to range from 6% to 26.9%, while disabling hearing loss affects approximately 4.5% to 18.3% of the population across all age groups, as indicated by community-based studies [7]. Recent studies have also highlighted that ear diseases affect an estimated 11.6% to 16.6% of the Indian population, placing a substantial burden on public health and socio-economic costs [8,9].

The human ear can be divided into three parts: the outer ear, the middle ear, and the inner ear. Infections related to these parts are described as otitis externa in the outer ear, otitis media in the middle ear and otitis interna in the inner ear [10-12]. The most common of these infections is otitis media, which refers to the inflammation of the middle ear. It can be categorised as either suppurative, including Acute Suppurative otitis Media (ASOM) and Chronic Suppurative Otitis Media (CSOM) or non suppurative, known as otitis Media With Effusion (OME) [13-15]. ASOM is defined as the presence of fluid in the middle ear accompanied by the rapid onset of signs and symptoms of inflammation and infection [16,17]. On the other hand, CSOM is characterised by the prolonged presence of fluid in the middle ear with infection, while OME refers to the presence of effusion in the middle ear without acute infection [14,15].

The cause of ear infections can be attributed to bacterial, fungal, and very rarely viral pathogens. Among bacterial pathogens, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Streptococcus pyogenes*, *Haemophilus influenzae*, *Moraxella catarrhalis*, and Proteus species (spp). have been identified as the causative agents of ear infections [18-21].

Risk factors associated with ear infections include upper respiratory tract infections, a previous history of ASOM and a history of tonsillitis, among others. Untreated ASOM can lead to complications such as CSOM, perforation of the eardrum, facial nerve paralysis, mastoiditis and meningitis [14].

Treating ASOM with appropriate antibiotics can prevent its progression to CSOM. In developing countries, empirical antibiotics are often prescribed without conducting an Antibiotic Sensitivity Test (AST) to determine the susceptibility of pathogenic bacteria to the antibiotics [22]. Since AST is not routinely ordered by clinicians, it can result in the misuse or overuse of antibiotics, leading to the emergence of antibiotic resistance [22,23]. The novelty of the present study lies in the scarcity of data on the prevalence of preventable ear disorders in our country [24]. The present study was aimed to discuss the incidence of multidrug-resistant bacteria and associated risk factors, as well as, the clinical presentation of the Multidrug Resistance (MDR) isolates at a tertiary care centre.

MATERIALS AND METHODS

A retrospective analytical study was conducted in the Bacteriology section of the Department of Microbiology, Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India. The study provided inpatient and outpatient services in Northern India from January 2021 to January 2023, and all the data were analysed in February 2023. The study was approved by the Institutional Ethics Committee (2021-52-EMP-EXP dated 13/04/2021).

The study included 83 patients with suspected suppurative bacterial ear infections from various departments of a tertiary care centre. All ear discharge samples obtained in the laboratory between January 2021 and January 2023 were included in the study, without employing any specific sampling technique.

Inclusion criteria: All ear pus samples in the form of two cotton ear swabs and intraoperative ear pus samples from patients with suspected ear infections were included in the study.

Exclusion criteria: Ear pus samples sent to the Bacteriology section of the Microbiology laboratory with a delay of more than two hours, if only one swab was received, if there was visible contamination of the sample, or if the samples yielded non pathogenic skin commensals, fungal isolates or viral infections were excluded from the study.

Study Procedure

Data collection: The authors retrospectively collected the laboratory records of all ear pus samples, including their antibiotic sensitivity reports, from patients suspected of having suppurative ear infections across various departments of the Institute. Demographic and clinical data were extracted from the laboratory record registers, the electronic record system, and the ward registers. In cases where a diagnosis was not specified, ASOM and CSOM were determined based on the duration of ear discharge. Ear discharge lasting longer than 14 days was identified as chronic ear infection, while ear discharge lasting less than 14 days was identified as an acute ear infection.

Laboratory processing: Strict aseptic precautions were maintained while collecting ear pus samples from each patient. Within two hours of collection, the ear swab was sent to the Bacteriology section of the Microscopy Department for microscopy, culture, and AST. The samples were directly inoculated on blood agar, MacConkey agar, and Robertson Cooked Meat (RCM) broth. A microscopic examination was performed using another swab. All inoculated media were incubated at 37°C for 18-24 hours. Bacterial colonies were identified using Gram-stained smears, culture characteristics, biochemical identification and MALDI-TOF-MS. The Kirby-Bauer disc diffusion method, according to Clinical and Laboratory Standards Institute (CLSI) guidelines 2023 [25], was used for AST. MDR was defined as resistance to three or more classes of antibiotics and Extensive Drug Resistance (XDR) was defined as resistance to drugs of last resort [26].

STATISTICAL ANALYSIS

The statistical analysis for the present study involved observing frequencies. Quantitative variables were expressed as mean and Standard Deviation (SD). The analysis of risk factors for MDR used the Chi-square test for all categorical variables. Statistical analysis was performed using IBM SPSS software version 20.0 (SPSS Inc.). Comparison of two means was conducted using GraphPad Prism version 9.5.1 (GraphPad Software Inc.). A p-value <0.05 was considered statistically significant.

RESULTS

A total of 83 ear discharge samples were included in the present retrospective study, most commonly obtained from patients admitted to the Otorhinolaryngology ward, 47 (56.63%). This was followed by the Haematology ward, 12 (14.46%) and the Nephrology ward, 9 (10.84%) over a period of two years [Table/Fig-1].

Department of the institute inhabiting patients with suspected suppurative ear infections	Number of patients n (%)
Critical care medicine ward	6 (7.23)
Endocrinology ward	1 (1.20)
Otorhinolaryngeology ward	47 (56.63)
Haematology ward	12 (14.46)
Neonatology ward	1 (1.20)
Nephrology ward	9 (10.84)
Neurology ward	2 (2.41)
Neurosurgery ward	4 (4.82)
Plastic surgery ward	1 (1.20)

[Table/Fig-1]: Distribution of patients with suspected suppurative ear infections in various departments of the institute (N=83).

The mean age of patients who participated in the present study was 35.39±20.93 years, with the age of patients ranging from one year to 78 years. A predominant gender was found to be affected in this study, with 56 (67.47%) of them being males, as observed in [Table/Fig-2]. The maximum number of patients with acute and chronic ear infections belonged to the age group of 11-20 years in 24 (28.9%) patients, followed by those belonging to the age group of 31-50 years 18 (21.69%) patients. A total of 40 (48.19%) patients underwent at least a single operative procedure and antibiotic treatment, with Amoxicillin and Clavulanic acid being the most common antibiotic used.

Demographic characteristics and risk factors	Total no. of cases with suspected ear infections (N=83)	Patients with infection (n=69)	Patients without infection (n=14)	p-value
Age (in years) (mean±SD)	35.39±20.93	35.41±19.80	35.29±26.69	0.98
Gender, n (%)				
Male	56 (67.47)	46 (66.67)	10 (71.43)	0.73
Female	27 (32.53)	23 (33.33)	4 (28.57)	0.73
Associated symptoms, n (%)				
Hearing loss	45 (54.22)	38 (55.07)	7 (50.0)	0.73
Ear discharge	76 (91.57)	62 (89.86)	14 (100.0)	0.21
Asthma	18 (21.69)	14 (20.29)	4 (28.57)	0.49
Headache	53 (63.86)	44 (63.77)	9 (64.29)	0.97
Tonsillitis	10 (12.05)	7 (10.14)	3 (21.43)	0.24
Mastoiditis	19 (22.89)	17 (24.64)	2 (14.29)	0.40
Underlying co-morbidities, n (%)				
Diabetes Mellitus (DM)	34 (40.96)	32 (46.38)	2 (14.29)	**0.026**
Respiratory allergies	36 (43.37)	27 (39.13)	9 (64.29)	0.083
Hypertension	28 (33.73)	23 (33.33)	5 (35.71)	0.86
Postoperative condition	40 (48.19)	38 (55.07)	2 (14.29)	**0.005**

Malignancy	15 (18.07)	13 (18.84)	2 (14.29)	0.64
Immunosupression	32 (38.55)	27 (39.13)	5 (35.71)	0.81
Organ transplant	8 (9.64)	8 (11.59)	0	0.18
External Auditory Canal (EAC) reconstruction using postaural incision	8 (9.64)	8 (11.59)	0	0.18
Canal Wall Down (CWD) mastoidectomy with Total Titanium Prosthesis (TORP) ossiculoplasty	6 (7.23)	6 (8.69)	0	0.252
Type of otitis media, n (%)				
Acute Suppurative Otitis Media (ASOM)	53 (63.86)	43 (62.32)	10 (71.43)	0.52
Chronic Suppurative Otitis Media (CSOM)	25 (30.12)	21 (30.43)	4 (28.57)	0.89
Otitis Media with Effusion (OME) (Glue ear)	5 (6.024)	5 (7.25)	0	0.32

[Table/Fig-2]: Comparison of demographic characteristics and risk factors among patients with and without suppurative ear infections (N=83).
SD: Standard deviation; Chi-square test used; The p-value in bold font indicates statistically significant values

Total 69 (83.13%) patients were suspected for suppurative bacterial ear infections. The comparison of demographic characteristics and risk factors among patients with and without suppurative ear infections, as demonstrated in [Table/Fig-2]. The most common risk factors associated with the acquisition of infection included postoperative conditions in 40 (48.19%) patients, followed by respiratory allergies in 36 (43.37%) patients and type 2 DM in 34 (40.96%) patients. The Chi-square test indicates that postoperative conditions (p-value=0.005) and DM (p-value=0.026) could be identified as statistically significant risk factors for developing suppurative ear infections compared to sterile ear discharge. The most common surgeries that patients susceptible to infection due to postoperative conditions underwent were External Auditory Canal (EAC) reconstruction using postaural incision in 8 (9.64%) samples, followed by Canal Wall Down (CWD) mastoidectomy with Total Titanium Prosthesis (TORP) ossiculoplasty in 6 (7.23%) samples [Table/Fig-2].

Among the 83 patients included in the study cohort, 69 (83.13%) monomicrobial pathogens were identified in 69 patients with suspected suppurative ear infections. Out of 69 pathogens, 67 were of bacterial and two were of fungal species. *Pseudomonas aeruginosa* in 32/69 (46.38%) samples and Methicillin-resistant Coagulase Negative Staphylococcus (MRCONS) in 7/69 (10.14%) samples are the predominant bacterial isolates identified among the pathogenic Gram-positive cocci responsible for causing ear infections [Table/Fig-3]. *Pseudomonas aeruginosa* was recognised as the most common Gram-negative pathogen in cases with suppurative ear infections. Out of the 69 bacterial isolates, nine different species of pathogenic bacteria were identified. Among the isolated pathogens, there was a a predominance of 46/69 (66.67%) Gram-negative Bacteria (GNB), and 21/69 (30.43%) isolates were Gram-positive bacteria, in a ratio of 2.19:1.

Microorganism isolated	Number of isolates, n (%)
Acinetobacter baumannii	4 (5.79)
Citrobacter freundii	1 (1.45)
Enterococcus spp.	3 (4.35)
Escherichia coli	1 (1.45)
Klebsiella pneumoniae	3 (4.35)
MRCONS	7 (10.14)
MRSA	5 (7.25)
MSCONS	4 (5.79)
MSSA	1 (1.45)
Proteus mirabilis	1 (1.45)
Pseudomonas aeruginosa	32 (46.38)
Pseudomonas putida	4 (5.79)
Streptococcus spp	1 (1.45)
Mycelial fungus	1 (1.45)
Yeast-like cells	1 (1.45)

[Table/Fig-3]: Distribution of microorganisms isolated from cases with suppurative ear infections (n=69).
MSCONS: Methicillin-sensitive coagulase-negative Staphylococcus; MSSA: Methicillin-sensitive *Staphylococcus aureus*; MRCONS: Methicillin-resistant coagulase-negative Staphylococcus; MRSA: Methicillin-resistant Staphylococcus aureus

[Table/Fig-4] describes the prevalence and distribution of bacterial isolates by age category, gender and type of suppurative ear infections. The patients were divided into two age groups: those below 14 years of age and those above 14 years of age. Most acute ear infections were reported in the age group below 14 years, while chronic ear infections were reported in patients between 15 years and 44 years of age.

Applying the Chi-square test to the commonly isolated bacteria in patients with suppurative infections, *Pseudomonas aeruginosa* (p-value=0.026) was significantly isolated from patients above 14 years of age. When comparing the isolation of common pathogens based on gender, *Staphylococcus aureus* (p-value=0.006) was significantly isolated from female patients. Furthermore, when comparing the

Variables	Number of commonly isolated pathogenic bacteria causing ear infection (n)						
	Pseudomonas aeruginosa	CONS	*Staphylococcus aureus*	*Pseudomonas putida*	*Acinetobacter baumannii*	*Klebsiella pneumoniae*	Enterococcus spp.
Age category							
<14 years	11	2	1	0	0	0	0
>14 years	21	9	5	4	4	3	3
p-value	**0.026**	0.762	0.757	0.281	0.281	0.353	0.353
Gender							
Male	12	3	1	1	1	0	0
Female	20	8	5	3	3	3	3
p-value	0.444	0.689	**0.006**	0.742	0.742	0.221	0.221
Type of otitis media							
ASOM	22	6	4	2	0	2	3
CSOM	10	5	2	2	4	1	0
p-value	0.577	0.432	0.932	0.517	**0.005**	0.953	0.196

[Table/Fig-4]: Prevalence and distribution of bacterial isolates by age category, gender and type of suppurative ear infections (n=63).
CONS: Coagulase-negative staphylococcus; ASOM: Acute suppurative otitis media; CSOM: Chronic suppurative otitis media

nature of infection responsible for getting infected with a common pathogen, *Acinetobacter baumannii* (p-value=0.005) was significantly isolated in patients suffering from CSOM. An antibiotic susceptibility test was performed for all pathogenic isolates causing suppurative ear infections. A total of 27 antibiotics were tested against nine species of bacterial isolates obtained from ear pus samples. Out of among all the antimicrobial agents tested, the highest resistance was observed towards fluoroquinolones in 51/67 (76.11%), followed by extended-spectrum beta-lactams 43/67 (64.18%), penicillins in 43/67 (64.18%) and carbapenems in 22/67 (32.84%) samples. The majority of the Gram-negative bacilli isolated were susceptible to colistin (45/46, 97.83%), followed by amikacin in 35/46 (76.09%) samples. Similarly, the majority of Gram-positive cocci were susceptible to vancomycin in all 21/21 (100%), followed by teicoplanin in 20/21 (95.24%) samples.

Among the Gram-positive cocci, an increased level of resistance was observed for levofloxacin in 16/21 (76.19%), erythromycin in 14/21 (66.67%) and ampicillin-sulbactam in 13/21 (61.90%) samples, as represented in [Table/Fig-5]. Out of the 17 Staphylococcus spp. isolated from the ear pus samples, 11 (64.71%) were Coagulase-negative Staphylococcus (CONS). Among the 11 CONS isolates, 7 (63.64%) were resistant to methicillin, while 4 (36.36%) were sensitive to methicillin. Additionally, 6/17 (35.29%) *Staphylococcus aureus* isolates were identified, of which 5 (83.33%) were resistant to methicillin.

Various classes of antibiotics	Drug resistance among isolates, n (%)
Vancomycin	0
Teicoplanin	1 (4.76)
Fluoroquinolones (Levofloxacin)	16 (76.19)
Macrolides (Erythromycin)	14 (66.67)
Ampicillin-sulbactam	13 (61.90)

[Table/Fig-5]: MDR pattern of all Gram-positive cocci isolated from cases with suppurative ear infections (n=21).

However, there is a high susceptibility to colistin in 45/46 (97.83%) followed by amikacin (aminoglycosides) in 35/46 (76.09%) samples. [Table/Fig-6] represent the MDR pattern of Gram-negative pathogens isolated from cases with suppurative ear infections. A high level of fluoroquinolone resistance 35/46 (76.09%), penicillin resistance in 30/46 (65.22%), extended-spectrum beta-lactam resistance (in 30/46 (65.22%), and carbapenem resistance in 22/46 (47.83%) samples was observed in patients with suppurative ear infections caused by GNB.

Various classes of antibiotics	Drug resistance among isolates, n (%)
Polymyxins (Colistin)	1 (2.17)
Aminoglycosides	11 (23.91)
Carbapenem resistance	22 (47.83)
Penicillin resistance	30 (65.22)
Extended-spectrum beta-lactamases	30 (65.22)
Fluoroquinolone resistance	35 (76.09)

[Table/Fig-6]: MDR pattern of Gram-negative pathogens isolated from cases with suppurative ear infections (n=46).

[Table/Fig-7] represents the demographic characteristics and risk factors among patients suffering from MDR GNB, which cause suppurative ear infections.

Demographic characteristics and risk factors	Cases of MDR suppurative ear infections (n=20/46, 43.48%)
Age (in years) (mean±SD)	31.15±17.30
Gender, n (%)	
Male	15 (75)
Female	5 (25)
Associated symptoms, n (%)	
Hearing loss	12 (60)
Ear discharge	16 (80)
Asthma	10 (50)
Headache	15 (75)
Tonsillitis	1 (5)
Mastoiditis	5 (25)
Underlying co-morbidities, n (%)	
Diabetes Mellitus (DM)	9 (45)
Respiratory allergies	10 (50)
Hypertension	4 (20)
Postoperative condition	16 (80)
Malignancy	3 (15)
Immunosupression	8 (40)
Organ transplant	1 (5)
Type of otitis media, n (%)	
Acute Suppurative Otitis Media (ASOM)	11 (55)
Chronic Suppurative Otitis Media (CSOM)	7 (35)
Otitis Media with Effusion (OME) (glue ear)	2 (10)

[Table/Fig-7]: Demographic characteristics and risk factors among patients suffering from multidrug-resistant Gram-negative Bacteria (GNB) causing suppurative ear infections (n=20).

DISCUSSION

Approximately, 5% of the world's population is affected by disabling hearing loss, which significantly impacts their quality of life. This condition is more prevalent in middle to low-income countries [2,13]. In the present study, the prevalence of ear infection among patients with ear discharge was identified as in 69 (83.13%) patients, among patients who presented to the tertiary care centre with chief complaints of ear discharge over the last two years. Interestingly, the majority of these patients were over 14-year-old, which contrasts with previous studies that focused on ear infections in children under the age of four years [27-29]. However, the present study findings align with a study conducted in Ethiopia, where the age group most affected by suppurative ear infections was 16-35 years.

GNB constituted 46/69 (66.67%) samples of the bacterial ear infections we observed. The predominant isolates were *Pseudomonas aeruginosa* in 32/69 (46.38%), CONS in 11/69 (15.94%), *Staphylococcus aureus* in 6/69 (8.69%), *Pseudomonas putida* in 4/69 (5.79%) and *Acinetobacter baumannii* in 4/69 (5.79%) samples. These findings are consistent with a study conducted in Bangladesh, where Pseudomonas species (31.5%) and *Staphylococcus aureus* (37%) were commonly identified bacteria responsible for ear infections [30]. Older literature also reported *Staphylococcus aureus*, Pseudomonas spp. and Proteus spp. as common pathogenic microorganisms [31-33]. This can be attributed to the ubiquitous presence of these pathogens in the environment, soil and as part of the normal skin flora [34-36].

Over a span of two years in the present study 1600 bed tertiary care hospital, tests were conducted on all pathogenic isolates responsible for ear infections to assess their susceptibility to 27 antibiotics, including penicillins, extended-spectrum beta-lactam antibiotics, fluoroquinolones and carbapenems. A high rate of resistance to fluoroquinolones in 35/46 (76.09%) samples, among GNB isolates was observed, which contrasts with a study conducted by Getaneh A et al., that reported lower drug resistance to fluoroquinolones [37]. Regardless of AST, the most commonly prescribed drug for patients with ear infections at the centre was amoxicillin-clavulanic acid.

Gram-positive cocci isolated from ear infections in patients from the present study's cohort underwent susceptibility testing for antibiotics, including ampicillin, ampicillin-sulbactam, cefoxitin,

erythromycin, levofloxacin, vancomycin and teicoplanin. It was observed that there is a level of resistance to levofloxacin 16/21 (76.19%), followed by erythromycin in 14/21 (66.67%), and ampicillin-sulbactam in 13/21 (61.90%) samples. Vancomycin was found to be the most effective antibiotic against Gram-positive cocci isolates, which corroborates with the findings of Getaneh A et al., where 94.3% of Gram-positive cocci isolates were susceptible to the antibiotic [37].

In the present study's cohort, it was observed that there is a prevailing incidence of GNB in 46/69 (66.67%) samples. The overall rate of MDR among GNB in the present study cohort was found to be in 20/46 (43.48%) samples. This aligns with the studies conducted by Getaneh A et al., and Endaylalu K et al., where an increasing trend of MDR infections caused by GNB was identified [37,38]. The increasing trend of MDR infections among GNB has been observed worldwide and is rapidly becoming a concern for healthcare workers and the community at large. The lack of strict hospital infection control methods and antibiotic stewardship programs has led to the emergence of MDR species and inappropriate drug regimens, further contributing to the rise of drug-resistant microorganisms. Higher antimicrobial resistance in GNB could be attributed to Fluoroquinolone, Penicillin and extended-spectrum beta-lactams resistance, as found in recent studies [37,39]. With increasing MDR each day, the development of newer mechanisms of resistance among microorganisms will lead to adverse outcomes and complications that can affect the learning and cognitive skills in children and cause unemployment and morbidity in adults. Therefore, it is essential for physicians to be aware of the spectrum and antibiotic susceptibility patterns of pathogens in order to adequately treat patients and prevent complications.

Limitation(s)

The limitations of the present study include, firstly, the retrospective nature of the study where the data was mostly collected based on an electronic data system or ward records, which could lead to investigator or observer bias. Secondly, the study was conducted at a single-centre so its findings only represent the patients visiting the Outpatient and Inpatient Departments of the Institute. Since, the present was a time-bound study, the sample size was limited.

CONCLUSION(S)

The present study describes the incidence of bacterial ear infections, the spectrum of pathogenic microbial isolates risk factors associated with bacterial ear infections, and their drug susceptibility to prevent morbidity and complications such as the emergence of multidrug-resistant microorganisms, which can lead to the loss of auditory function. This information aims to assist clinicians in the targeted treatment of patients, particularly those with multidrug-resistant isolates.

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