

# Study of Microbiological Profile and Antibiotic Sensitivity Pattern of Ear Infections in Patients Attending a Secondary Healthcare Setting at Sirsi, Karnataka

Anil S<sup>1</sup>, Medha R Hegdekatte<sup>2</sup>

<sup>1</sup>Department of ENT, <sup>2</sup> Microbiologist and Laboratory Incharge,  
Rotary Charitable Hospital, Sirsi, Karnataka

Corresponding Author: Dr Anil S

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## ABSTRACT

**Background:** Ear infections are among the most common ENT disorders encountered in clinical practice. With the inadvertent use of antibiotics, antimicrobial resistance among otopathogens has become a major public health concern. Understanding the local microbiological profile and antibiotic sensitivity pattern is crucial for effective treatment and antibiotic stewardship.

**Aim:** To evaluate the microbiological profile and their antibiotic sensitivity pattern in ear infections at a secondary healthcare setting at Sirsi.

**Materials and Methods:** This retrospective study was jointly conducted by ENT department and Microbiology department of Dr. Lalita R Kamat Memorial Pathological Laboratory at Rotary Charitable Hospital, a secondary healthcare setting in Sirsi of Uttara Kannada district, Karnataka. The data was collected from November 2022 to October 2025. A total of 100 patients were included in this study. The ear discharge collected with sterile swabs was subjected to Gram's staining and culture of the causative organism. Susceptibility testing was done by the Kirby-Bauer disk diffusion method following CLSI guidelines.

**Results:** Out of 100 ear swab results obtained, 79 % showed bacterial growth, 8% were fungal growth, 4% showed polymicrobial growth and 9% of cases showed no growth on culture. The most common microorganism identified was *Pseudomonas aeruginosa* (26.92%), followed by *Staphylococcus aureus* (22.11%). Aminoglycosides and fluoroquinolones showed great efficacy against *Pseudomonas aeruginosa* and *Staphylococcus aureus* on antibiotic susceptibility testing while notable resistance was observed to several routinely used antibiotics.

**Conclusion:** Regular surveillance of regional antimicrobial resistance patterns and implementation of rational antibiotic use are essential to improve the clinical outcomes and tackle the emergence of multidrug resistant microorganisms

**Keywords:** Ear infection, microbial isolates, sensitivity pattern, *Pseudomonas*, *Staphylococcus*.

## INTRODUCTION

Ear infections are among the most common ENT disorders encountered in clinical practice, affecting individuals across all age groups and contributing significantly to the global burden of preventable hearing loss. Ear infection affects about 65–330 million people worldwide, and about 60% of them suffer from significant hearing loss [1]. This accounts for a major health and economic problems, especially in the developing countries where resources for diagnosis and treatments are limited [2]. They range from mild, self-limiting external ear infections to severe middle ear infections that can lead to chronic otitis media and its complications if not appropriately managed. The etiological agents responsible for ear infections are diverse, including both bacterial and fungal pathogens, whose prevalence varies with geography, climate, socioeconomic conditions and patterns of antimicrobial usage. For instance, in the USA and Europe, the prevalence is decreasing due to increased hygiene and awareness, whereas it is increasing in the developing countries [3]. In recent years, the emergence of antibiotic resistance among common pathogens has become a growing concern, particularly in resource-limited and rural healthcare settings. Understanding the local microbiological profile and antibiotic sensitivity patterns is essential for guiding empirical therapy, optimizing patient outcomes and curbing the misuse of antibiotics.

Sirsi, a semi-urban area in the Uttara Kannada district of Karnataka, primarily depends on secondary healthcare facilities for routine medical care. However, limited data exist from this region regarding the pathogens responsible for ear infections and their resistance profiles.

Therefore, the present study was undertaken to identify the microbiological profile of ear infections and to determine the antibiotic sensitivity pattern of the isolated organisms in patients attending a secondary healthcare setting at Sirsi, Karnataka. The findings of this study aim to provide valuable insights

for clinicians to implement effective, evidence-based management strategies and to contribute to regional antibiotic stewardship efforts.

## Objective

The aim of this study is to evaluate the microbiological profile and their antibiotic sensitivity pattern in ear infections at a secondary healthcare setting at Sirsi, a town in Malenadu region of Karnataka located in the heart of western Ghats, known for its lush forests and hilly terrain.

## MATERIALS & METHODS

This retrospective study was jointly conducted by ENT department and Microbiology department of Dr. Lalita R Kamat Memorial Pathological Laboratory at Rotary Charitable Hospital, a secondary healthcare setting in Sirsi of Uttara Kannada district, Karnataka.

The records of the patients who had undergone ear swab testing for ear infection who presented with ear discharge were collected. Patient's data such as age, gender, findings and diagnosis were obtained from the Medical Records Department at Rotary Charitable Hospital, Sirsi. Any patient who underwent an ear swab collection at the otorhinolaryngology outpatient clinic was included in the study. Ear swabs were taken in the outpatient block of Otorhinolaryngology unit in our hospital and sent to the Microbiology Laboratory for culture and sensitivity tests. They were collected in patients who did not respond to initial line of medical management and with persistent or recurrent infection. The data was collected from November 2022 to October 2025.

### 1. Isolation and Identification of Bacteria

The specimen from the patient's ear with discharge was taken using the sterile swab and swab samples were cultured aerobically on MacConkey agar, blood agar and chocolate agar plate. Plates were incubated at 37°C for 48 hours. The plates were

commercially purchased from Bharat Associates, Hubballi and manufactured by Microexpress, Tulip Diagnostics.

Identification of Bacteria were done by gram staining, colony morphology and biochemical testing. This includes manual procedures using many chemical reagents like Indole, Methyl red, Vogus proskauer reagent, Citrate, Oxidase, Catalase and media like Citrate, Triple Sugar Iron and Mannitol. Fungal identification was done by KOH wet mount, Indian ink test and gram staining.

## 2. Antimicrobial Susceptibility Testing

Susceptibility testing was done by the Kirby-Bauer disk diffusion method following CLSI guidelines. Muller Hinton Agar plates were used for this purpose.

After 24-hour incubation at 37°C the zones of inhibition in millimetre (clear areas around the disc where bacterial growth stopped) are measured and compared to CLSI interpretive criteria to determine bacterial susceptibility or resistance to the tested antibiotics.

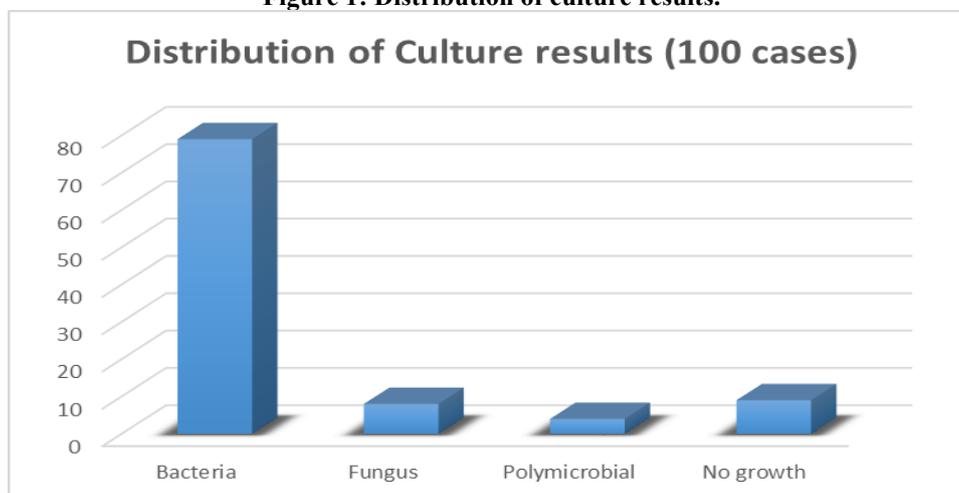
## RESULT

A total of 100 ears of 100 patients were included in the study with maximum patients in the age group of above 60 years. 52 of them were male and 48 were female. Majority of the patients who presented with ear discharge were diagnosed of chronic otitis media (57%). 22 cases were otitis externa and 21 cases were acute suppurative otitis media.

Sex	n
Male	52
Female	48
Total	100

Age group in years	n
0-2	4
2-10	9
11-20	9
21-30	11
31-40	14
41-50	14
51-60	11
Above 60	28
Total	100

**Figure 1: Distribution of culture results.**



Out of 100 ear swab results obtained, 79 % showed bacterial growth, 8% were fungal growth, 4% showed polymicrobial growth and 9% of cases showed no growth on

culture. Considering polymicrobial growth also, 104 isolates were obtained out of which 83 were bacteria, 12 were fungi and 9 showed no growth.

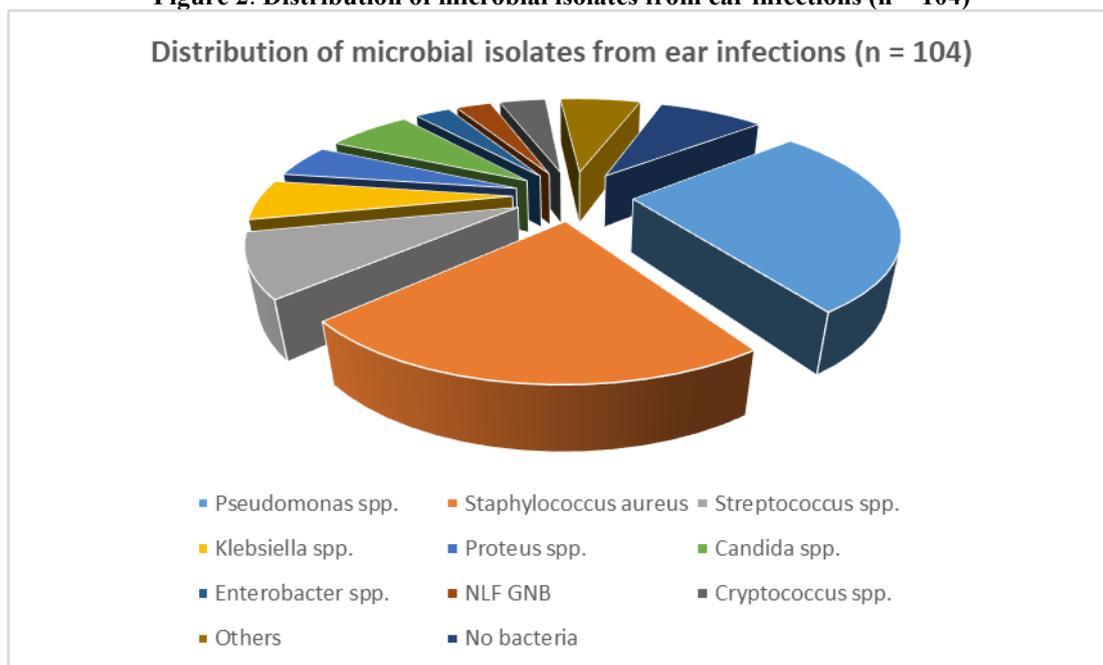
**Table 3. Distribution of microbial isolates from ear infections (n = 104)**

Microorganisms	Number of isolates n
Pseudomonas spp.	28
Staphylococcus aureus	23
Streptococcus spp.	9
Klebsiella spp.	6
Proteus spp.	5
Candida spp.	7
Enterobacter spp.	3
NLF GNB	3
Cryptococcus spp.	4
CONS	1
Moraxella spp.	1
Turicella otitidis	1
Aspergillus spp.	1
Escherichia coli	1
Haemophilus influenzae	1
Enterococcus spp.	1
No bacterial growth	9
Total	104

The most common microorganism identified was *Pseudomonas aeruginosa* (26.92%), followed by *Staphylococcus aureus* (22.11%). *Candida albicans* (6.73%), *Cryptococcus* (3.84%) and 1 *Aspergillus* were the fungal species identified.

Polymicrobial infection was seen in 4 cases. They were non haemolytic *Streptococcus* & *Candida*, *Proteus* & *Cryptococcus*, *Candida* & *Cryptococcus* and extended spectrum beta lactamase producing *Enterobacteriaceae* & *Klebsiella*.

**Figure 2. Distribution of microbial isolates from ear infections (n = 104)**



28 isolates of Pseudomonas were tested for antibiotic sensitivity to amoxicillin/clavulanate, piperacillin/tazobactam, cefixime, cefuroxime, ceftazidime, chloramphenicol, ciprofloxacin, levofloxacin, gentamicin, amikacin, netilmicin and azithromycin. The maximum sensitivity was seen amikacin and netilmicin (96.42%) while piperacillin/tazobactam and

gentamicin showed 92.85% sensitivity. Least sensitivity was seen with cefixime, cefuroxime (0%) and amoxicillin/clavulanate (14.28%). Table 4 summarizes results.

#### Antibiogram of Pseudomonas aeruginosa (N - 28)

**Table 4. Sensitivity pattern of antimicrobial agents.**

Antimicrobial agent	Sensitivity	Resistant	% Sensitivity
Amoxicillin/clavulanate	4	24	14.28%
Piperacillin/Tazobactam	26	2	92.85%
Cefixime	0	28	0%
Cefuroxime	0	28	0%
Ceftazidime	19	9	67.85 %
Chloramphenicol	11	17	39.28 %
Ciprofloxacin	25	3	89.28 %
Levofloxacin	25	3	89.28%
Gentamicin	26	2	92.85%
Amikacin	27	1	96.42%
Netilmicin	27	1	96.42 %
Azithromycin	22	6	78.57%

**Table 5. Antibiogram of Staphylococcus aureus (N -23)**

Antimicrobial agent	MSSA (6)		MRSA (17)	
	Sensitivity	Resistant	Sensitivity	Resistant
Amoxicillin/clavulanate	5 (83%)	1 (17%)	10 (59%)	7 (41%)
Piperacillin/Tazobactam	6 (100%)	0 (0%)	14 (82%)	3 (18%)
Ampicillin	2 (33%)	4 (67 %)	0 (0%)	17 (100%)
Cefixime	5 (83%)	1 (17%)	2 (12%)	15 (88%)
Cefuroxime	6 (100%)	0 (0%)	13 (76%)	4 (24%)
Linezolid	5 (83%)	1 (17%)	14 (82%)	3 (18%)
Vancomycin	3 (50%)	3 (50%)	9 (53%)	8 (47%)
Ciprofloxacin	1(17%)	5 (83%)	1 (6%)	16 (94%)
Levofloxacin	3 (50%)	3 (50%)	7 (41%)	10 (59%)
Gentamicin	6 (100%)	0 (0%)	12 (71%)	5 (29%)
Netilmicin	6 (100%)	0 (0%)	17 (100%)	0 (0%)
Clindamycin	4 (67%)	2 (33%)	14 (82%)	3 (18%)

Staphylococcus was isolated in 23 ear swabs and were tested for sensitivity to penicillin, amoxicillin/ clavulanate, piperacillin/tazobactam, cefixime, cefuroxime, ciprofloxacin, levofloxacin, gentamicin, netilmicin, clindamycin, vancomycin and linezolid. 17 of the 23 isolates of Staphylococcus aureus showed resistance to Methicillin (MRSA). The most effective antibiotics were netilmicin (100% sensitivity) followed by piperacillin/tazobactam, linezolid and clindamycin

(82%). Ampicillin showed 0% sensitivity in MRSA. 6 of the 23 isolates of staphylococcus aureus were MSSA. cefuroxime, piperacillin/ tazobactam, netilmicin and gentamicin showed 100 % sensitivity whereas ciprofloxacin was the least sensitive among the antibiotics tested (17%).

#### DISCUSSION

Ear infections remain a significant cause of morbidity in patients of all age groups,

particularly in developing countries, where factors such as poor hygiene, overcrowding, and limited access to healthcare contribute to their persistence. The rampant indiscriminate use of antibiotics adds to the persistence of ear infections. The present study evaluated the microbiological profile and antibiotic susceptibility patterns of ear infections among patients attending a secondary healthcare setting in Sirsi, Karnataka, with the aim of studying the regional microbiological profile of ear infections and guiding appropriate empirical therapy thus preventing complications.

In the present study, the prevalence of ear infections was slightly higher among males (52%) compared to females (48%). Similar male predominance has been reported in several studies like Nwasbuisi et al. [4], Kumar et al. [5] and Patel KR et al. [6] studies. It may be attributed to greater outdoor exposure and occupational factors among males. However, there is no clear explanation whether there is a gender predilection in ear infections.

In our study, the greatest number of cases were seen in age group of more than 60 years. However, study by Loy et al. [7] showed increased prevalence of CSOM in 30-40 years age. In a study by Addas et al. [8] the majority of cases were seen between 0-17 years.

The most commonly isolated microorganism in our study was *Pseudomonas aeruginosa* (26.92%) followed by *Staphylococcus aureus* (22.11%). *Pseudomonas aeruginosa* is a ubiquitous pathogen capable of infecting virtually all tissues. [9] A large variety of virulence factors contribute to its pathogenicity. These factors include pili, flagella, lipopolysaccharide, proteases, exotoxin A and exoenzymes. Flagella and pili are essential for the pathogen's motility and adherence. [10] The presence of enzymes such as proteases and elastases help in breakdown of tissue proteins. [11,12]

Our finding is consistent with studies done by Yeli S et al. [13] at UAE, Addas F et al [8] at Saudi Arabia, Al-Tulaibawi NAJ [14] et al.

at Iraq where the *Pseudomonas aeruginosa* was the predominant microorganism isolated. *Pseudomonas* followed by *Staphylococcus aureus* were the most common pathogens isolated from ear infections in studies conducted at Ireland [15] and Greece [16].

In our present study, aminoglycosides and fluoroquinolones showed excellent activity against *Pseudomonas aeruginosa* isolates from ear infections. Amikacin and Netilmicin demonstrated the highest sensitivity (96.43%), followed by gentamicin (92.86%) emphasizing their effectiveness particularly as topical therapy. *Pseudomonas aeruginosa* showed high susceptibility to Ciprofloxacin and Levofloxacin as well (89.29%), reaffirming their role as preferred agents in *P. aeruginosa*-associated ear infections. Piperacillin-tazobactam showed excellent efficacy (92.85%) and are thus useful in severe infections requiring systemic treatment. Moderate sensitivity to ceftazidime (67.86%) suggests emerging resistance to third-generation cephalosporins. Complete resistance to Cefixime and Cefuroxime and poor sensitivity to amoxicillin-clavulanate (14.28%) reflect the intrinsic resistance of *P. aeruginosa* to these antibiotics. K Mozafari et al. [17] study showed high sensitivity to ciprofloxacin (95%) and gentamicin (85%) whereas Addas, et al. [8] study showed high sensitivity to piperacillin (100%), gentamycin (95.83%) and ciprofloxacin (92.8%). These results are in par with our study results.

In our study, 17 out of 23 isolates of *Staphylococcus aureus* were MRSA strains which constitutes 73.91% of overall *Staphylococcus aureus* isolated. In study by Addas F et al [8], the MRSA isolates were 11.54% of the total *Staphylococcus aureus* isolates. The MRSA isolates constituted 22.6% in a study by Sunil et al. [18]. This is in contrast with our study findings in which MRSA showed a significant proportion of total Staph aureus isolates. The most effective antibiotics against MRSA isolates

were Netilmicin (100% sensitivity) followed by Piperacillin/Tazobactam, Linezolid and Clindamycin (82%). Vancomycin was sensitive in 53% of the cases. MRSA isolates exhibited higher resistance to  $\beta$ -lactam antibiotics and fluoroquinolones compared to MSSA. Aminoglycosides, particularly Netilmicin, demonstrated excellent in vitro activity against both MSSA and MRSA isolates. In the present study, MRSA isolates from ear infections demonstrated marked resistance to fluoroquinolones, with ciprofloxacin sensitivity of only 6%, which is comparable to findings reported by Park et al.<sup>[19]</sup> and studies where fluoroquinolone resistance was common. It may be attributed to prior topical antibiotic exposure in chronic ear infections. Aminoglycoside susceptibility among MRSA isolates showed variability across studies; our gentamicin sensitivity rate of 71% is similar to Indian study of Ramashesh R et al.<sup>[20]</sup>. Clindamycin demonstrated good in vitro activity against MRSA in the present study, comparable to Duarte MJ et al.<sup>[21]</sup> and other studies although inducible resistance remains a concern. Studies by Park MK et al.<sup>[19]</sup>, Ramashesh R et al.<sup>[20]</sup>, Duarte MJ et al.<sup>[21]</sup> and most other published literature reports showed near universal susceptibility of MRSA isolates to vancomycin and linezolid. Therefore, the reduced sensitivity observed in the present study should be interpreted cautiously and may reflect methodological limitations such as disc diffusion testing and small sample size and warrants cautious interpretation.

## CONCLUSION

This study highlights the diverse microbiological etiology of ear infections in patients attending a secondary healthcare setting in Sirsi, Karnataka, with *Pseudomonas aeruginosa* and *Staphylococcus aureus* being the predominant isolates. The antibiotic susceptibility patterns revealed good activity of aminoglycosides and fluoroquinolones against common pathogens, while notable

resistance was observed to several routinely used antibiotics. These findings highlight the limitations of empirical therapy and emphasize the need for culture-based diagnosis for effective management of ear infections. Regular surveillance of regional antimicrobial resistance patterns and implementation of rational antibiotic use are essential to improve the clinical outcomes, tackle the emergence of multidrug resistant microorganisms and reduce the financial burden on patients.

## Declaration by Authors

**Ethical Approval:** Not required as it involved a retrospective study of anonymized patient data.

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**Conflict of Interest:** The authors declare no conflict of interest.

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