OPEN ACCESS

doi.org/10.59736/IJP.24.02.1073

ORIGINAL ARTICLE

Patterns of Resistance of Pseudomonas aeruginosa and Staphylococcus aureus in Chronic Suppurative Otitis Media: Cross-Sectional Study

Malik Ali Hasham Awan[1], Muhammad Sohail Awan[1]

[1] Section of Otorhinolaryngology, Department of Surgery, Aga Khan University Hospital, Karachi

ABSTRACT

Background: To determine the resistance pattern of Staphylococcus aureus and Pseudomonas aeruginosa in patients with chronic otitis media

Methods: A Cross-sectional Observational study was conducted; a total of 191 aural swabs were sent from chronic suppurative otitis media patients. Resistance profiles were determined by standard culture and the Kirby-Bauer disc diffusion method in accordance with CLSI 2024 Guidelines, and the minimum inhibitory concentration method was used for vancomycin. Data were analysed by SPSS Version 27.0

Results: Of 191 cultures, 160 (83.8%) demonstrated bacterial growth. Among culture-positive samples, Staphylococcus aureus was isolated in 56 (35.0%) and Pseudomonas aeruginosa in 51 (31.9%). Pseudomonas aeruginosa exhibited substantial resistance to commonly used empiric fluoroquinolones, with 45.1 % resistant to ciprofloxacin and 39.2 % resistant to levofloxacin. Meanwhile, they showed less resistance to aminoglycosides, with only 33.3% resistant to Tobramycin. Marked sensitivity to restricted antibiotics such as Piperacillin/Tazobactam (80.4%) and Carbapenems (Imipenem 100%, Meropenem 98%) was observed. *Staphylococcus aureus* showed marked sensitivity to Vancomycin (98.2%) and Linezolid (96.4%), which are restricted antibiotics; meanwhile, it exhibited high resistance to Oxacillin (64.3%) and substantial resistance to erythromycin (53.6%).

Conclusion: Growing resistance to commonly used empiric topical antibiotics should be a concern and routine culture driven antibiotics should be incorporated into practice. Meanwhile, Prudent use of restricted antibiotics is essential. Vancomycin and linezolid should be used cautiously for Staphylococcus aureus, while piperacillin–tazobactam and carbapenems should be reserved for appropriately selected Pseudomonas aeruginosa infections to help preserve their future effectiveness.

Keywords: Antibiotic Susceptibility, Otitis Media, *Staphylococcus aureus, Pseudomonas aeruginosa.*

This article may be cited as: Awan MAH, Awan MS. Patterns of Resistance of pseudomonas aeruginosa and staphylococcus aureus in chronic suppurative otitis Media: Cross-sectional study. Int J Pathol: 24(2):239-44. https://doi.org/10.59736/IJP.24.02.1073

Introduction

Chronic Suppurative Otitis Media (CSOM) is defined as persistent purulent discharge from the ear in the presence of a perforated tympanic membrane for more than three months, with associated inflammation of the middle ear cleft (1). It disproportionately burdens socio economically disadvantaged populations, where overcrowded living conditions, inadequate sanitation, and limited access to healthcare.

CORRESPONDING AUTHOR
Malik Ali Hasham Awan
Section of Otorhinolaryngology, Department of Surgery, Aga Khan University Hospital, Karachi
malik.awan@aku.edu

The disease remains particularly prevalent in low- and middle-income countries, including Pakistan. (2,3). The causative organisms are bacteria, which occur as a superimposed infection over the viral upper respiratory tract infection because of the resulting eustachian dysfunction. Worldwide, the most common causative organisms are Staphylococcus aureus and Pseudomonas Aeruginosa so, as in Pakistan. (4,5) Because of the widespread use of Empiric antibiotics, there is a growing concern for increased resistance to commonly used topical antibiotics like oxacillin and fluoroquinolone, which are the cornerstone of empiric therapy. (6,7,8)

Despite the clinical importance of antimicrobial resistance in CSOM, locally generated susceptibility data remain limited. Therefore, this study aims to characterize the local antimicrobial resistance patterns and assess whether current empirical prescribing practices may contribute to resistance, while evaluating the sensitivity of reserved antibiotics. Through this observational cross-sectional study, we aimed to outline the current resistance pattern of the two most common causative organisms and the frequency of resistance to oxacillin for Staphylococcus aureus and fluoroquinolone for Pseudomonas aeruginosa, which are the most widely used topical empiric antibiotics. (3)

Methods

An Observational, Cross-sectional Study was conducted at the section of otolaryngology, Aga Khan University Hospital, after getting Ethical review Committee approval with the following Reference 2025-10978-33123, over a period of six months and patients were enrolled by using Non-Probability Consecutive sampling. Sample Size was calculated using the openEpi software with Confidence interval of 95%, using the Culture Positivity proportion of 85.5% from Khan et al4, with precision level of 5%, the sample size came out to be 191. Only patients who were diagnosed with CSOM and culture showed Staphylococcus aureus and Pseudomonas aeruginosa growth were included, all patients with other isolates were excluded. Aural swabs were taken in a completely sterile fashion under a microscope from the middle ear and sent to the microbiology lab within one hour of collection

Specimens was cultured on blood agar and MacConkey agar at 37°C for 24–48 hours, and bacteria identified by Gram staining, colony morphology and hemolysis, along with urease, citrate, and triple sugar iron reactions. Staphylococcus aureus was confirmed by catalase and coagulase tests, whereas Pseudomonas aeruginosa was identified by oxidase testing. Antimicrobial susceptibility testing was performed on pure isolates by Kirby–Bauer disk diffusion on Mueller–Hinton agar using a 0.5 McFarland inoculum, with incubation at 35 ± 2°C for 16–18 hours. Interpretation of results was done according to CLSI M100 (2024) criteria. Vancomycin susceptibility in Staphylococcus aureus isolates was determined separately by the minimum inhibitory concentration (MIC) method.

All the data were completely anonymized and recorded in a password-secured structured proforma and was exported into IBM SPSS Statistics Version 27.0. Descriptive statistics were reported in terms of frequencies and percentages, along with the absolute number, and a p-value of <0.05 was taken as statistically significant.

Results

Of the 191 cultures obtained, 160 (83.8%) demonstrated bacterial growth. Among the culture-positive samples, *Staphylococcus aureus* was the most frequently isolated organism, identified in 56 (35.0%) samples, followed by *Pseudomonas aeruginosa* in 51 (31.9%). The remaining 53 isolates comprised *Klebsiella spp*. in 21 (13.1%), *Proteus mirabilis* in 19 (11.9%), and *Escherichia coli* in 13 (8.1%) samples. These organisms were not included in the subsequent antimicrobial resistance profiling, which focused on *S. aureus* and *P. aeruginosa* Cultures. The mean age in the *Staphylococcus aureus* group was 25.13 years (Standard Deviation ±12.13), with a range of 0-47 years and composed of 31 males (55.4%) and 25 Females (44.6%).

The mean age in the *Pseudomonas aeruginosa* group was 29.61(SD ±12.56), ranging from 3 to 59 years and composed of 29 males (56.9%) and 22 Females (43.1%) The isolated *Staphylococcus Aureus* exhibited high resistance to Oxacillin (64.3%) and substantial resistance to erythromycin (15 µg) (53.6%). On the other hand, high susceptibility was observed to restricted agents such as Vancomycin (n=55, 98.2%), Linezolid (30 µg) (n=54, 96.4). A full breakdown of resistance frequencies is provided in Table 1.

Table 1: Antibiotic Resistance Profile of *Staphylococcus aureus* Isolates (n=56)

Antibiotic	Resistant, n (%)	Sensitive, n (%)	Intermediate, n (%)
Levofloxacin	21 (37.5)	35 (62.5)	0 (0)
Oxacillin	36 (64.3)	20 (35.7)	0 (0)
Erythromycin	30 (53.6)	16 (28.6)	10 (17.9)
Gentamicin	21 (37.5)	34 (60.7)	1 (1.8)
Tetracycline	17 (30.4)	39 (69.6)	0 (0)
Amikacin	14 (25.0)	39 (69.6)	3 (5.4)
Clindamycin	12 (21.4)	43 (76.8)	1 (1.8)
Linezolid	2 (3.6)	54 (96.4)	0 (0)
Vancomycin MIC	1 (1.8)	55 (98.2)	0 (0)

The isolated *Pseudomonas aeruginosa* showed substantial resistance to fluoroquinolones commonly used as first line topical empiric therapy, with 45.1 % resistant to ciprofloxacin (5 µg) and 39.2 % resistant to levofloxacin (5 µg). In contrast, resistance to aminoglycosides such as Tobramycin (10 µg) was lower (33.3%), while 74.5% were sensitive to Piperacillin/tazobactam (100/10 µg). Notably, all isolates were sensitive to Imipenem (10 µg) (100%), and very high susceptibility was observed for Meropenem (10 µg) (n=50, 98.0%). The complete resistance profile is shown in **Table 2.**

Table 2: Antibiotic Resistance Profile of Pseudomonas aeruginosa Isolates (n=51)

Antibiotic	Resistant, n (%)	Sensitive, n (%)	Intermediate, n (%)
Ciprofloxacin	23 (45.1)	25 (49.0)	3 (5.9)
Levofloxacin	20 (39.2)	28 (54.9)	3 (5.9)
Tobramycin	17 (33.3)	34 (66.7)	0 (0)
Aztreonam	14 (27.5)	30 (58.8)	7 (13.7)
Piperacillin-Tazobactam	10 (19.6)	38 (74.5)	3 (5.9)
Ceftazidime	3 (5.9)	47 (92.2)	1 (2.0)
Meropenem	1 (2.0)	50 (98.0)	0 (0)
Imipenem	0 (0)	51 (100)	0 (0)

Discussion

In this study, the most common isolated organism in CSOM is Staphylococcus aureus, which contrasts with the findings of some local and regional studies. Khan et al and Deshmukh and Manthale both found Pseudomonas aeruginosa most prevalent organism. (4,10) However Staphylococcus aureus is the most common pathogen in CSOM, as shown in work done by both Sahu et al. (9) and Iqbal et al. (11). A crucial finding of this study is the troublesome resistance to Oxacillin among Staphylococcus aureus, used as a proxy for methicillin Resistance, even higher than the resistance reported from Pakistan and the subcontinent (9,11)

The assuring trend which emerged from this investigation is the maintained high susceptibility to the restricted antibiotics, with Vancomycin (98.2%, n=55), Linezolid (96.4%, n=54) maintaining their complete efficacy against Staphylococcus aureus, this pattern of preserved efficacy is in accordance with work done by Imran et al. (4) who reported 80% and 76% susceptibility to linezolid and Vancomycin and Iqbal et al.(11) who reported 100% susceptibility to both antibiotics, these finding of maintained efficacy across various studies from the region highlight the caution use of this antibiotics to prevent emergence of resistance. (12,13)

Among the Pseudomonas isolates, a significant trend was noted toward substantial Fluoroquinolone resistance emergence (39.2-45.1%), this finding of us aligns with data from the subcontinent and beyond. (13,14). Consistent with a Middle Eastern study reporting low aminoglycoside resistance in Staphylococcus aureus and Pseudomonas aeruginosa. (14) Our findings also showed favorable profiles for gentamicin (60.7%) and tobramycin (66.7%), respectively. The susceptibility profile for carbapenems was notably strong among Pseudomonas aeruginosa isolates. All tested isolates were susceptible to imipenem (100%), and meropenem susceptibility reached 98.0%, establishing these agents as cornerstone therapies for complex cases, as seen elsewhere in the world, with more than 90% susceptibility to carbapenems .(15)

Our results align with Deshmukh and Manthale's (10) finding of preserved imipenem susceptibility (100% in both studies), confirming carbapenems as a cornerstone therapy. However, notable differences exist in other classes. While some regional data describe elevated resistance (7), our analysis reveals comparatively lower resistance for Pseudomonas aeruginosa: 19.6% to piperacillin-tazobactam (16,17). These figures are consistent with regional studies indicating roughly 75%-90% susceptibility to piperacillin-tazobactam. (18,19,20). The limitation of this study is its single-center design and defined cohort size and D-zone testing for inducible clindamycin resistance could not be verified from the available laboratory records; therefore, clindamycin susceptibility findings should be interpreted with caution. At the same time, this approach provides a focused profile of local resistance patterns, studies with larger, multi-center cohorts are recommended to confirm and generalize these findings.

Conclusion

The study outlined an important trend of increasing resistance to commonly used first-line empirical regimens like ciprofloxacin, while amino glycosides (Gentamicin and Tobramycin) are still maintaining their efficacy. The last line agents like vancomycin and linezolid maintain complete efficacy against Staphylococcus aureus, and Carbapenem sagainst Pseudomonas aeruginosa, mandating cautious culture-based use of these agents to safeguard their potency.

Source of Fundings: None

Conflict of Interest: None

References

1. Acuin J. Global Burden of Disease Due to Chronic Suppurative Otitis Media: Disease, Deafness, Deaths and DALYs. In: Chronic Suppurative Otitis Media—Burden of Illness and Management Options. Geneva: World Health Organization; 2004.
2. Monasta L, Ronfani L, Marchetti F, Montico M, Vecchi Brumatti L, Bavcar A, et al. Burden of disease caused by otitis media: systematic review and global estimates. PLoS One. 2012;7(4):e36226.
3. World Health Organization. Chronic Suppurative Otitis Media -Burden of Illness and Management Options. World Health Organization; 2004. Available from: http://WHO Libr Cat Data.
4. Khan I, Osama M, Ullah I, Haq IU. Microbiological Spectrum and Antibiotics Sensitivity Pattern of Chronic Suppurative Otitis Media (CSOM) Patients: A prospective study from a Tertiary Care Hospital in Peshawar. Pak J Med Sci. 2025;41(1):194-9.
5. Chandra Sahu M, Swain SK. Surveillance of antibiotic sensitivity pattern in chronic suppurative otitis media of an Indian teaching hospital. World J Otorhinolaryngol Head Neck Surg. 2019;5(2):88–94.
6. Choi HG, Park KH, Park SN, Jun BC, Lee DH, Yeo SW. The appropriate medical management of methicillin-resistant Staphylococcus aureus in chronic suppurative otitis media. Acta Otolaryngol. 2010;130(1):42–6.
7. Razzak S, Sohail M, Uddin F, Dogar MR. Antimicrobial Resistance Patterns in Pseudomonas Aeruginosa Isolated from Chronic Suppurative Otitis Media. J Coll Physicians Surg Pak. 2025;35(7):866-70.
8. Bilal H, Khan MN, Rehman T, Hameed MF, Yang X. Antibiotic resistance in Pakistan: a systematic review of past decade. BMC Infect Dis. 2021;21(1):244.
9. Sahu, R., Baral, P., Sahu, B., Singh, S., Sahu, M. Understanding antibiotic resistance patterns in chronic suppurative otitis media (CSOM) at a Tertiary Care Hospital. Microbes and Infectious Diseases, 2024Dec 15. doi: 10.21608/mid.2024.330220.2302
10. Deshmukh KA, Manthale D. Prevalence and antibiotic susceptibility of Pseudomonas aeruginosa isolated from chronic suppurative otitis media. Int J Otorhinolaryngol Head NeckSurg.2016Dec.28;3(1):56-60.

https://www.ijorl.com/index.php/ijorl/article/view/251
11. Iqbal N, Anwar S, Salim S, Tehseen T, Ali S, Raza A. Antibiogram of chronic suppurative otitis media in relation to the current bacteriological profile in a tertiary care hospital. Infect Dis J Pak. 2024; 33(2): 69-73. DOI:https://doi.org/10.61529/idjp. v33i2.29
12. Lee, C.H., Kim, KM., Shin, JI. et al. Clinical impact of major pathogenic genotypes of Pseudomonas aeruginosa associated with refractory chronic suppurative otitis media. Eur J Clin Microbiol Infect Dis 43, 2429–40 (2024). https://doi.org/10.1007/s10096-024-04957-x
13. Rath S, Das SR, Padhy RN. Surveillance of bacteria Pseudomonas aeruginosa and MRSA associated with chronic suppurative otitis media. Braz J Otorhinolaryngol. 2017 Mar-Apr;83(2):201206.doi:10.1016/j.bjorl.2016.03.008. Epub 2016 Apr 22.
14. Aza Bahadeen Taha. Bacteriological profile, antibiotic susceptibility, and biofilm formation in children with chronic suppurative otitis media. International Journal of Pediatric Otorhinolaryngology. Volume 188,2025,112208, ISSN 0165-5876 https://doi.org/10.1016/j.ijporl.2024.112208.
15. Artono A, Purnami N, Handoko E, Widodo ADW, Juniastuti J. Pseudomonas aeruginosa in Chronic Suppurative Otitis Media. Infect Chemother. 2025 Mar;57(1):63-71. doi: 10.3947/ic.2024.0062.
16. Arshad M, Ashfaq AH, Riaz N, Rehman A, Maqbool S, Jamil AA, et al. Bacteriological profile and antimicrobial susceptibility pattern of pus aspirate in chronic suppurative otitis media patients. The Microbe. 2025; 7:100336https://doi.org/10.1016/j.microb.2025.100336
17. Naku A. Assessment of bacteriological causes of CSOM and to know their antibiotic sensitivity pattern. Pain.;51:0-4. doi: 10.69605/ijlbpr_13.7.2024.111
18. Goyal, Dimpal; Pal, Nita; Agrawal, Yash1; Hooja, Saroj. A Study of Bacteriological Profiles, Biofilm Production, and Antibiotic Susceptibility among Isolates of Chronic Suppurative Otitis Media at a Tertiary Care Hospital. Medical Journal of Dr. D.Y. Patil Vidyapeeth 18(1): p 92-8, Jan–Feb 2025. | DOI: 10.4103/mjdrdypu.mjdrdypu_628_23
19. Govindaraj S, Iype JV, Srinivasa V, Jayendiran S. Bacteriological profile and their antibiotic susceptibility pattern in chronic suppurative otitis media (TTD) in a tertiary care hospital. Int J Otorhinolaryngol Head Neck Surg 2019;5:8715.DOI:http://dx.doi.org/10.18203/issn.2454-5929.ijohns20192137.
20. Chavan, R.P., Ingole, S.M. & Patil, R.J. Assessment of Hearing Clinical and Microbiological Profile in Active CSOM Patients: A Prospective Observational Study. Indian J Otolaryngol Head Neck Surg 77, 56945704(2025).https://doi.org/10.1007/s12070-025-0604

HISTORY	
Date received:	02.05.2026
Date sent for review:	11.05.2026
Date received reviewers comments:	22.06.2026
Date received revised manuscript:	25.06.2026
Date accepted:	11.06.2026

CONTRIBUTION OF AUTHORS	
AUTHOR	**CONTRIBUTION**
Conception/Design	MAHA,MSA
Data acquisition, analysis and interpretation	MAHA,MSA
Manuscript writing and approval	MAHA,MSA
All the authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed.	