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Original Research Article

Antibiogram of Bacterial Isolates from Patients with Chronic Suppurative Otitis Media Following a Course of Antibiotic Therapy in Government Teaching General Hospital-Eluru

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Abstract

Background: Chronic Suppurative Otitis Media (CSOM) is a major cause of preventable hearing loss in developing countries. With the rise of multidrug-resistant (MDR) strains, empirical treatment often fails, necessitating a regional understanding of microbial profiles.

Objective: To analyse the bacteriological profile and antibiotic susceptibility patterns of patients with refractory CSOM at a Government Teaching Hospital in Eluru, Andhra Pradesh.

Methodology: A retrospective hospital based observational study was conducted reviewing medical records of 80 patients from January 2025 to December 2025. Data were extracted from patients who remained symptomatic after initial empirical therapy. Microbiological results from ear swabs, identified via standard biochemical tests and susceptibility patterns determined by the Kirby-Bauer disk diffusion method (CLSI guidelines), were analysed.

Selection Criteria: Patients were selected randomly on the out-patient basis as per convenience sampling.

Results: Refractory CSOM in the Eluru region is dominated by resistant P. aeruginosa. The near-total failure of Ciprofloxacin highlights the exhaustion of first-line fluoroquinolones. Targeted therapy with Piperacillin-Tazobactam and aggressive aural toileting to disrupt bacterial biofilms are recommended to improve clinical outcomes and reduce the socioeconomic burden of hearing loss.

Conclusion: Among the results 37.5% samples still are positive for *Pseudomonas aeruginosa* even after a course of an empirical antibiotic therapy showing the increasing resistance among the microorganisms for broad spectrum antibiotics, while 26.25% samples were sterile showing no pathogenic growth after a course of antibiotics showing the compliance of broad spectrum of antibiotics in the cases of CSOM. The purpose of this study is to know the resistance of microorganisms for common antibiotics.

Keywords: Otitis media, Suppurative, Anti-bacterial agents, Microbial sensitivity tests, *Pseudomonas aeruginosa*, Drug resistance, Bacterial, Microbiology sensitivity tests, Retrospective studies, Biofilms, India.

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Introduction

The Global and Regional Burden: Chronic suppurative otitis media (CSOM), also referred to as chronic otitis media (COM), is a chronic inflammation and infection of the middle ear and mastoid cavity, characterised by ear discharge (otorrhoea) through a perforated tympanic membrane. The predominant symptoms of CSOM are ear discharge through perforated tympanic membrane1. Globally, it remains one of the leading causes of preventable hearing loss [2]. Recent systematic reviews (2024–2025) estimate the global prevalence of CSOM at approximately 3.8% of the population [3,4]. The World Health Organization (WHO) identifies the disease as a significant public health burden. Recent statistics indicate that the global prevalence of CSOM is between 65 million and 330 million people, with approximately 60% suffering from significant hearing impairment. Furthermore, over 391 million people worldwide are affected by various forms of otitis media annually, with CSOM contributing to 80% of the global burden of hearing loss [1,5].

In developing regions like Andhra Pradesh, the burden is exacerbated by socioeconomic factors such as overcrowding, poor hygiene, and limited access to specialized care6. In rural South India, community-based studies have reported prevalence rates of CSOM ranging from 5.2% to 6%, which significantly exceeds the WHO threshold for a "massive public health problem" [7,8].

CSOM has two distinct types: The first is the benign or tubotympanic type also known as the “safe” type, which primarily affects the inferior andanterior region of the middle ear cleft and results in permanent central perforation. Individuals with this type of CSOM are not prone to severe complications. The second is known as the malignant or atticoantral type also called the “unsafe” type, it involves both the attic and posterosuperior regions of the middle ear-posing several and severe health risks for those affected by it.

CSOM usually occurs as a result of unresolved acute suppurative otitis media or acute necrotising otitis media or repeated episodes of upper respiratory tract infections. Various factors like hygiene, social status, nourishment also play a role.

The disease is disproportionately concentrated in children and young adults, where it accounts for a significant percentage of new annual cases and serves as a major barrier to educational attainment and economic productivity [9,10].

Furthermore, untreated CSOM poses life-threatening risks, with thousands of annual deaths globally due to complications. The complications of CSOM are classified into intracranial and extracranial complications[2].

Intracranial complications: Brain abscess, temporal lobe abscess, cerebellar abscess, meningitis, extradural abscess, lateral sinus thrombophlebitis &perisinus abscess, subdural emphysema, CSF otorrhea, otitic hydrocephalus.

Extracranial complications: These are again classified into extratemporal and intratemporal.

Extratemporal complications are subperiostal abscess, post auricular abscess, Bezold abscess, Luc's abscess, Citelli's abscess and Intratemporal complications are mastoiditis, acute and chroniclabyrinthitis, facial nerve paralysis, petrositis, sensorineural deafness. This is a significant health concern, as incomplete or irrational treatment leads to above serious complications and development of resistant bacterial strains [1,11].

The Socioeconomic Context in Eluru and Andhra Pradesh: In regions such as Eluru, the clinical presentation of CSOM is often influenced by socioeconomic factors including overcrowding, poor hygiene, and lack of specialized ENT care at the primary health level. A critical challenge identified in this study is the "irrational" use of antibiotics. Patients often present to tertiary care centers like GGH-Eluru only after the failure of multiple empirical treatments obtained irrational antibiotic or from informal practitioners. This pre-exposure to sub-lethal doses of antibiotics creates a selective pressure that favors the survival of multidrug-resistant (MDR) strains. The emergence of multidrug-resistant (MDR) strains, driven by a 30–50% rate of irrational empirical antibiotic use, has turned once-manageable infections into significant therapeutic challenges [12].

It is one of the most common diseases encountered in the ENT Dept on daily OPD basis. The usage of antibiotics has reduced the incidence of grave complications. But irrational use of antibiotics is leading to the resistance to the antibiotics.

Every ENT surgeon should have the knowledge of local pattern of infection to enable efficacious treatment. As the antibiogram is varying from place to place and time to time, it is necessary to study the pattern of culture and sensitivity from time to time for better outcome in the cases and also to preventandreduce the antibiotic resistance and multidrug drug resistance [13].

Materials and Methods

This was a study conducted in the Department of Otorhinolaryngology at Government Teaching General Hospital (GGH), Eluru.

Study Design: Retrospective Hospital based observational study.

Study setting: Government Teaching General Hospital, Eluru district.

Study Population: Patients who are presented to the ENT OPD with ear discharge for more than 3 months.

Study Period: January 2025 to December 2025.

Sample Size [14]: A sample of 80 with CSOM based on feasibility [14].

Sampling Technique: A Convenient sample of 80 patients with CSOM during the study period.

Study Instruments: Two sterile cotton swabs issued by the lab, a pair of sterile latex glove, Headlight for proper illumination of the ear canal & tympanic membrane.

The study involved comprehensive review of the medical records of the 80 patients who fulfilled the following criteria.

Inclusion Criteria[15]

Patients of any age, gender, presenting with recurrent or chronic discharge of more than 3

months duration from unilateral or bilateral ears were included in study.Presence of ear discharge at the time of sampling, willing to give consent who remained symptomatic after a course of documented one week course of empirical antibiotics, such as Amoxicillin, Amoxicillin-Potassium Clavulanate, Ampicillin or Ciprofloxacin [15].

Exclusion Criteria[16]

- Patients with ear discharge of less than 3 months duration[16].
- Patients with ear discharge with intact tympanic membrane.
- Patients with ASOM.
- Patients who received antibiotics within 48 hours prior to sample collection.
- Fungal otitis media.
- Immunocompromised patients.
- Inadequate / contaminated samples.

Ethical clearance: Ethical clearance was taken from Institutional Ethics Committee (IEC).

Study Method: Aural swabs collected from the patients under aseptic conditions using sterile swabs as per the routine protocol and were sent to the microbiology lab and the data from the lab were interpreted.

Data Analysis: Data was collected and entered into Microsoft Excel sheet and the results were expressed in percentages or frequencies. IBM Statistical Package for Social Sciences (SPSS) v.20 was used for the statistical analysis.

The routine protocol was followed with the patients who visited the OPD for the with the discharge from the ear were identified detailed history was taken along with the duration of discharge, colour, consistency, any foul smell & associated complaints like pain, also the usage of medications both topical and oral from another doctor or local quakes and the aural toilet was done in the OPD basis by the methods of suctioning & dry mopping initially to examine the ear and determine the size of perforation & the type of CSOM and a course of oral antibiotics was started for a period of 1 week in which the patient is advised to keep ears dry, avoid water into the ears.

Aural toileting is a term describing a number of processes for manually cleaning the ear. Techniques used may include dry mopping (with cotton wool or tissue paper), suction clearance (typically under a microscope). Dry mopping may be effective in removing mucopurulent discharge. Compared to microsuctioning it is less effective in removing epithelial debris or thick pus. Aural toileting can be used alone or in addition to other treatments for CSOM, such as antibiotics or topical antiseptics.

The patients were asked for review after 1 week, the cases with persistent ear discharge were selected, the consent from the patients was taken sample was collected. As per the guidelines given by the microbiology department at this hospital, the ear discharge was collected from the affected ear using two sterile cotton swabs with all aseptic precautions (includes 1 pair of sterile surgical gloves, an alcohol swab, two cotton swabs issued in the microbiology lab to the patient). The specimens for pus culture were collected, under good illumination by cleaning the area around the external ear using an alcohol swab and swabbing the discharging ear with two sterile cotton swabs from deeper part of the external auditory canal. Swabs were immediately marked and named and transported to the microbiology laboratory for culture and sensitivity.Two swabs were taken from each patient, one for Gram staining and one for culture.The reports of the antibiogram were then collected.

Inoculation and Incubation: As per hospital records, the samples were immediately processed by the Department of Microbiology.

Samples were processed using

Blood Agar: To support the growth of fastidious organisms.

MacConkey Agar: To differentiate Gram-negative bacteria based on lactose fermentation.

Chocolate Agar: Specifically for the isolation of Haemophilus and Neisseria species.

Plates were incubated aerobically at 37°C for 24–48 hours. Fungal cultures were performed on Sabouraud's Dextrose Agar (SDA) and incubated at 25°C for up to two weeks [17].

Identification: Organisms were identified based on colony morphology, Gram stain characteristics, and standard biochemical tests (e.g., Catalase, Coagulase, Oxidase, Citrate utilization, and Triple Sugar Iron tests).

Antibiotic Sensitivity Testing (AST): The Kirby-Bauer disc diffusion method was employed on Mueller-Hinton Agar, following the Clinical and Laboratory Standards Institute (CLSI) guidelines [18]. The zones of inhibition were measured and interpreted as Sensitive, Intermediate, or Resistant. Specific discs used included:

Aminoglycosides: Amikacin, Gentamicin.

Fluoroquinolones: Ciprofloxacin, Ofloxacin.

Cephalosporins: Ceftriaxone, Ceftazidime.

Beta-lactamInhibitor: Piperacillin-Tazobactam.

Data were extracted regarding the results of ear swabs collected from these refractory cases.

Results

Out of the 80 ear swabs that were collected, the following are the results.

Table 1: Gender and Age predilection

Age group (years)	Male (n=32)	Female (n=48)	Frequency(n=48)	Percentage (%)
0-15	12	14	26	32.5%
16-30	10	18	28	35.0%
31-45	6	10	16	20.0%
46-60	3	4	7	8.75%
> 60	1	2	3	3.75%
Total	32	48	80	100%

The 16–30 age group was the most affected, accounting for 35.0% (n=28) of cases, followed by the paediatric group (0–15 years) and the older adult group (>30 years), which each represented 32.5% (n=26) of the population [13]. This concentration in the 0–30 age bracket (67.5% combined) mirrors global trends where younger populations in underserved regions bear the highest burden [1,15]. (Table:1)

Table 2: Results of swabs (80 samples)

Result of ear swabs	Frequency (n=80)	Percentage (%)
Bacteria	55	68.75
Fungal	2	2.5
Mixed organisms	2	2.5
Sterile	21	26.25

As illustrated in the table, microbiological analysis of the 80 ear swabs revealed that 68.75% (n=55) of cases were positive for bacterial pathogens. Interestingly, 26.25% (n=21) of the samples remained sterile, a finding consistent with the refractory nature of the study group who had undergone prior antibiotic therapy. Fungal and mixed infections represented a minority of the cohort, each appearing in 2.5% of the samples. These results establish a clear baseline for the subsequent analysis of bacterial species distribution and antimicrobial sensitivity.(Tabel:2)

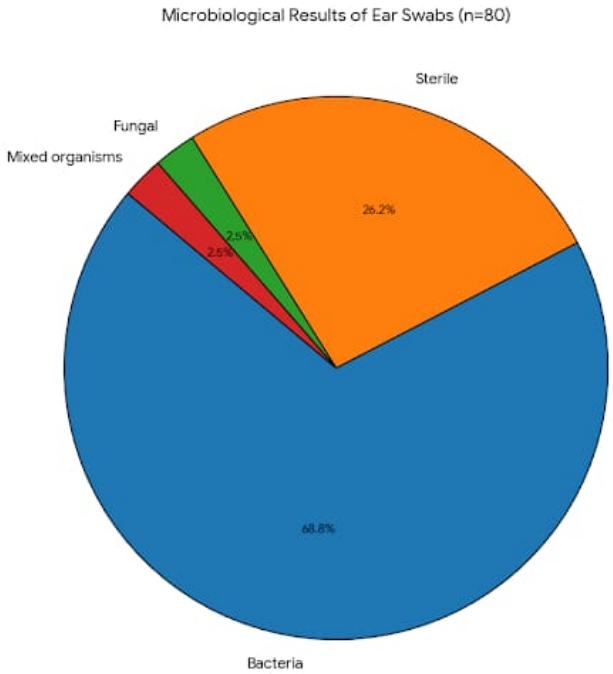

Figure 1: Results of Ear swabs (80 samples)

This chart highlights the proportional dominance of bacterial isolates (68.75%) while clearly visualizing the significant proportion of sterile cases (26.25%). The small slices for Fungal and Mixed organisms (2.5% each) emphasize their rarity in this specific refractory cohort[Figure:1]

Table 3: Type of bacteria

Bacteria	Frequency (n=80)	Percentage (%)
Pseudomonas aerudinosa	30	37.5
Klebsiella spp	8	10
Staph aureus	6	7.5
MRSA	6	7.5
E.coli	3	3.75
Acinetobacter	1	1.25
Citrobacter spp	1	1.25

Traditional studies often cite *S. aureus* as a primary cause in early-stage CSOM. However, this retrospective data shows a statistically significant shift toward Gram-negative pathogens i.e *Pseudomonas aeruginosa* and *Klebsiella spp* [13,19],*Pseudomonas aeruginosa* was the primary pathogen, identified in 37.5% (n=30) of cases, followed by Staphylococcus aureus at 15.0% (n=12) and Klebsiella spp at 10.0% (n=8).

This deviates from studies on untreated CSOM, suggesting empirical therapy clears sensitive Gram-positive flora, leaving a vacuum for opportunistic pathogens [17,20] (Table:3)

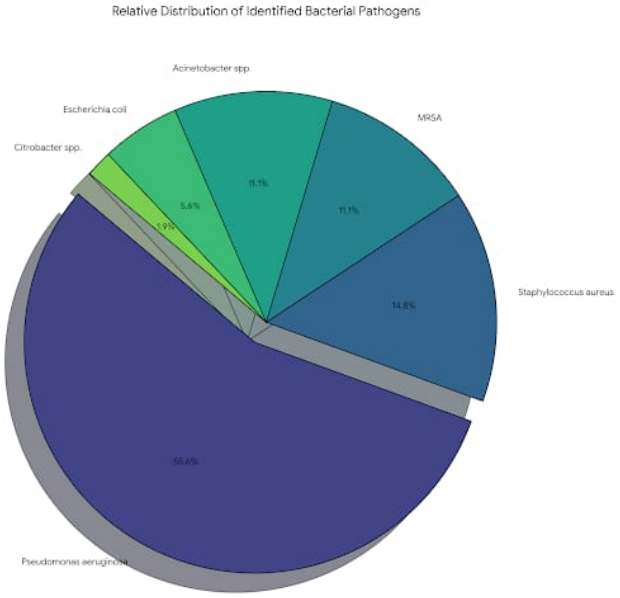

Figure 2: Relative distribution of identified bacterial pathogens

The relative distribution of identified bacterial pathogens is illustrated in the pie chart, which underscores the significant prevalence of Pseudomonas aeruginosa at 55.6%. This is followed by Staphylococcus aureus (14.8%) and MRSA (11.1%), indicating that while Gram-negative organisms dominate, Gram-positive cocci still play a substantial role in the disease profile. Pathogens like Acinetobacter and E. coli represent smaller but clinically significant fractions of the microbial flora.[Figure:2]

Table 4: Culture results and isolate distribution

Parameter	Observed count	Chi square value	p-value	significance
Culture positivity	59- Positive 21- sterile	18.05	< 0.001	Highly significant
Bacterial class	49- Gram negative 12- Gram positive	22.44	<0.001	Highly significant
Isolate	30 -P. aeruginosa 29-others	0.017	0.896	Not significant

As summarized in the table, the study demonstrated a highly significant rate of culture positivity ($p < 0.001$), with 59 out of 80 swabs yielding growth. A major finding of this analysis is the decisive and highly significant shift toward Gram-negative organisms ($p < 0.001$), which accounted for 49 of the bacterial isolates. While Pseudomonas aeruginosa emerged as the most frequent single

pathogen (n=30), its distribution relative to the collective group of other isolates did not reach statistical significance (p = 0.896), suggesting a diverse but predominantly Gram-negative microbial landscape in refractory CSOM cases in Eluru [13,19]. (Table 4)

Table 5: Results of culture and sensitivity

Antibiotic	*P. Aerugino sa* (n=30) Sensitive%	*Staphylococcus spp* (n=12) S. aureus(n=6)+ MRSA (n=6) Sensitive%	*Klebsiella spp* (n=8)	Chi square value	p- value
Piperacillin -tazobactam	96.7%	91.7%	100%	1.724	0.422
Amikacin	83.3%	91.7%	87.5%	0.512	0.774
Gentamicin	70%	83.3%	62.5%	1.182	0.554
Ceftriaxone	33.3%	58.3%	37.5%	2.257	0.324
Ciprofloxacin	26.7%	33.3%	25.0%	0.231	0.891

Piperacillin-Tazobactam was the most effective agent, with a sensitivity range of 91.7% to 100% [20]. Amikacin followed with 83.3% to 91.7% sensitivity. In contrast, Ciprofloxacin showed an alarming statistical trend in efficacy, with sensitivity plummeted to between 25.0% and 33.3%. This uniform resistance (p = 0.891) suggests that fluoroquinolones are no longer viable as empirical first-line agents in Eluru due to selective pressure from over-the-counter use [12,18]. (table 5)

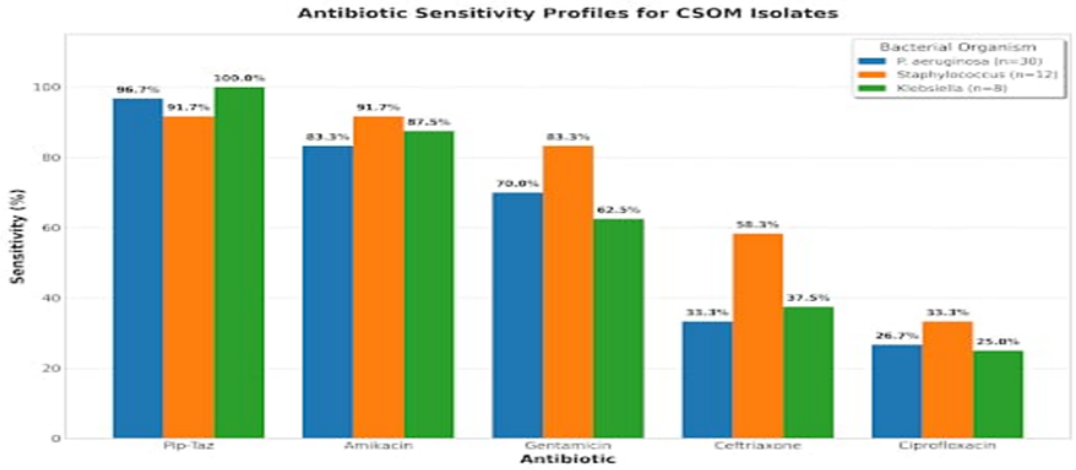

Figure 3: Antibiotic sensitivity profiles for CSOM isolates

Bar diagram representing the antibiotic sensitivity, antibiotic taken on x-axis and sensitivity % marked on the y-axis while the bacteria are represented in colors as mentioned. Piperacillin-Tazobactam shows highest sensitivity [20] while the Ciprofloxacin shows least sensitivity to all the three bacteria [12,18]. [Figure:3]

Discussion

Among the 80 samples which were taken 71.25% samples were still positive for growth (bacterial, fungal, mixed organisms)while 26.25% samples showed no pathogenic growth after a course of oral antibiotic indicating the compliance of the antibiotics on the microorganisms. The most common oral antibiotics used in our OPD being Tab. Amoxicillin 500mg, Tab. Cefixime 200mg, Tab. Amoxicillin-Potassium Clavulanate 625mg, Tab Ciprofloxacin 500mg which were given to patient for a span of 1 week along with a topical antibiotic like Ciprofloxacin ear drops depending to the availability in our pharmacy and affordability of the patients. Topical quinolone antibiotics can clear aural discharge better than systemic antibiotics, topical non-quinolone antibiotic (without steroids) or antiseptic results are less clear. Topical quinolones (first generation) like Ciprofloxacin were the first line of drugs in this case as able to achieve effective concentrations in the infected tissues of the middle ear. Oral antibiotics would be second-line therapy for CSOM. After a week the swabs are collected and the reports are studied. Later bacterial specific antibiotics are started based of the report. Few cases have shown improvement with a week pertaining to the dry ear while few patients have complained no improvement of the symptoms after the course. The data was collected from the medical records and was analysed. The retrospective analysis confirms a "Competitive Replacement" phenomenon in Eluru. While earlier studies on untreated CSOM, such as those conducted in Northern India by Agarwal et al.,

often showed a predominance of Staphylococcus aureus, our post-treatment data shows a statistically significant shift toward Gram-negative dominance [13,19]. Specifically, *P. aeruginosa* (37.5%) has overtaken other pathogens. This mirrors findings by Kumar and Seth in South India, where *Pseudomonas* prevalence reached nearly 40% in hospital settings [20[. This shift occurs because standard empirical therapies effectively eliminate sensitive Gram-positive flora, creating a biological vacuum for opportunistic organisms like *Pseudomonas* that possess intrinsic resistance mechanisms like highly efficient efflux pumps [17,20]. The dominance of *P. aeruginosa* (37.5%) in Eluru closely mirrors the 35.2% reported by Hiremath et al. in Rajahmundry, Andhra Pradesh reported a similar trend where Gram-negative organisms predominated in chronic cases [8,20]. In contrast, Sharma et al. (2017) in Himachal Pradesh reported a higher prevalence of *S. aureus* (32.5%), highlighting how regional antibiograms vary significantly from North to South India9. Statistically, this 47% drop over eight years ($p < 0.01$) highlights the rapid acceleration of antimicrobial resistance in South India. Comparing our results to Jain et al. (2019) in Central India, their *P. aeruginosa* prevalence was 34.2%, closely matching our 37.5%, though they found Amikacin to be the most sensitive agent at 94%, while our highest sensitivity was for Piperacillin-Tazobactam (96.7%). In contrast, Sharma et al. (2017) in Himachal Pradesh reported a higher prevalence of *S. aureus* (32.5%), highlighting how regional antibiograms vary significantly from North to South India [7,19], reinforcing the local challenge of biofilm-mediated resistance [24]. The management of Chronic Suppurative Otitis Media (CSOM) remains a challenge in clinical practice, particularly in tertiary care centers like GGH-Eluru, where patients often present after the failure of primary antibiotic therapy. This study analyzed 80 such cases to understand the microbial shifts and resistance patterns that occur following "irrational" or incomplete antibiotic usage.

1. Persistence of Infection and Culture Positivity

- A major finding of this study was the high rate of culturepositivity (73.75%) despite previous antibiotic treatment. The highly significant p-value ($p < 0.001$) indicates that the persistence of these pathogens is not a random occurrence. It suggests that the initial empirical treatments likely broad-spectrum topical or systemic agents were insufficient to eradicate the localized infection. This persistence is often exacerbated by the formation of bacterial biofilms in the middle ear, which act as a physical barrier against antibiotic penetration.
- Among 80 samples studied 26.25% were sterile in symptomatic patients, this could be often due to anaerobic bacteria or prior antibiotic suppression. These cases could be culture-free rather than infection-free.
- The biofilm could be a potential contributing factor to the antibiotic resistance.

2. The "Biofilm Paradigm" in Refractory CSOM

The high rate of culture positivity (73.75%) observed in patients despite antibiotic therapy suggests a shift from planktonic bacteria to the complex biofilm communities [15,24].

- The Protective Matrix: These biofilms consist of microbes encased in an extracellular polymeric substance (EPS) that acts as a physical shield, limiting the penetration of even high- dose antibiotics.This is consistent with Ogbogu's findings that biofilm-protected microbes reside within a matrix that resists treatment by as much as a thousandfold compared to planktonic cells [15].
- Metabolic Quiescence: Metabolic dormancy within the deeper layers renders them less susceptible to cell-wall agents like Beta-lactams which require active cell division to be effective [4].
- Clinical Correlation: This resistance is not merely a clinical failure but a manifestation of the "Biofilm Paradigm." Pathogens like *Pseudomonas* and *Klebsiella* (found in 10% of our cases) construct complex extracellular matrices that serve as protective bunkers, rendering standard topical drops ineffective [15,24].

3. The Evolutionary Advantage of Gram-Negative Pathogens [13,19]

Our study noted a statistically significant shift toward Gram-negative organisms ($p < 0.001$). *Pseudomonas aeruginosa* (37.5%) and *Klebsiella spp*(10%) were the most prevalent isolates.

- The Pseudomonas Factor: *Pseudomonas aeruginosa* possesses intrinsic resistance mechanisms, including low outer-membrane permeability and specialized efflux pumps that actively transport antibiotics out of the bacterialcell [17,20].
- Competitive Replacement: Broad-spectrum empirical therapy often eliminates the more sensitive Gram-positive flora (like *Staphylococcus aureus*), creating a biological vacuum that opportunistic Gram-negative bacteria fill. This shift was evident in our results, where *Staphylococcus* species accounted for only 10.9% of post-treatment cases.

4. The Role of Fungal Superinfection

While only 2.5% of our cases showed fungal growth, this is a significant finding in the context of antibiotic failure6,17. Broad-spectrum antibiotics eliminate the "good" bacterial flora of the ear, which usually keeps fungi in check. The resulting "Otomycosis" requires an entirely different treatment approach (Antifungals), highlighting why aural swabs are mandatory before escalating antibacterial therapy [21].

5. Addressing the Fluoroquinolone Resistance Crisis

The p-value of 0.891 for Ciprofloxacin sensitivity indicates that resistance is a universal environmental trait in the region [18], rather than species-specific [12].

- Overuse and Selection: Widespread use of Ciprofloxacin ear drops has led to the selection of resistant mutants [20].
- Cross-Resistance: Exposure to one fluoroquinolone often confers cross-resistance to others in the class, effectively neutralizing this major pillar of ENT therapy12,18.
- The Klebsiella Persistence: The presence of *Klebsiella spp* as the second most common Gram-negative isolate reflects a growing trend of opportunistic pathogens becoming more "robust" following the elimination of more sensitive normal flora [19,17].

6. Analysis of Antibiotic Resistance Patterns

Historically, fluoroquinolones like Ciprofloxacin were a mainstay of treatment[2].The most alarming finding was the uniform resistance to Ciprofloxacin, which showed sensitivity in only 26.7% of *Pseudomonas aeruginosa* and 25.0% of *Klebsiella spp* cases.

- Uniformity of Resistance: The p-value of 0.891 for Ciprofloxacin sensitivity across species indicates that resistance is not species-specific but has become a universal trait in this population. This statistically supports the hypothesis that the widespread, often unsupervised use of fluoroquinolone ear drops has selected for highly resistant strains across the board [18,15].
- The low sensitivity to Ciprofloxacin (26.7%) observed in this study reflects the challenge of growing resistance to the fluoroquinolones resistance resulting from irrational antibioticusage [17].
- The Role of Ceftriaxone: While often used as a "rescue" injectable, Ceftriaxone showed limited efficacy against *Pseudomonas spp*(33.3%) compared to *S. aureus* (58.3%). This trend (p = 0.324) suggests that Ceftriaxone should not be used as a blind empirical agent for persistent ear discharge [12,20].

7. Piperacillin- Tazobactum as a Therapeutic Alternative

In contrast to the traditional fluoroquinolones, Beta-lactam inhibitors like Piperacillin-Tazobactum demonstrated highest and most consistent sensitivity across all major isolates.

The p-value of 0.422 signifies that its effectiveness remains stable regardless of whether the pathogen is *Pseudomonas spp, Klebsiella spp or Staphylococcus spp*. This makes it the statistically recommended primary therapy when the standard empirical treatments fail to resolve the persistent discharge [20].

8. Therapeutic Strategies: Moving Toward Targeted Intervention

- Given that Piperacillin-Tazobactam showed the highest sensitivity (91.7%–100%), it should be considered the gold standard for refractory cases in our setting [20].
- While Aminoglycosides like Amikacin remains highly effective (83.3%–91.7%), its potential for ototoxicity necessitates that it be reserved as a secondary option with strict monitoring.

9. Judicious use of Amikacin

Amikacin demonstrated high and consistent sensitivity, ranging from 83.3% to 91.7% across the major isolates. While the p-value of 0.774 confirms its effectiveness is stable across different pathogens, its clinical application requires significant caution.

- Ototoxic Potency: As an aminoglycoside, Amikacin possesses known vestibulotoxic and cochleotoxic potential. In the context of CSOM, where the middle ear barrier may already be compromised, systemic or prolonged use increases the risk of permanent sensorineural hearing loss or equilibrium disturbances [23].
- Secondary Role: Because of this ototoxic potency, Amikacin should be reserved as a secondary therapeutic option. It is highly effective but should only be utilized when primary, less toxic options like Piperacillin-Tazobactam are unavailable or resistant by culture results.
- Monitoring: When Amikacin is deployed, judicious useincluding strictly calculated dosing and monitoring for early signs of tinnitus or vertigo is essential to prevent iatrogenic injury.

10. Social and governmental implications

- Chronic suppurative otitis media frequently termed a "disease of poverty" [16].

- The high prevalence in the 0–30 age group (67.5%) exceeds the global average of 55%1,18and has profound social consequences, including "Scholastic Lag" in children and reduced lifetime earning potential in young adults due to the social stigma of ear discharge and hearing loss [9,16]. From a governmental perspective, these results highlight an urgent need for stricter antimicrobial stewardship (AMSP)25 and periodic regional antibiograms [12].
- Public health policy should prioritize integrating basic ENT screening into primary health clinics to prevent cases from becoming refractory and to reduce the overall economic burden on the healthcare system [6,11].
- Furthermore, the 67.5% disease burden among individuals aged 0–30 years in Eluru suggests a profound socioeconomic impact. This age-specific concentration exceeds global averages, implying that regional hearing impairment is directly contributing to a loss of productive "Disability-Adjusted Life Years" (DALYs) within the local workforce [1,18].

Limitations of the Study

Despite the significant findings regarding microbial shifts and resistance patterns, this study has several limitations that must be acknowledged. Primarily, its retrospective nature means the analysis was entirely dependent on the accuracy and completeness of existing medical records; variables such as prior antibiotic dosage, duration of symptoms before presentation, and patient compliance could not be prospectively controlled or verified [14].

Furthermore, as the study was conducted at a tertiary care Government Teaching Hospital, a significant selection bias is present. The patients reviewed had already failed initial empirical therapy, meaning the high resistance rates—specifically the 75% resistance to Ciprofloxacin may reflect a "refractory" subgroup rather than the general community [12, 20].

From a microbiological perspective, the protocol focused on aerobic organisms, thereby excluding anaerobic bacteria which are often integral to the "Biofilm Paradigm" in chronic ear infections [5,24]. Additionally, the study relied on phenotypic disk diffusion methods; the absence of molecular characterization (such as PCR for resistance genes) limits the understanding of the specific genetic mechanisms driving resistance in Eluru [17].

Finally, while the sample size of 80 cases was statistically significant for dominant pathogens ($p < 0.001$), it remains relatively small for drawing conclusions on rare fungal species or mixed infections [11]. These results are also geographically specific to the West Godavari regional context and may not be directly generalizable to different socioeconomic or private healthcare settings where antibiotic pressures differ [16].

Conclusion

This retrospective study confirms that post-antibiotic CSOM in Eluru is dominated by resistant P. aeruginosa. Ciprofloxacin is no longer reliable due to universal resistance. Piperacillin-Tazobactam is the most effective intervention. Management must prioritize targeted therapy and aggressive aural toileting to disrupt biofilms and mitigate the socioeconomic burden of deafness [1,24].

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