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Bacterial Agents of Otitis Media and their Antibiotic Resistance Profile: A Retrospective Clinical Presentation at St. Dominic Hospital, Akwatia, Ghana

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Abstract

Background: Otitis media is an important public health condition, particularly in children. Globally, it is estimated that 391.3 million people were affected by otitis media in 2021. It is ranked the fifth leading global burden of disease and the second cause of hearing loss. This study was conducted to identify the bacterial agents causing otitis media and their antibiotic susceptibility patterns at the St. Dominic Hospital in Ghana from 2020-2022.

Methods: A retrospective study involving 130 archived records was conducted at St. Dominic Hospital in the Eastern Region of Ghana. Data from the laboratory records in the department from 2020 to 2022 were retrieved. Data collected were entered into a Microsoft Excel 365 file, cleaned and exported into STATA version 15 statistical software for analysis. P-value <0.05 was considered statistically significant.

Results: Within the study period, 130 suspected cases of otitis media were investigated in the laboratory. Of these, 46.2% (60/130) recorded bacterial growth. Isolates were predominantly Gram-negatives, with *Pseudomonas aeruginosa* [(28.3%) 17/60] and *Proteus* species [(26.7%) 16/60] accounted for majority of the cases. *Staphylococcus aureus* [(16.7%) 10/60] and Coagulase Negative Staphylococci [(8.3%) 5/60] were the only Gram-positive organisms isolated. All the *Klebsiella* species and *Proteus* species tested against ceftriaxone and meropenem were resistant, respectively. None of the isolates tested against amikacin was resistant.

Conclusion: The study highlights varying antimicrobial resistance patterns among the *S. aureus* and Gram-negative isolates, emphasising the importance of prudent antibiotic use, robust antibiotic stewardship practices, and continued surveillance to combat antimicrobial resistance effectively.

Keywords: Otitis media, *P. aeruginosa*, *S. aureus*, Antibiotic resistance, Ghana

Background

Otitis media (OM) refers to a range of infections and inflammatory conditions affecting the middle ear and remains an important public health concern worldwide. It can be broadly classified into acute otitis media (AOM) and chronic suppurative otitis media (CSOM). AOM is characterised by the sudden onset of symptoms such as fever, ear pain, irritability, and signs of middle ear inflammation, including erythema, swelling, and sometimes perforation of the tympanic membrane. If not properly managed, AOM can progress to CSOM, which is marked by persistent ear discharge and a perforated eardrum despite treatment with antibiotics [1, 2].

The global number of otitis media cases rose from 322.1 million in 1992 to 391.3 million in 2021[3] . The most common bacterial pathogens implicated in OM are *Streptococcus pneumoniae*, non-typeable *Haemophilus influenzae*, and *Moraxella catarrhalis*, while less frequently associated organisms include *Staphylococcus aureus* and Group A *Streptococcus* [4-6]. Before reaching school age, about 80–90% of children experience at least one episode of AOM or otitis media with effusion (OME) [4].

In Africa, the burden of OM is disproportionately high due to limited healthcare access, poor health-seeking behaviour, and inadequate diagnostic capacity [7]. Studies report a high prevalence of *S. aureus, P aeruginosa*, and *Proteus species* as the predominant aetiologic agents, alongside *S. pneumoniae* and *H. Influenzae* [8, 9]. A review by Tesfa, Mitiku [9] in sub–Saharan Africa, reported bacterial isolates from otitis media cases as high as 92%, indicating a significant bacterial contribution to OM in the region. In Ghana, previous studies by Dayie, Bannah [10] and Appiah-Korang, Asare-Gyasi [11] reported *P. aeruginosa* as the major isolate in ear discharge.

The treatment of OM generally involves antibiotics; however, the choice of drug should be guided by susceptibility testing due to the rising trend of antimicrobial resistance (AMR). Commonly used antibiotics include penicillins, macrolides, and fluoroquinolones. However, widespread and inappropriate antibiotic use has resulted in multidrug resistance (MDR) among OM pathogens. Globally, approximately 50% of *S. pneumoniae* strains are penicillin-resistant, and many *M. catarrhalis* and *H. influenzae* strains show resistance to aminopenicillins [12]. In Africa, studies have reported high resistance to commonly used antibiotics such as penicillin, amoxicillin, erythromycin, sulfamethoxazole-trimethoprim, and amoxicillin-clavulanic acid, while susceptibility to ciprofloxacin, gentamicin, and norfloxacin remains relatively high [8, 13-15]. Wasihun and Zemene [15] in a study in Ethiopia found that 74.5% of bacterial isolates from OM cases were multidrug resistant, highlighting the urgent need for culture and susceptibility testing before initiating treatment.

Given the high prevalence of OM, the predominance of bacterial aetiologic agents, and the alarming rate of AMR, there is a critical need for empirical local data to inform antibiotic therapy. This study, therefore, aimed to determine the bacterial causes of otitis media and their antibiotic resistance patterns at St. Dominic Hospital in Ghana.

Methodology

Study design

The study was retrospective research with archived data retrieved from laboratory records from January 2020 to December 2022 in St. Dominic Hospital, Akwatia, Ghana.

Study site

The study was conducted at St. Dominic Hospital, located in Akwatia in the Eastern Region of Ghana. The hospital operates as a secondary healthcare facility with a bed capacity of 357. It comprises well-organised wards, specialised clinics, public health units, and diagnostic departments, providing a wide range of comprehensive and robust healthcare services.

St. Dominic Hospital is a member of the Christian Health Association of Ghana (CHAG) and serves as a major referral centre for the Denkyembour, Kwaebibirem, West Akyem, and Birim North Districts, as well as the Birim Central Municipality. Geographically, the hospital lies between latitude 7°30'W and 7°30'E and longitude 1°30'N and 1°30'S.

Inclusion criteria

Archived results of suspected otitis media culture and susceptibility testing with bacterial aetiology from 2020-2022 were included in the study.

Exclusion criteria

10 archived results with incomplete and missing information (age, sex, department, test and susceptibility results) were excluded from the study.

Sample collection

Ear samples were collected by specialists in the Ear, Nose and Throat (ENT) Clinic of the hospital using sterile cotton swabs under aseptic conditions. The samples were immediately sent to the laboratory for culture.

Sample processing, bacterial isolation, identification, and antibiotic susceptibility testing

The samples were cultured on Blood agar, Chocolate agar, and MacConkey agar, following the standard operating procedures for culturing ear swabs, and incubated at 37°C for 24 to 48 hours. Inoculated Blood and MacConkey agar were incubated aerobically, while chocolate agar was incubated in a microaerophilic environment. Growths were identified by colonial morphology, Gram staining reaction, triple sugar iron (TSI) fermentation, urease, citrate, indole, oxidase, motility, catalase, and coagulase tests [16, 17]. Antibiotic susceptibility testing was performed using the Kirby-Bauer disc diffusion method as performed by Deku [18], except that sterile normal saline was used instead of buffered phosphate saline, and the determination of the turbidity of the bacterial suspension using Densi CHEK plus densitometer was substituted with a macroscopic comparison with the 0.5 McFarland standard. The interpretation of the test result was done according to Clinical and Laboratory Standards Institute (CLSI) guidelines [19]. *E. coli* ATCC 25922 and *K. pneumoniae* ATCC 700603 were used as controls.

Data handling and analysis

Data extracted from the study were entered into Microsoft Excel 365, cleaned, checked for completeness and consistency, coded, and then exported to STATA version 15 statistical software for inferential and descriptive analysis. Descriptive statistics were used to summarise sociodemographic characteristics, prevalence of otitis media, bacterial isolates, and antibiotic resistance patterns, with results presented as frequencies, percentages, means, and 95% confidence intervals. Associations between categorical variables were assessed using Chi-square tests, as this method is appropriate for testing relationships between categorical variables when expected cell counts are sufficient. Logistic regression models were applied to determine crude and adjusted odds ratios (cOR, aOR) with 95% confidence intervals for factors associated with otitis media, while modified Poisson regression with robust error variance was used to estimate adjusted prevalence ratios (aPR) for determinants of antibiotic resistance, given the high prevalence of resistance, where odds ratios may overestimate associations. A p-value of <0.05 was considered statistically significant.

Results

Sociodemographic characteristics stratified by prevalence of otitis media among study participants

Among the 130 suspected otitis media cases, the overall prevalence of bacterial causative agents was 46.2% (60/130). Age was significantly associated with otitis media (p = 0.018). Adolescents constituted 6.2% (8/130) of the participants, 75% (6/8) of whom had experienced otitis media. Sex was not significantly associated with the infection (female: 45.5%, male: 47.2%; p = 0.847). Out-patient participants had a significantly higher prevalence [(55.1%), 43/78] compared to in-patients [(32.7%), 17/52], with increased odds of otitis media (aOR = 2.52; 95% CI: 1.22–5.23; p = 0.013). Year of diagnosis was also significant (p = 0.014); compared to 2020, participants in 2021 had significantly lower odds of otitis media (aOR = 0.36; 95% CI: 0.13–0.98; p = 0.046), while prevalence in 2022 remained similar (aOR = 0.88; 95% CI: 0.35–2.23; p = 0.782). (Table 1).

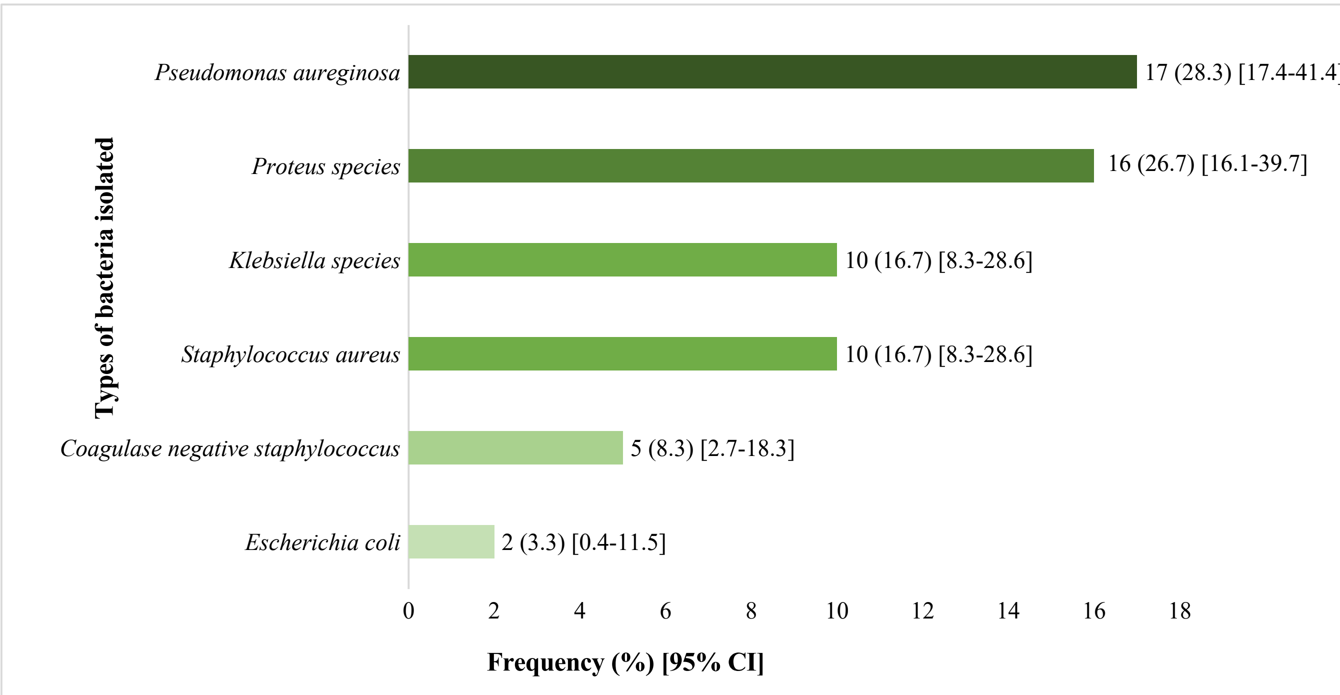
Table 1: Sociodemographic characteristics stratified by prevalence of otitis media among study participants

Variables	Total, n (%)	Otitis media, n (%)	p-value	cOR [95% CI] p-value	aOR [95% CI] p-value
Total	**130 (100.0)**	**60 (46.2)**			
Age (years)			**0.018**		
Infants (Under 1)	8 (6.2)	4 (50.0) [15.7-84.3]		1	
Toddlers and pre-schoolers (1-4)	25 (19.2)	16 (64.0) [42.5-82.0]		1.78 [0.35-8.88] 0.483	
School-age children (5-12)	19 (14.6)	12 (63.2) [38.4-83.7]		1.71 [0.32-9.11] 0.527	
Middle adolescents (13-17)	8 (6.2)	6 (75.0) [34.9-96.8]		3.00 [0.36-24.91] 0.309	
Young adults (18-24)	19 (14.6)	7 (36.8) [16.3-61.6]		0.58 [0.11-3.10] 0.527	
Adults (25-64)	44 (33.9)	14 (31.8) [18.6-47.6]		0.47 [0.10-2.09] 0.327	
Elderly (65 and above)	7 (5.4)	1 (14.3) [0.4-57.9]		0.17 [0.01-2.09] 0.165	
Sex			0.847		
Female	77 (59.2)	35 (45.5) [34.1-57.3]		1	
Male	53 (40.8)	25 (47.2) [33.3-61.4]		1.07 [0.53-2.16] 0.847	
Ward			**0.012**		
In-patient	52 (40.0)	17 (32.7) [20.3-47.1]		1	
Out-patient	78 (60.0)	43 (55.1) [43.4-66.4]		2.52 [1.22-5.23] **0.013**	
Year			**0.014**		
2020	47 (36.2)	26 (55.3) [40.1-69.8]		1	1
2021	43 (33.1)	12 (27.9) [15.3-43.7]		0.31 [0.13-0.75] **0.010**	0.36 [0.13-0.98] **0.046**
2022	40 (30.8)	22 (55.0) [38.5-70.7]		0.99 [0.42-2.30] 0.976	0.88 [0.35-2.23] 0.782

cOR; Crude Odds ratio, aOR: Adjusted odds ratio, CI: Confidence interval, P-value less than 0.050 was considered statistically significant

Types of bacteria isolated among study participants

Pseudomonas aeruginosa was the most frequently isolated organism, accounting for 28.3% (95% CI: 17.4–41.4), followed closely by *Proteus species* at 26.7% (95% CI: 16.1–39.7). Details of these results are shown in Figure 1.



Total number of bacteria isolated= 60

Figure 1: Types of bacteria isolated among study participants

Antimicrobial resistance stratified by bacteria isolated among study participants

Table 2 presents the pattern of antibiotic resistance (ABR) stratified by bacterial isolates among the study participants. Overall, there was complete resistance to cloxacillin (7/7) and erythromycin (4/4), followed by penicillin [(80.0%), 8/10] and ceftazidime [(57.5%), 23/40] while complete susceptibility was observed to amikacin (39/39), levofloxacin (13/13), and amoxicillin-clavulanate (8/8). For Gram-positive isolates, *Staphylococcus aureus* and coagulase-negative staphylococci (CoNS) showed notable resistance to penicillin [(50.0%), 4/8 each] and erythromycin (75.0% in *S. aureus*), whereas Gram-negative isolates exhibited moderate resistance to third-generation cephalosporins (14.3%–57.5%). *Pseudomonas aeruginosa* demonstrated resistance to ceftazidime [(43.5%), 10/23] while *E. coli* isolates (n=2) were largely susceptible across tested antibiotics.

Table 2: Antibiotic resistance stratified by bacteria isolated among study participants

ABR	Total antibiotic tested	Overall ABR	Bacteria isolated						
			CoNs (n=5)	*S. aureus* (n=10)	*Klebsiella species* (n=10)	*Proteus species* (n=16)	*Pseudomonas aeruginosa* (n=17)	*E. coli* (n=2)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
CRO	14	2 (14.3)	NA	NA	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
CAZ	40	23 (57.5)	NA	NA	4 (17.4)	7 (30.4)	10 (43.5)	2 (8.7)
CXM	28	10 (35.7)	NA	NA	4 (40.0)	5 (50.0)	NA	1 (10.0)
CTX	28	6 (21.4)	NA	NA	3 (50.0)	2 (33.3)	NA	1 (16.7)
CX	7	7 (100.0)	3 (42.9)	4 (57.1)	NA	NA	NA	NA
AMK	39	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
CN	28	4 (14.3)	0 (0.0)	2 (50.0)	0 (0.0)	2 (50.0)	0 (0.0)	0 (0.0)
ERY	4	4 (100,0)	3 (75.0)	1 (25.0)	NA	NA	NA	NA
MRP	22	2 (9.1)	NA	NA	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)
LEV	13	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
CIP	26	5 (19.2)	0 (0.0)	3 (60.0)	0 (0.0)	2 (40.0)	0 (0.0)	0 (0.0)
AMP	12	1 (8.3)	NA	NA	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
TET	6	2 (33.3)	NA	NA	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)
PEN	10	8 (80.0)	4 (50.0)	4 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
AMC	8	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Ceftriaxone (CRO), ceftazidime (CAZ), cefuroxime (CXM), cefotaxime (CTX), cloxacillin (CX), amikacin (AMK), gentamicin (CN), erythromycin (ERY), meropenem (MRP), levofloxacin (LEV), ciprofloxacin (CIP), ampicillin (AMP), tetracycline (TET), penicillin (PEN), and amoxicillin-clavulanate (AMC) NA; Not applicable.

Prevalence ratio of factors associated with ABR among study participants

Antibiotic resistance (ABR) was significantly associated with age, ward type, and year of diagnosis. Infants (under 1 year) and school-age children (5–12 years) exhibited 100% ABR, with toddlers and preschoolers (1–4 years) showing significantly reduced prevalence ratio (aPR = 0.43; 95% CI: 0.22–0.82; $p = 0.010$). Out-patients had higher ABR prevalence (86.1%) compared to in-patients (58.8%), though adjusted analysis showed no significant difference (aPR = 1.03; 95% CI: 0.64–1.70; $p = 0.900$). Year-wise, ABR was highest in 2020 (84.6%), but prevalence was lower in 2021 (aPR = 0.74; 95% CI: 0.40–1.38) and slightly higher in 2022 (aPR = 1.04; 95% CI: 0.86–1.25), though these differences were not statistically significant. No significant associations were found between ABR and sex ($p = 0.791$) or organism type ($p = 0.218$), although *Klebsiella* spp had relatively higher resistance (70%) compared to other isolates (Table 3).

Table 3: Prevalence ratio of factors associated with ABR among study participants

Variables	No ABR n (%) [95% CI]	ABR n (%) [95% CI]	p-value	cPR [95% CI] p-value	aPR [95% CI] p-value
Overall	13 (21.7) [12.1-31.2]	47(78.3) [65.8-84.9]			
Age (years)			**<0.001**		
Infants (Under 1)	0 (0.0) [0.0-60.2]	4 (100.0) [39.7-100.0]		1	1
Toddlers and pre-schoolers (1-4)	9 (56.3) [29.9-80.3]	7 (43.8) [19.8-70.2]		0.44 [0.25-0.77] **0.004**	0.43 [0.22-0.82] **0.010**
School-age children (5-12)	0 (0.0) [0.0-26.5]	12 (100.0) [73.5-100.0]		1.00 [1.00-1.00] 1.00	1.10 [0.84-1.45] 0.475
Middle adolescents (13-17)	3 (50.0) [11.8-88.2]	3 (50.0) [11.8-88.2		0.500 [0.22-1.12] 0.092	0.63 [0.28-1.38] 0.244
Young adults (18-24)	0 (0.0) [0.0-50.0]	7 (100.0) [59.0-100.0]		1.00 [1.00-100] 1.00	1.10 [0.87-1.38] 0.414
Adults (25-64)/Elderly (65 and above)	1 (6.7) [0.2-32.0]	14 (93.3) [68.0-99.8]		0.93 [0.81-1.07] 0.321	1.05 [0.83-1.32] 0.690
Sex			0.791		
Female	8 (22.9) [10.5-40.2]	27 (77.1) [59.8-89.6]		1	1
Male	5 (20.0) [6.8-40.7]	20 (80.0) [59.3-93.2]		1.04 [0.79-1.36] 0.791	1.25 [0.96-1.64] 0.104
Ward			**0.021**		
In-patient	7 (41.2) [18.5-67.1]	10 (58.8) [32.9-81.5]		1	1
Out-patient	6 (13.9) [5.3-27.9]	37 (86.1) [72.1-94.7]		1.46 [0.96-2.22] 0.075	1.03 [0.64-1.70] 0.900
Year			**0.028**		
2020	4 (15.4) [4.4-34.9]	22 (84.6) [65.1-95.6]		1	1
2021	6 (50.0) [21.1-78.9]	6 (50.0) [21.1-78.9]		0.59 [0.33-1.07] 0.083	0.74 [0.40-1.38] 0.342
2022	3 (13.6) [2.9-34.9]	19 (86.4) [65.1-97.1]		1.02 [0.80-1.29] 0.865	1.04 [0.86-1.25] 0.692
Organisms isolated			0.218		
Coagulase-negative staphylococcus	0 (0.0) [0.0-52.2]	5 (100.0) [47.8-100]		1	1
Staphylococcus aureus	0 (0.0) [0.0-30.9]	10 (100.0) [69.2-100]		1.00 [1.00-1.00] 1.00	1.07 [0.75-1.51] 0.725
Klebsiella species	3 (30.0) [6.7-65.3]	7 (70.0) [34.8-93.3]		0.70 [0.46-1.05] 0.088	1.50 [0.91-2.47] 0.114
Proteus species	4 (25.0) [7.3-52.4]	12 (75.0) [74.6-92.7]		0.75 [0.56-0.99] **0.048**	0.88 [0.65-1.18] 0.387
P. aeruginosa/E. coli	6 (31.6) [12.6-56.6]	13 (68.4) [43.4-87.4]		0.68 [0.50-0.93] **0.016**	0.85 [0.65-1.10] 0.218

aPR; Adjusted prevalence ratio, cPR; Crude prevalence ratio, ABR; Antibiotic resistance, CI; Confidence interval, P-value less than 0.050 was considered statistically significant

Discussion

The study recorded bacterial growth in 60 (46.2%) cases and provides insight into the bacteriological agents associated with otitis media infections among patients who visited St. Dominic Hospital from 2020 to 2022. The data revealed a diverse range of bacterial isolates contributing to these infections, with *P. aeruginosa* emerging as the most prevalent bacteriological agent, accounting for 28.3% of cases. This finding is significant as *P. aeruginosa* is known for its ability to cause severe infections and its resistance to many antibiotics, posing challenges for treatment. In agreement with this study, previous studies in Ghana reported *P. aeruginosa* as the major isolate in ear discharge [10, 11]. Also, previous studies in Palestine [20] and South East England [21] reported a higher prevalence of *P. aeruginosa* for ear infections in their respective studies. In contrast, earlier studies in Northwest Ethiopia, Southwest Ethiopia, Southern Ethiopia, and Northeastern Ethiopia reported *S. aureus* [16, 22, 23] and *Proteus* species [24] respectively as predominant pathogens causing ear infections. Variation in causative organisms of otitis media could be due to age, vaccination status of the population, geographical location, and antibiotic use.

The prevalence of bacterial isolates varies across different age groups. *P. aeruginosa* and *Proteus* species were predominant isolates responsible for otitis media in this study. Most of the causative organisms were isolated from adolescent patients aged between 13-17 years (75.0%), and toddlers and pre-school children (64.0%). The low prevalence of the causative organisms in young adults and the elderly is an intriguing observation that could prompt further investigation into potential age-related factors influencing bacterial colonisation in otitis media cases. The observed age-related difference in otitis media is statistically significant.

Understanding the distribution of these isolates is crucial for guiding clinical decision-making, such as selecting appropriate antibiotics and developing effective prevention strategies. Further analysis of the factors contributing to the prevalence of *P. aeruginosa* could provide insights into the epidemiology of otitis media infections in this setting and inform targeted interventions to reduce its impact. As such, this data underscores the importance of ongoing surveillance and research to address the complex dynamics of bacterial infections and improve patients' clinical outcomes.

Based on gender, department (inpatient vs. outpatient), and study period, the study observed a higher proportion (47.2%) of bacterial isolates in males compared to females (45.5%). This underscores the need for gender-specific considerations in understanding otitis media infections. However, the statistical analysis reveals that this difference is not significant, implying that gender might not be a significant determinant of bacterial colonisation and infection in otitis media cases. The male predominance of otitis media is consistent with a study conducted in Ethiopia by [25]. In contrast to our study, ear infection was higher in females than in males in a study in Benin City, Nigeria [26]. Similarly, the comparison between inpatients and outpatients indicates a higher proportion of bacterial isolates among outpatients, with a significant statistical difference. This difference in the infection rate could be due to differences in the patient population, exposure to specific risk factors such as tobacco smoking and low socioeconomic status [27], and variations in immune responses. In developing countries like Ghana, malnutrition, contaminated water, poor hygiene, overcrowding, human immunodeficiency virus infection, tuberculosis, malaria, and poor access to health care increase the risk for chronicity and complications of otitis media [28-30]. There is a significant difference in the infection rate across the three-year study period, suggesting that there might be substantial factors that impact the prevalence of bacterial strains causing otitis media.

The results of this study analysis also revealed 15 Gram-positive Staphylococcal bacterial species from the ear swab samples, with *S. aureus* predominance. Isolates of *S. aureus* exhibited resistance to penicillin, cloxacillin, ciprofloxacin, gentamicin, and erythromycin, but are susceptible to other antimicrobial agents. Most of the isolated bacteria in similar studies in Northeastern Ethiopia [24], Southwest, Ethiopia [22], and Southwest, Ethiopia [23] showed a high level of resistance to ampicillin and amoxicillin.

Among the Gram-negative isolates, *P. aeruginosa* was prominent and displayed resistance to ceftazidime, but susceptible to the remaining antibiotics tested. The remaining organisms showed varied levels of resistance to other antibiotics, which is consistent with previous studies by other researchers [22, 31]. These findings underscore the importance of targeted antimicrobial therapy based on susceptibility testing to effectively manage bacterial infections, especially where various organisms are involved, and susceptibility patterns may vary widely.

Recommendations and Future Research

This study shows the need for hospitals to use antibiotics more judiciously and to follow good antibiotic stewardship practices to help combat antibiotic resistance. Regular testing of ear infections to know which bacteria are present and which antibiotics work best should be encouraged. People should also be educated about not using antibiotics without a doctor's advice and about completing their prescribed medicines. Improving hospital laboratories and enforcing legislations on how antibiotics are sold will help manage this problem.

Future studies should look at the different types of ear infections separately and determine how bacteria acquired resistance to these antibiotics. More long-term studies across different hospitals are needed to track changes in resistance over time. Studies to investigate other microbial causes of otitis media is encouraged.

Limitations

This study did not retrieve separate data on AOM and CSOM, which is a limitation of the current analysis. The lack of differentiated data may mask important differences between these two conditions, and future research should prioritise collecting and analysing separate data on AOM and CSOM to advance our understanding of these conditions. The small sample size used in this study may limit the generalizability of the study's findings. Again, the retrospective design of this study may introduce biases due to reliance on existing records and potential inaccuracies in documentation.

Conclusion

Pseudomonas aeruginosa and *Proteus* species were the main causes of otitis media, with higher infection rates among adolescents and out-patients. The isolates showed high resistance to penicillin and first-generation cephalosporins but remained fully susceptible to amikacin, levofloxacin, and amoxicillin–clavulanate, which are recommended for empirical therapy. These findings emphasize the need for continuous surveillance, antibiotic stewardship, and targeted preventive strategies to reduce otitis media infections in the study area.

Declarations

Ethical approval and consent to participate

This study is part of a bigger project with ethical approval reference number UHAS-REC A.3 [3] 23-24 obtained from the University of Health and Allied Sciences' Research Ethics Committee. In addition, written permission was sought from the management of the St. Dominic Hospital, Akwatia, for the use of data generated at the microbiology unit of the facility for the study. The study was carried out according to the ethical standards as laid down by the University of Health and Allied Sciences' Research Ethics Committee and in the Declaration of Helsinki. Informed consent was not sought from the participants because the study was a retrospective one. All archived data for the study will be kept undisclosed and used for the study only. Informed consent was waived by the Research Ethics Committee of the University of Health and Allied Sciences, Ghana.

Consent for publication

Not applicable

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The authors received no external funding for this study.

Conflict of interest

The authors declared no conflict of interest.

Availability of data and materials

The data used for the study are available from the corresponding author upon reasonable request.

Clinical trial number

Not applicable.

Authors' contributions

JGD, FEG and JMN conceptualised the study idea, FEG, VAE, and EuA carried out the methodology, JGD administered the project, JGD, EA, MW, IB, KOD provided resources for the execution of the study, FEG, VAE, and EuA carried out the investigations, MW, KA, IB and KOD did formal analysis, JGD, IB, KA and EA wrote the original draft, and JGD and KOD did review and editing. All authors read and approved the final version of the manuscript.

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