e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.8.20

International Journal of Pharmaceutical Quality Assurance 2025; 16(8); 118-122

Original Research Article

Alarming Rise of Antibiotic Resistance in ENT Infections: A Snapshot from the Developing World

Daisy Bacchani[1], Vibhor B. Kumar[2], Pravek Khetani[3]

[1]Assistant Professor, Department of Microbiology, Vyas Medical College and Hospital, Jodhpur, Rajasthan, India

[2]Assistant Professor, Department of ENT, Vyas Medical College and Hospital, Jodhpur, Rajasthan, India

[3]Associate Professor, Department of Conservative Dentistry and Endodontics, Vyas Medical College and Hospital, Jodhpur, Rajasthan, India

Received: 05-06-2025 / Revised: 04-07-2025 / Accepted: 05-08-2025

Corresponding Author: Dr. Vibhor B Kumar

Conflict of interest: Nil

Abstract:

Background: Otitis media is a prevalent ENT infection in developing regions, increasingly complicated by antimicrobial resistance. Empirical treatment without microbiological guidance has led to selective pressure, promoting resistant strains. The need for local surveillance of pathogen profiles and resistance trends to guide successful therapy and stewardship activities is highlighted by rising failure rates and the prevalence of biofilm-forming organisms such as Pseudomonas aeruginosa and Staphylococcus aureus.

Methods: For ten months, a prospective observational study was carried out at a tertiary care center, involving 390 patients with clinically diagnosed otitis media. All patients presented with profuse otorrhea unresponsive to empirical antibiotics. Aural swabs were collected under aseptic precautions, cultured on standard media, and put through the Kirby-Bauer disc diffusion method of antimicrobial susceptibility testing in compliance with CLSI recommendations.

Results: Pseudomonas aeruginosa and Proteus mirabilis were the predominant Gram-negative isolates, while S. aureus was the most common Gram-positive organism. High resistance rates (>70%) were observed against ampicillin, amoxicillin-clavulanate, and cotrimoxazole. Sensitivity was better retained with ciprofloxacin, gentamicin, and amikacin, although early signs of resistance were noted. Multidrug-resistant (MDR) phenotypes were common, particularly among Pseudomonas isolates.

Conclusion: The microbial landscape of ENT infections is shifting, with a growing prevalence of MDR pathogens and declining efficacy of conventional antibiotics. Empirical treatment protocols must be reevaluated in light of local resistance data. Routine culture and sensitivity testing should be integrated into clinical practice to support evidence-based antibiotic stewardship and improve patient outcomes.

Introduction

One of the most widespread diseases in the world, otitis media affects both adults and children, and it is especially prevalent in underdeveloped nations. Otitis media, which is characterized by middle ear inflammation and infection, can result in chronic otorrhea., conductive hearing loss, and in untreated cases, serious intracranial or extracranial complications. While acute episodes are often self-limiting or responsive to empirical antibiotics, chronic or recurrent cases increasingly demonstrate poor therapeutic outcomes.

In resource-limited settings, treatment is frequently initiated empirically, without microbiological confirmation, owing to constraints in diagnostic infrastructure. This approach, coupled with indiscriminate antibiotic use and inadequate regulatory oversight, has contributed significantly to the emergence of antimicrobial-resistant organisms. Pathogens commonly implicated in otitis media—such as P. aeruginosa, Proteus mirabilis, and S. aureus—are now frequently showing resistance to first-line antibiotics, including ampicillin, amoxicillin-clavulanate, and cotrimoxazole.

This shift in microbial aetiology and resistance patterns poses a serious challenge to effective management, particularly in vulnerable populations such as children. There is an urgent need for regional surveillance studies that assess the evolving microbiological profile of otitis media and inform empirical treatment guidelines.

In order to provide useful information to support clinical decision-making and antibiotic stewardship initiatives, the current study intends to examine the shifting bacteriological spectrum and antibiotic sensitivity patterns in patients presenting with otitis media at a tertiary care center in a developing nation.

Materials and Methods

This prospective observational study was undertaken over a 10-month period at the Department of Microbiology in a tertiary care institution in Jodhpur Rajasthan. The institutional ethics committee gave its approval. After gaining informed agreement, 390 individuals who had symptoms suggestive of otitis media were included.

Inclusion Criteria: Patients of all age groups presenting with profuse ear discharge unresponsive to prior empirical antibiotic therapy were included. Both acute and chronic cases were considered. Patients with immunocompromised status, previous ear surgery, or those on long-term antibiotic therapy were excluded.

Clinical Evaluation: All patients underwent a systematic clinical evaluation, including detailed medical history, general physical examination, and thorough head and neck assessment. Otoscopic examination and palpation of cervical lymph nodes were performed in all cases. Baseline investigations included (CBC), fasting blood glucose levels, viral serology (including HIV, HBsAg, and HCV), and chest X-ray. Patients presenting with neck swelling or signs suggestive of abscess formation were additionally evaluated with ultrasonography of the neck to confirm the presence of an abscess and guide further management.

Microbiological Sampling and Processing: Using sterile cotton-tipped applicators, aural swabs were taken from the middle ear discharge while maintaining aseptic conditions. The microbiology lab received the samples right away for sensitivity testing and culture. Swabs were incubated for 24 to 48 hours at 37°C with suitable atmospheric conditions after being inoculated on blood agar, MacConkey agar, and chocolate agar. Standard biochemical techniques were used to identify the bacterial isolates.

Antibiotic Sensitivity Testing: The Kirby-Bauer disk diffusion method on Mueller-Hinton agar was used to test for antibiotic susceptibility in accordance with the most recent criteria from the Clinical and Laboratory Standards Institute (CLSI). Amoxicillin-clavulanic acid, ampicillin, ciprofloxacin, gentamicin, amikacin, ceftriaxone, and cotrimoxazole were among the antibiotics that were tested. CLSI breakpoints were used to classify the results as sensitive, moderate, or resistant. Resistance to at least one agent in three or more antimicrobial classes was referred to as (MDR).

Results

Over the course of ten months, 390 participants having a clinical diagnosis of otitis media were included in the study. The study population consisted of both pediatric and adult patients, with a slight male predominance. The majority of patients presented with complaints of persistent otorrhea, reduced hearing, and ear fullness, and had a history of inadequate response to previous empirical antibiotic therapy. Out of the 390 patients, 218 (55.9%) were male and 172 (44.1%) were female. The age range was 2 to 65 years, with the highest incidence observed in the pediatric age group (1–15 years), comprising 56.7% of the total cases.

Out of a total of 390 samples, 362 (92.8%) demonstrated positive bacterial growth, while 28 (7.2%) were culture-negative. The predominant organism isolated was Pseudomonas aeruginosa, accounting for 39.8% (144) of all isolates, followed by Proteus mirabilis at 19.9% (72), Staphylococcus aureus at 18.8% (68), Escherichia coli at 9.4% (34), and Klebsiella pneumoniae at 7.2% (26). The remaining 5% (18 isolates) included Enterobacter species and coagulase-negative Staphylococci.

The antibiotic resistance patterns observed in the major bacterial isolates revealed concerning trends. Ampicillin showed the highest resistance rates, with 85% to 100% of isolates being resistant. Resistance to amoxicillin–clavulanic acid was also notably high, particularly in Pseudomonas aeruginosa (78%) and Proteus species (82%). Cotrimoxazole exhibited resistance rates ranging from 70% to 90% across all major pathogens. In contrast, ciprofloxacin retained moderate efficacy, with 64% of P. aeruginosa and 72% of Staphylococcus aureus isolates remaining sensitive. Gentamicin demonstrated good activity, with 70% to 85% of Gram-negative isolates showing susceptibility. Among the antibiotics tested, amikacin emerged as the most effective, with sensitivity rates of 88% in P. aeruginosa and 92% in Escherichia coli.Sensitivity values are expressed as percentages of isolates susceptible to the respective antibiotic.

(MDR) was most prevalent in Pseudomonas aeruginosa (46.4%) and Staphylococcus aureus (41.2%). Among the antibiotics tested, Amikacin demonstrated the highest overall sensitivity across isolates. Conversely, resistance to commonly used first-line oral antibiotics—ampicillin, amoxicillin–clavulanate, and cotrimoxazole—was notably high across all organisms. Pseudomonas aeruginosa emerged as the most common isolate in both pediatric and adult age groups. Interestingly, pediatric isolates exhibited slightly higher sensitivity to gentamicin and ciprofloxacin compared to adults. Nevertheless, both age groups continued to exhibit substantial resistance to first-line oral antibiotics such ampicillin and cotrimoxazole.

MDR patterns were more pronounced in adult patients, particularly among S. aureus and Klebsiella pneumoniae isolates.

Table 1: Antibiotic Sensitivity Patterns of Major Bacterial Isolates in Otitis Media (n = 362 culture-positive cases)

Antibiotic	P. aeruginosa (n=144)	S. aureus (n=68)	Proteus mirabilis (n=72)	E. coli (n=34)	K. pneumoniae (n=26)
Ampicillin	10%	18%	12%	15%	19%
Amoxicillin-Clavulanate	22%	26%	18%	30%	34%
Cotrimoxazole	28%	24%	22%	20%	27%
Ciprofloxacin	64%	72%	68%	61%	58%
Gentamicin	78%	70%	82%	75%	69%
Amikacin	88%	76%	91%	92%	85%
Ceftriaxone	54%	60%	57%	66%	62%

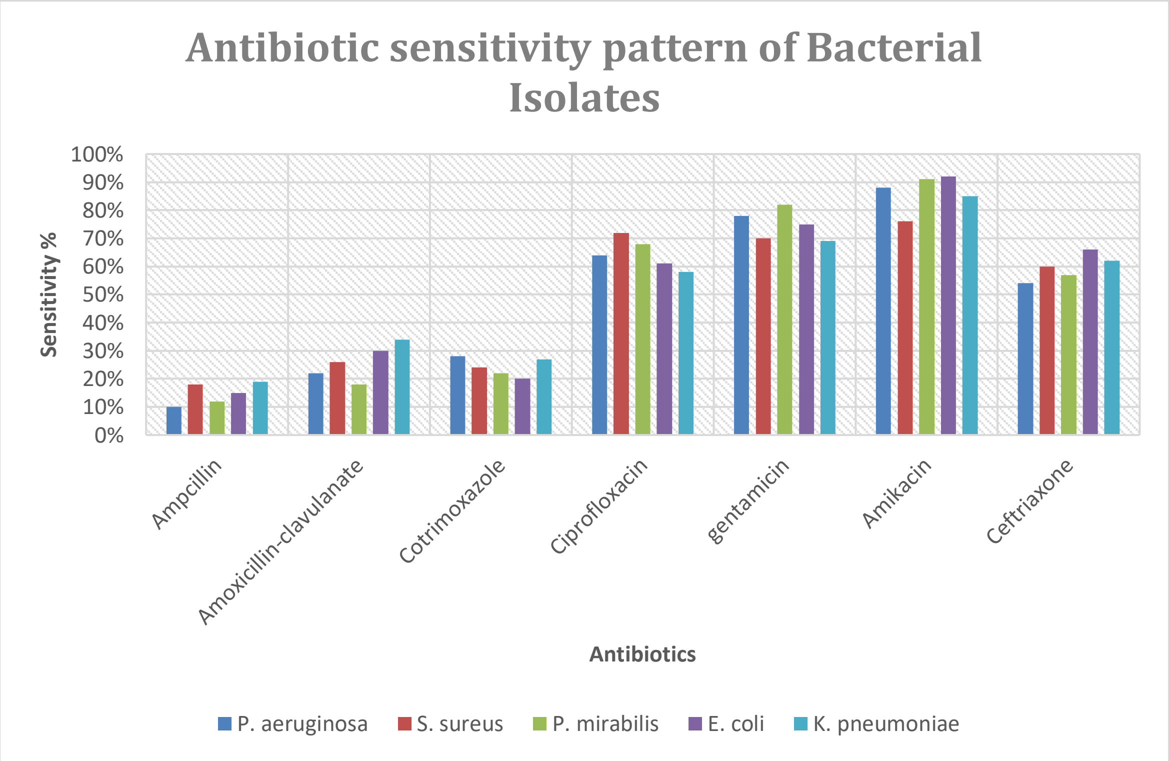

Figure 1: Antibiotic Sensitivity Pattern of Bacterial Isolates Against Commonly Used Antibiotics

Table 2: Comparison of Bacterial Isolates in Pediatric vs Adult Patients

Organism	Pediatric (n = 182)	Adult (n = 208)
Pseudomonas aeruginosa	72 (39.6%)	72 (34.6%)
Proteus mirabilis	36 (19.8%)	36 (17.3%)
Staphylococcus aureus	28 (15.4%)	40 (19.2%)
E. coli	18 (9.9%)	16 (7.7%)
Klebsiella pneumoniae	16 (8.8%)	10 (4.8%)
Others	12 (6.6%)	34 (16.4%)

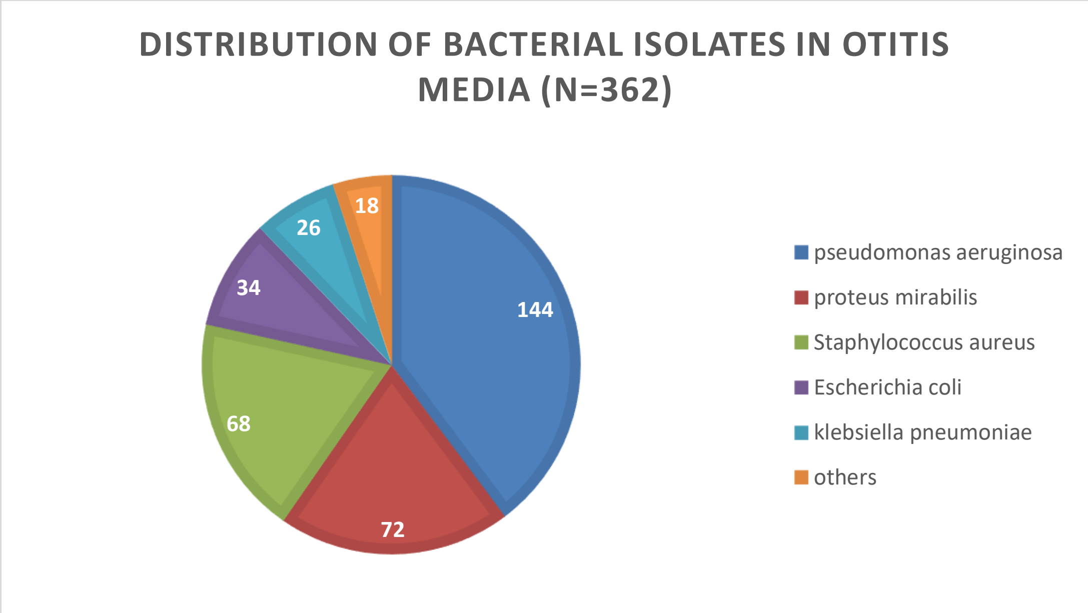

Figure 2: Distribution of Bacterial Isolates in Otitis Media Cases (N=362)

Discussion

The microbiological profile and antibiotic susceptibility patterns of otitis media cases at a tertiary care hospital in a developing country changed significantly over a 10-month period, according to this study. Pseudomonas aeruginosa was the most commonly isolated pathogen, followed by Proteus mirabilis and Staphylococcus aureus. Gram-negative organisms were found to be predominant. These results are in line with earlier research from South Asia and sub-Saharan Africa, which found that Pseudomonas species are the main cause of chronic suppurative otitis media (CSOM), especially in humid regions [1,2].

There is significant concern over the high level of resistance to first-line antibiotics like ampicillin, amoxicillin-clavulanate, and cotrimoxazole that has been observed. These agents, often prescribed empirically at primary and secondary care levels, showed markedly reduced efficacy in this cohort—an outcome that increases the risk of treatment failure and chronic infection. Similar resistance patterns have been reported in other developing regions, where unregulated antibiotic use, over-the-counter availability, and incomplete adherence to therapy have been major contributors to antimicrobial resistance [3,4].

Among the tested antibiotics, amikacin showed the highest overall sensitivity, followed by gentamicin and ciprofloxacin. While these antibiotics remain relatively effective, caution must be exercised in their use—particularly aminoglycosides, which carry ototoxic and nephrotoxic risks, especially in pediatric populations [5]. Their role as empiric agents should therefore be carefully balanced with microbiological guidance.

Multidrug resistance (MDR) was found in a substantial proportion of isolates, notably P. aeruginosa (46.4%) and S. aureus (41.2%). The high MDR rate is aligned with recent findings from similar tertiary care settings and underscores the need for robust antibiotic stewardship initiatives [6,7]. The possible contribution of biofilm formation—especially by P. aeruginosa—in chronic and recurrent cases may also play a role in therapeutic resistance, though this was not quantitatively evaluated in our study [8].

Interestingly, pediatric isolates showed slightly higher susceptibility to ciprofloxacin and gentamicin compared to adults. These age-related differences in sensitivity could reflect varied antibiotic exposure, immune function, or comorbidities and merit further investigation [9].

Overall, these findings reaffirm the importance of localized microbial surveillance and reinforce the limitations of empirical therapy in regions with rising resistance. Regular culture and sensitivity testing should be integrated into clinical practice, not only to improve patient outcomes but also to inform regional treatment protocols and policy-making [10,11].

References

1. Tesfa T, Mitiku H, Sisay M, et al. Bacterial otitis media in sub-Saharan Africa: a systematic review and meta-analysis. BMC Infect Dis. 2020;20:225.
2. Deshmukh K, Manthale D. Prevalence and antibiotic susceptibility of Pseudomonas aeruginosa in CSOM. Int J Otorhinolaryngol Head Neck Surg. 2016.
3. Baral B, et al. Antibiotic resistance in patients with chronic ear discharge in Nepal. Nepal Med Coll J. 2021.

4. Kaur R, Morris M. Antibiotic resistance patterns in otitis media pathogens. Pediatrics. 2013;131(1):e395-e408.
5. Lee SK, et al. Antimicrobial resistance of P. aeruginosa in CSOM. Otolaryngol Head Neck Surg. 2010;143(4):500–5.
6. Agarwal S, et al. Clinico-bacteriological profile and resistance patterns in CSOM. J Fam Med Prim Care. 2021;10(2):885–9.
7. Xu J, Du Q, Shu Y, et al. Resistance patterns in CSOM isolates in China. Int J Pediatr Otorhinolaryngol. 2021;143:110623.
8. Hall-Stoodley L, et al. Biofilm formation and antibiotic resistance in ENT infections. Nat Rev Microbiol. 2004;2(2):95–108.
9. Bhat N, et al. Comparison of bacterial isolates in pediatric vs adult otitis media. Indian J Otolaryngol Head Neck Surg. 2019;71(1):89–93.
10. WHO. Global Action Plan on Antimicrobial Resistance. World Health Organization; 2015.
11. CLSI. Performance Standards for Antimicrobial Susceptibility Testing. 31st ed. CLSI supplement M100. Clinical and Laboratory Standards Institute; 2021.