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Orapuh Journal

ORIGINAL ARTICLE

Journal of Oral & Public Health

Clinical and bacteriological profile of suppurative otitis media in Kinshasa: A descriptive cross-sectional study

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ARTICLE INFO

Received: *17 March 2025*
Accepted: *28 April 2025*
Published: *30 May 2025*

Keywords:
Bacteriological profile, suppurative otitis media, antibiotic susceptibility patterns, bacterial infection, antibiotic therapy

Peer-Review: *Externally peer-reviewed*

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To cite:
Kasonga, B. L., Tshingamb, K. Y., Kembia, T. E., Ntumba, M. A., Pholo, M. J., Banza, L. E., Mbuyamba, N. J., Kamwiziku, K. G., Lunguyla, M. O., & Nyembue, T. D. (2025). Clinical and bacteriological profile of suppurative otitis media in Kinshasa: A descriptive cross-sectional study. *Orapuh Journal, 6*(5), e1249
https://dx.doi.org/10.4314/orapj.v6i5.49

ISSN: *2644-3740*

Published by Orapuh, Inc. (info@orapuh.org)

Editor-in-Chief: Prof. V. E. Adamu
Orapuh, Inc., UMTG PMB 405, Serrekunda, The Gambia, editor@orapuh.org.

ABSTRACT

Introduction

Suppurative otitis media (SOM) is a predominantly bacterial disease that is common in low-income countries. The bacterial spectrum responsible for SOM and the antibiotic susceptibility patterns vary over time and between regions, necessitating periodic updates to improve disease management.

Purpose

This study aimed to determine the clinical and bacteriological profile of SOM in Kinshasa.

Methods

This descriptive cross-sectional study included 71 patients with SOM who were followed at the University Hospital of Kinshasa from April to October 2024. Sociodemographic and clinical data were collected. A middle ear suppuration swab was taken via the external auditory canal near the perforated eardrum. After Gram staining of the samples, inoculation was carried out on various culture media to isolate the bacteria. Finally, an antibiogram was performed using the Kirby-Bauer technique. Statistical data analysis was conducted using SPSS version 27.0.

Results

The mean age of the patients was 33 ± 21.7 years, with ages ranging from 1 to 82 years. The majority of patients were male (53.5%), while 46.5% were female. Chronic suppurative otitis media (CSOM) was the most prevalent form of the disease, accounting for 67.6% of cases. Otorrhea was unilateral in three-quarters of the patients and was associated with hypoacusis in 69% of cases. Out of the 90 swabs collected, 76% showed microbial growth. Among the positive cultures, 70.6% were Gram-negative bacteria, while 29.4% were Gram-positive. The most frequently isolated bacterium was *Pseudomonas aeruginosa*, followed by *Staphylococcus aureus*. Ciprofloxacin demonstrated the highest efficacy against all isolated bacteria, followed by gentamicin.

Conclusion

Suppurative otitis media is a bacterial infection, and antibiotic therapy should be guided by bacteriological data to develop empiric antibiotic guidelines, prevent bacterial resistance, and reduce the risk of complications.

INTRODUCTION

Suppurative otitis media (SOM) is an inflammation of the middle ear characterized by purulent discharge through the perforated tympanic membrane. It may be classified as acute when suppuration lasts less than three months, but when it persists beyond three months, it becomes chronic suppurative otitis media (CSOM). CSOM is primarily bacterial in origin and can be influenced by various anatomophysiological, environmental, and socioeconomic factors (Schilder et al., 2016; Mittal et al., 2015).

CSOM remains a significant health problem in resource-limited settings, predominantly affecting children under the age of five. It is a preventable cause of hearing loss and represents the leading reason for antibiotic prescriptions in paediatric care. If not properly treated, CSOM can result in serious extra- and intracranial complications (Henok et al., 2023).

The World Health Organization (WHO) estimates that 65 to 330 million people worldwide suffer from otitis media, of whom 50% develop hearing loss, and approximately 28,000 people die each year from complications related to the disease. The prevalence of CSOM varies across regions, ranging from 1% to 46%. It is highest in Western Pacific countries (2.5% to 43%), followed by Southeast Asia (0.9% to 7.8%), Africa (0.4% to 4.2%), Central and South America (3%), the Eastern Mediterranean (1.4%), and Europe (0.4%) (Monasta et al., 2012).

Several bacteriological studies have identified *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis* as the most frequently isolated pathogens in acute suppurative otitis media (ASOM) (Khatun et al., 2021; Henok et al., 2023). In contrast, *Staphylococcus aureus* and *Pseudomonas aeruginosa* are the most commonly implicated bacteria in CSOM (Ngo et al., 2016; Dayie et al., 2022; Aduda et al., 2012). However, the antibiotic susceptibility profiles of these pathogens vary across different studies.

In the Democratic Republic of Congo (DRC), few studies have examined the bacteriological profile of suppurative otitis media. Nyembue et al. (2005) reported *Pseudomonas* and *Citrobacter* as the most commonly isolated bacteria in CSOM, showing high susceptibility to ofloxacin and neomycin. However, the bacterial spectrum and antibiotic susceptibility patterns have changed over time and across different regions. To update the data reported in the region twenty years ago by Nyembue et al. (2005), the present study aimed to evaluate the clinical and bacteriological profile, as well as antibiotic sensitivity, to support the rational management of SOM in Kinshasa.

METHODS

A descriptive cross-sectional study was conducted from April to October 2024 at the University Hospital of Kinshasa. The study population consisted of patients of all ages diagnosed with suppurative otitis media (SOM) during consultations at the ENT Department. Patients who had taken local or systemic antibiotics within the seven days prior to swab collection were excluded. Socio-demographic and clinical data were collected during consultations using a pre-established form.

The sample was based on convenience and included all patients diagnosed with acute suppurative otitis media (ASOM) following otoscopy (defined as otorrhea through a tympanic perforation lasting less than three months) and chronic suppurative otitis media (CSOM) (defined as otorrhea through a tympanic perforation lasting three months or more) seen during ENT consultations at the University Hospital of Kinshasa. Patients taking local or systemic antibiotics during the seven days prior to consultation were excluded, as well as those with external otitis.

Bacteriological Data

Middle ear suppurations were collected aseptically after disinfecting the auricle with a sodium hypochlorite solution and aspirating the pus that had exited into the external auditory canal. Using a sterile swab, suppurations from the middle ear were collected in contact with the perforated eardrum, placed in a preservation tube, and sent immediately to the microbiology laboratory.

After Gram staining to differentiate Gram-positive from Gram-negative bacteria, specimens were inoculated onto various culture media, including blood agar, MacConkey agar, chocolate agar, and thioglycolate. The culture plates were incubated at 37°C for 24 to 48 hours. Isolates were identified according to standard bacteriological procedures (Berche, 2012; Humphries et al., 2021). Antimicrobial susceptibility testing was performed using the diffusion

method following the Kirby-Bauer technique on Mueller-Hinton medium (Low et al., 2016).

Data Analysis

Data entry was performed using Excel, and statistical analysis was conducted using SPSS version 21. Descriptive statistics were applied to summarize the sample, including the mean age, standard deviation, and percentages. The chi-square test was employed to compare bacteriological data between the two types of suppurative otitis media. A p-value of 0.05 was considered the threshold for statistical significance.

Ethical Considerations

This study was approved by the National Ethical Health Committee (No. 624/CNES/BN/PMMF/2024). Written informed consent was obtained from patients and guardians in the case of minors.

RESULTS

Sociodemographic Characteristics of Patients

A total of 71 patients were included in the current study, of whom 48 (67.6%) had chronic suppurative otitis media (CSOM) and 23 (34.4%) had acute suppurative otitis media (ASOM). The mean age of the patients was 33.7 ± 21.7 years, with an age range of 1 to 82 years.

As shown in **Table 1**, the age group 11–20 years was the most represented (21.1%). Males predominated (53.5%), with a sex ratio of 1.2. The majority of the patients were non-academics (59.2%) and unemployed (54.9%).

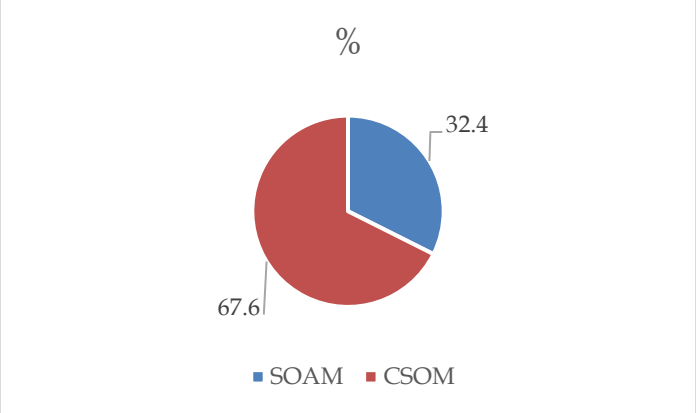
Table 1:
Socio-demographic Characteristics of Patients

Variable	Total (N=71) n (%)
Age group	
≤10	10 (14.1)
11 – 20	15 (21.1)
21 – 30	11 (15.5)
31 – 40	10 (14.1)
41 – 50	6 (8.5)
51 – 60	8 (11.3)
≥61	11 (15.5)
Gender	
Male	38 (53.5)
Female	33 (46.5)
Education Level	
Non university	42 (59.2)
University	29 (40.8)
Profession	
Unemployed	32 (45.1)
Employed	39 (54.9)

Types of Suppurative Otitis Media

As illustrated in **Figure 1**, CSOM was the most common form of otitis media in this study, accounting for 67.6% of cases.

Figure 1:
Distribution of Patients by SOM Type



Clinical Features

Among the medical histories reported, rhinosinusitis and tonsillitis were the most prevalent, followed by a history of ear surgery. Otorrhea was observed in all patients, while hearing loss was the most frequently reported symptom, followed by rhinorrhea and nasal obstruction **(Table 2)**.

Table 2:
Patient Medical History and Complaints

Parameter	Total (N=71) n(%)
Past-history	
Rhinosinusitis	20 (28.2)
Tonsillitis	15 (21.1)
Ear surgery	12 (16.6)
Mellitus diabetes	7 (9.9)
Adenoids	5 (7.0)
Family history of Otitis media	4 (5.6)
Ear trauma	3 (4.2)
Other (HIV, Gastroesophageal reflux)	3 (4.2)
Complaint	
Otorrhea	71 (100.0)
Hearing loss	49 (69.0)
Rhinorrhea	30 (42.3)
Nasal obstruction	25 (35.2)
Tinnitus	20 (28.2)
Earache	19 (26.3)

Among the 71 patients, otorrhea was bilateral in 19 (26.8%) patients and unilateral in 52 (73.2%) patients. Of the 90 affected ears, otorrhea was predominantly purulent and fetid, as shown in **Table 3**.

Table 3:
Characteristics of Otorrhea

Otorrhea	Effectif (N=90) n (%)
Appearance	
Sero-mucosal	7(7.8)
Purulent	83(92.2)
Odor	
Non fetid	26(28.9)
Fetid	64(71.1)

Otoscopic Findings

In 90 suppurated ears, tympanic perforation was oval-shaped in 50% of cases **(Table 4)**. The tympanic perforation was predominantly located in the right ear.

Table 4:
Otoscopic Findings Among Patients

Otoscopic finding	Right ear *(N=71) n (%)*	Left ear *(N=71) n (%)*	Total N=142 *(n=142)*
▪ Aspect of eardrum			
Normal eardrum	23 (32.4)	29(40.8)	52 (36.6)
Perforated eardrum	48 (67.6)	42 (59.2)	90 (63.4)
Punctiform	3 (6.3)	3 (7.1)	6 (4.2)
Kidney-shaped	8 (16.7)	5 (7.0)	13 (9.2)
Oval-shaped	37 (77.1)	34 (81.0)	71 (50.0)

Bacteriological Profile

Of the 90 swabs collected, 22% were sterile. Table 5 shows that out of 68 positive cultures, 48 (70.6%) were Gram-negative bacteria and 20 (29.4%) were Gram-positive. The majority of bacteria were identified in cases of CSOM.

Pseudomonas aeruginosa was the most frequently isolated bacterium, followed by Staphylococcus aureus, Proteus mirabilis, and *Klebsiella pneumoniae*. *Pseudomonas aeruginosa* was found exclusively in CSOM. In contrast, *Klebsiella pneumoniae* was significantly more common in CSOM, while *Staphylococcus aureus* was predominantly identified in ASOM. Proteus mirabilis was found equally in both types of SOM.

Table 5:
Bacteriological Profile of Patients with Suppurative Otitis Media

Germs	Total N=68 n (%)	ASOM n=23 n (%)	CSOM n=45 n (%)	P[1]
▪ Gram-negative (n=48)				
Pseudomonas aeruginosa	20 (29.4)	_	20 (44.4)	
Proteus mirabilis	8 (11.7)	3 (13.0)	5 (11.1)	0,506
Klebsiella pneumoniae	7 (10.2)	2 (8.7)	5 (11.1)	0,041
Citrobacter freundii	5 (7.4)	3 (13.0)	2 (4.4)	0,380
Escherichia coli	4 (5.8)	2 (8.7)	2 (4.4)	0,983
Enterobacter sp	3 (4.4)	_	3 (6.6)	0,609
Pseudomonas sp	1 (1.5)	_	1 (2.2)	-
▪ Gram positif (n=20)				
Staphylococcus aureus	12 (17.6)	8 (34.8)	4 (8.8)	0,027
Streptococcus pneumoniae	3 (4.4)	3 (13.0)	_	
Streptococcus pyogènes	2 (2.9)	2 (8.7)	_	
Turicella otitis	1 (1.5)	_	1 (2.2)	-
Staphylococcus epidermidis	1 (1.5)	_	1 (2.2)	-
Staphylococcus saprophyticus	1 (1.5)	_	1 (2.2)	-

Antibiotic Susceptibility of Gram-Negative Bacteria **Table 6** presents the susceptibility of Gram-negative bacteria to antibiotics. Ciprofloxacin showed the highest efficacy, followed by gentamicin, while chloramphenicol

https://dx.doi.org/10.4314/orapj.v6i5.49

was most effective against *Escherichia coli* and *Enterobacter sp*.

Susceptibility of Gram-negative Bacteria to Antibiotics

Table 6 presents the antibiotic susceptibility patterns of Gram-negative bacteria isolated from patients with suppurative otitis media (SOM). Pseudomonas aeruginosa, the most frequently isolated bacterium, showed the highest susceptibility to ciprofloxacin (100%) and gentamicin (75%). Conversely, it exhibited high resistance to amoxycillin-clavulanate (70%) and erythromycin (85%).

Table 6:
Susceptibility of Gram-negative bacteria to antibiotics

Bacteria	Antibiotics							
	Amoxy-Ac n(%)	Doxycyclin n(%)	Gentamycin n(%)	Ciprofloxacin n(%)	CAF n(%)	Cefotaxime n(%)	Erythromycin n(%)	Co-trimoxazole n(%)
P aeruginosa (n=20)								
S	6 (30,0)	4 (20,0)	15 (75,0)	20 (100,0)	10(50,0)	4 (20,0)	3 (15,0)	5 (25,0)
R	14 (70,0)	16 (80,0)	5 (25,0)	-	10(50,0)	16 (80,0)	17 (85,0)	15 (75,0)
Proteus mirabilis (n=8)								
S	3 (60,0)	3 (36,5)	3 (36,5)	8 (100,0)	4 (50)	3 (36,5)	2 (25)	4 (50,0)
R	5 (40,0)	5 (63,5)	5 (63,5)	-	4 (50)	5 (63,5)	6 (75)	4 (50,0)
K pneumonaie (n=7)								
S	3 (42,9)	-	4 (57,1)	6 (85,7)	2 (28,6)	3 (42,9)	4 (57,1)	3 (42,9)
R	4 (57,1)	-	3 (42,9)	1 (14,3)	5 (71,4)	4 (57,1)	3 (42,9)	4 (57,1)
Citrobacter freundii (n=5)								
S	2 (40,0)	-	3 (60,0)	4 (80,0)	3 (60,0)	2 (40,0)	1 (20,0)	2 (40,0)
R	3 (60,0)	5 (100,0)	2 (40,0)	1 (20,0)	2 (40,0)	3 (60,0)	4 (80,0)	3 (60,0)
Eschercha coli (n=4)								
S	2 (50,0)	3 (75,0)	2 (50,0)	3 (75,0)	4 (100,0)	2 (50,0)	1 (25,0)	1 (25,0)
R	2 (50,0)	1 (25,0)	2 (50,0)	1 (25,0)	-	2 (50,0)	3 (75,0)	3 (75,0)
Enterobacter sp (n=3)								
S	1 (33,0)	2 (67,0)	2 (67,0)	2 (67,0)	3 (100,0)	2 (67,0)	1 (33,0)	-
R	2 (67,0)	1 (33,0)	1 (33,0)	1 (33,0)	-	1 (33,0)	2 (67,0)	3 (100)

S (Susceptibility), R(resistance), Amoxy-Ac (amoxycillin -clavulanate), CAF (Chloramphenicol)

Susceptibility of Gram-positive Bacteria to Antibiotics

Table 7 analyzes the antibiotic susceptibility patterns of three Gram-positive bacterial strains. Staphylococcus aureus showed the highest susceptibility to ciprofloxacin (83%) and gentamicin (67%), while resistance was observed against amoxycillin-clavulanate (33%) and erythromycin (67%). Streptococcus pneumoniae exhibited high susceptibility to ciprofloxacin (100%) but showed resistance to gentamicin, amoxycillin-clavulanate, and doxycycline (67% each).

Table 7:
Susceptibility of Gram-negative bacteria to antibiotics

Germes	Antibiotics							
	Amoxy-AC n(%)	Doxycyclin n(%)	Gentamycin n(%)	Ciprofloxacin n(%)	CAF n(%)	Cefotaxim n(%)	Erythromycin n(%)	Co-trimoxazole n(%)
S. aureus (n= 12)								
S	4 (67,0)	7 (58,0)	8 (67,0)	10 (83,0)	7 (58,0)	5 (42,0)	4 (33,0)	4 (33,0)
R	8 (33,0)	5 (42,0)	4 (33,0)	2 (17,0)	5 (42,0)	7 (58,0)	8 (67,0)	4 (67,0)
S. pneumonaie (n=3)								
S	1(33,0)	1 (33,0)	1 (33,0)	3 (100,0)	2(67,0)	1 (33,0)	1 (33,0)	1 (33,0)
R	2(67,0)	2 (67,0)	2 (67,0)	-	1(33,0)	2 (67,0)	2 (67,0)	2 (67,0)
S Pyogenes (n=2)								
S	1 (50,0)	1 (50,0)	1 (50,0)	2 (100,0)	1(50,0)	1 (50,0)	1 (50,0)	1 (50,0)
R	1 (50,0)	1 (50,0)	1 (50,0)	-	1(50,0)	1 (50,0)	1 (50,0)	1 (50,0)

S (Susceptibility), R (Resistance), Amoxy-AC (Amoxycillin-Clavulanate), CAF (Chloramphenicol)

DISCUSSION

The current study allowed us to determine the clinical and bacteriological profile of suppurative otitis media (SOM) in our setting.

Socio-Demographic Characteristics

The mean age of patients was 33 ± 21.7 years (range: 1 to 82 years), with a predominance in the 11 to 20 age group. This predominance among young people may be attributed to an active lifestyle, such as swimming, which can reactivate otorrhea. The most represented age group was 10 to 20 years. These results are consistent with the findings of Draman et al. (2012) in Malaysia, Hiremath et al. (2019) in India, and Sammal et al. (2024). In contrast, Nyembue et al. (2005), who studied patients under 16 years of age, reported a higher frequency among children aged 0 to 5 years, likely due to their vulnerability to upper respiratory tract infections.

Regarding gender distribution, male patients constituted 53.5% of cases, compared to 46.5% for females, with a ratio of 1.2. This male predominance is similar to the findings of Basnet et al. (2017), Agha et al. (2012), Mahajan (2019), and Dayie et al. (2022). However, it differs from the studies of Draman et al. (2012), Kshatri et al. (2022), and Nyembue et al. (2005), who reported a female predominance.

In our study, more than half of the patients (62%) had a non-university education, and two-thirds were unemployed (67.6%). Individuals without higher education often engage in low-paying jobs, while the unemployed belong to a low-income group, limiting their access to quality healthcare. This situation may facilitate the progression of the disease towards complications.

Clinical Features

Otorrhea was the primary complaint, frequently accompanied by hearing loss (69.0%), and was mainly unilateral (73.2%). Additionally, tympanic perforation was observed in more than half of the ears examined (59%). These clinical findings align with the data reported by Draman et al. (2021) in Malaysia, reflecting the severity of SOM that requires close medical attention.

Regarding the type of SOM, chronic suppurative otitis media (CSOM) was identified in two-thirds of the cases. This could be due to a lack of disease awareness, neglect of otorrhea, and delayed consultation resulting from low socioeconomic status. Similar findings were reported in Iraq by Agha et al. (2021).

Bacteriology

Bacterial growth was observed in three-quarters of the cultures, with a predominance of Gram-negative bacteria. The bacteriological profile was dominated by *Pseudomonas aeruginosa* (29.6%), followed by *Staphylococcus aureus* (18.5%), Proteus mirabilis (11.1%), and *Klebsiella pneumoniae* (10.1%). These results are consistent with studies by Agha (2021) in Iraq, Nyembue et al. (2005) in the Democratic Republic of the Congo, Hiremath et al. (2019), Sammal et al. (2024) in India, and Dayie et al. (2022) in Ghana. However, other studies have shown different findings.

The high positivity rate of bacterial growth (70.6%) supports the notion that SOM is predominantly a bacterial disease, as reported in the literature (Mittal et al., 2011). Meanwhile, the absence of microbial growth in 20.4% of cultures could be attributed to the presence of anaerobic pathogens or fungal and viral agents not investigated in this study.

The high incidence of *Pseudomonas aeruginosa* may be linked to its resistance and its production of toxins and enzymes capable of destroying the mastoid (Hiremath et al., 2019; Sammal et al., 2024). However, other bacteriological studies by Basnet et al. (2017) in Nepal and Khatun et al. (2021) in Bangladesh identified *Klebsiella pneumoniae* as the most frequently isolated pathogen, followed by *Pseudomonas aeruginosa*.

Antibiotic Sensitivity

Regarding the antibiotic sensitivity of isolated bacteria, our study demonstrated that ciprofloxacin was the most effective against all bacteria, followed by gentamycin. This corroborates the findings of Nyembue et al. (2005), who, after two decades, reported that these antibiotics still retain their efficacy. Therefore, rational use is essential to prevent resistance.

Conversely, the combination of amoxicillin-clavulanic acid, chloramphenicol, and doxycycline showed moderate efficacy against Gram-positive bacteria. In contrast, co-trimoxazole, erythromycin, and cefotaxime were less effective against all isolated bacteria, likely due to excessive use in our region. However, Sammal et al. (2024) in India and Dayie et al. (2022) in Ghana reported that *Pseudomonas aeruginosa* exhibited resistance to ciprofloxacin.

This resistance could be attributed to the irrational use of antibiotics, often driven by low socioeconomic status, limited access to quality healthcare, self-medication, and the healthcare system's inadequacies in low-income countries. The rise in antimicrobial resistance makes infections increasingly untreatable, with significant health, economic, and social repercussions, ultimately hindering a country's development.

Limitations

This study had limitations, including a small sample size, a single-center design, and the absence of virological and mycological analyses. Nonetheless, it significantly contributes to understanding the bacterial profile and antibiotic use in SOM.

CONCLUSION

Given the predominance of *Pseudomonas aeruginosa* and its susceptibility to ciprofloxacin, empirical treatment protocols should prioritize this antibiotic while awaiting culture results. Regular updates on local antibiograms are crucial for guiding effective management.

Ethical Approval: Nil required.

Conflicts of Interest: None declared.

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Pholo, M. J.[1]:	Nil identified.
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Kamwiziku, K. G.[2]:	Nil identified.
Lunguyla, M. O.[2]:	Nil identified.
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REFERENCES

Aduda, D. S., Macharia, I. M., Mugwe, P., Oburra, H., Farragher, B., Brabin, B., & Mackenzie, I. (2013). Bacteriology of chronic suppurative otitis media (CSOM) in children in Garissa district, Kenya: A point prevalence study. *International Journal of Pediatric Otorhinolaryngology, 77*(7), 1107–1111. https://doi.org/10.1016/j.ijporl.2013.04.011

Agha, Z. H. M., & Al-Delaimi, M. S. (2021). Prevalence of common bacterial etiology and antimicrobial susceptibility pattern in patients with otitis media in Duhok Province–Iraq. *ZANCO Journal of Pure and Applied Sciences, 33*(4). https://doi.org/10.21271/zjpas.33.4.2

Basnet, R., Sharma, S., Rana, J. C., & Shah, P. K. (2017). Bacteriological study of otitis media and its antibiotic susceptibility pattern. *Journal of Nepal*

Health Research Council, 15(2), 124–129. https://doi.org/10.3126/jnhrc.v15i2.18186

Berche, P. (2012). Denis F., Ploy M. C., Martin C., Bingen É., & Quentin R. — Bactériologie médicale, techniques usuelles, Elsevier Masson, Paris, 2011, 631 pages. *Bulletin de l'Académie Nationale de Médecine, 196*(2), 542–544. https://doi.org/10.1016/s0001-4079(19)31847-3

Dayie, N. T., Bannah, V., Dwomoh, F. P., Kotey, F. C., & Donkor, E. S. (2022). Distribution and antimicrobial resistance profiles of bacterial aetiologies of childhood otitis media in Accra, Ghana. *Microbiology Insights, 15*. https://doi.org/10.1177/11786361221104446

Draman, W. N. A. W., Daud, M. K. M., Mohamad, H., Hassan, S. A., & Rahman, N. A. (2021). Evaluation of the current bacteriological profile and antibiotic sensitivity pattern in chronic suppurative otitis media. *Laryngoscope Investigative Otolaryngology, 6*(6), 1300–1306. https://doi.org/10.1002/lio2.682

Henok, E., Manilal, A., Oumer, Y., Keyta, G., Birru, M., Araya, B. D., Aklilu, A., Alahmadi, R., Raman, G., & Idhayadhulla, A. (2023). Factors associated with otitis media among pediatrics in two government hospitals in Arba Minch, Southern Ethiopia. *Infection and Drug Resistance, 16*, 6405–6426. https://doi.org/10.2147/idr.s424927

Hiremath, B., Mudhol, R. S., & Vagrali, M. A. (2018). Bacteriological profile and antimicrobial susceptibility pattern in chronic suppurative otitis media: A 1-year cross-sectional study. *Indian Journal of Otolaryngology and Head & Neck Surgery, 71*(S2), 1221–1226. https://doi.org/10.1007/s12070-018-1279-6

Humphries, R., Bobenchik, A. M., Hindler, J. A., & Schuetz, A. N. (2021). Overview of changes to the Clinical and Laboratory Standards Institute performance standards for antimicrobial susceptibility testing, M100, 31st edition. *Journal of Clinical Microbiology, 59*(12). https://doi.org/10.1128/jcm.00213-21

Khatun, M. R., Alam, K. M. F., Naznin, M., & Salam, M. A. (2021). Microbiology of chronic suppurative otitis media: An update from a tertiary care hospital in Bangladesh. *Pakistan Journal of Medical Sciences, 37*(3). https://doi.org/10.12669/pjms.37.3.3942

Low, D. E., De Azavedo, J., Weiss, K., Mazzulli, T., Kuhn, M., Church, D., Forward, K., Zhanel, G., Simor, A., & McGeer, A. (2002). Antimicrobial resistance among clinical isolates of Streptococcus pneumoniae in Canada during 2000. *Antimicrobial Agents and Chemotherapy, 46*(5), 1295–1301. https://doi.org/10.1128/aac.46.5.1295-1301.2002

Mahajan, T., Dass, A., Gupta, N., Chander, J., Saini, V., & Pol, S. A. (2018). Bacteriological profile in attico-antral type of chronic suppurative otitis media. *Indian Journal of Otolaryngology and Head & Neck Surgery, 71*(S2), 1412–1421. https://doi.org/10.1007/s12070-018-1486-1

Mittal, R., Lisi, C. V., Gerring, R., Mittal, J., Mathee, K., Narasimhan, G., Azad, R. K., Yao, Q., Grati, M., Yan, D., Eshraghi, A. A., Angeli, S. I., Telischi, F. F., & Liu, X. (2015). Current concepts in the pathogenesis and treatment of chronic suppurative otitis media. *Journal of Medical Microbiology, 64*(10), 1103–1116. https://doi.org/10.1099/jmm.0.000155

Monasta, L., Ronfani, L., Marchetti, F., Montico, M., Brumatti, L. V., Bavcar, A., Grasso, D., Barbiero, C., & Tamburlini, G. (2012). Burden of disease caused by otitis media: Systematic review and global estimates. *PLoS ONE, 7*(4), e36226. https://doi.org/10.1371/journal.pone.0036226

Ngo, C. C., Massa, H. M., Thornton, R. B., & Cripps, A. W. (2016). Predominant bacteria detected from the middle ear fluid of children experiencing otitis media: A systematic review. *PLoS ONE, 11*(3), e0150949. https://doi.org/10.1371/journal.pone.0150949

Nyembue, D., Tshiswaka, J., Sabue, M., & Muyunga, C. (2005). Bacteriology of chronic suppurative otitis media in Congolese children. *Community Ear and Hearing Health, 2*(2), 6. https://doi.org/10.56920/cehh.207

Sammal, M., Pant, B., Negi, N., & Sikarwar, V. (2024). Current trends in clinico-bacteriological profile and antimicrobial susceptibility pattern in active chronic suppurative otitis media at a tertiary care center in Uttarakhand: An observational study. *Cureus*. https://doi.org/10.7759/cureus.69525

Schilder, A. G. M., Chonmaitree, T., Cripps, A. W., Rosenfeld, R. M., Casselbrant, M. L., Haggard, M. P.,

& Venekamp, R. P. (2016). Otitis media. Nature *Reviews Disease Primers,* 2(1). https://doi.org/10.1038/nrdp.2016.63