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RESEARCH ARTICLE OPEN ACCESS

Knowledge, Attitude, and Practice Regarding Antibiotic use, Multidrug Resistance, and Herbal Drugs in Chronic Suppurative Otitis Media in Eastern India: A Cross-Sectional Study

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Abstract:

Introduction: The emergence of multidrug-resistant bacteria (MDR) in Chronic suppurative otitis media led to the search for alternative treatment strategies, particularly herbal formulations. However, there is a lack of patient and healthcare professional (HCP) perspectives, which are essential for guiding the adoption of such therapies. Therefore, this study evaluates the knowledge, attitudes, and practices (KAP) regarding antibiotic use, MDR bacteria, and herbal remedies in CSOM among patients and HCPs.

Methods: This cross-sectional study was conducted at a tertiary-care hospital in Eastern India. A total of 240 participants were included: 180 were adult CSOM-infected patients, and the remaining 60 were HCPs. A pre-validated, self-structured questionnaire was used to collect data from the participants. Appropriate statistical tests were employed to summarize the responses. Chi-square and ANOVA tests were used to assess the association between KAP levels and demographic data, with $p < 0.05$ considered statistically significant.

Results: Among CSOM-infected patients, 66.7% identified the causative bacterial organisms; 76.7% were aware of antibiotic resistance, whereas only 34.4% had heard of MDR bacteria. However, 90% of HCPs understood MDR bacteria, although 56.7% were still practising empirical antibiotic therapy. Both patients and HCPs had a positive attitude toward the use of standardised, safe herbal medicines for the treatment of CSOM infections. Education significantly influenced patient knowledge ($p < 0.001$), while years of practice influenced provider knowledge ($p = 0.045$).

Discussion : The outcomes of the present study highlighted a knowledge gap and inconsistencies in treatment practices used for MDR-CSOM cases among both patients and HCPs. Nevertheless, both groups supported the use of herbal remedies to treat MDR CSOM cases.

Conclusion : The present study highlighted the significance of patient education, rational antibiotic use, and the scientific validation of herbal drugs as a complementary drug in the treatment of MDR-CSOM patients.

Keywords: Chronic suppurative otitis media, Antibiotic resistance, MDR bacteria, Herbal remedies, KAP study, Integrative otology.

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1. INTRODUCTION

Chronic suppurative otitis media (CSOM) is a persistent inflammatory condition of the middle ear, typically characterised by continuous or recurrent ear discharge through a perforated tympanic membrane. Management of CSOM is primarily achieved with topical and systemic antibiotics. In untreated conditions, CSOM may lead to complications such as mastoiditis, intracranial infections, and permanent hearing impairment. It is one of the most important causes of hearing loss worldwide, particularly in developing and underdeveloped countries where CSOM is prevalent, and health care facilities are limited [1, 2].

The most frequently CSOM-causing bacteria are *Pseudomonas aeruginosa*, *Staphylococcus aureus, Proteus* species, and *Klebsiella* species. The problem of CSOM has rapidly escalated in the last two or three decades due to the emergence of multidrug-resistant (MDR) bacteria, making its treatment difficult. This clinical concern of MDR bacteria has been reported not only in India but also in other parts of the world [2-8]. Irrational and unprescribed use of antibiotics is one of the primary reasons that has significantly contributed to the emergence of these MDR bacteria. Bacteria causing CSOM are resistant to several classes of antibiotics, including beta-lactams, aminoglycosides, and fluoroquinolones, and this resistance is well documented. To address this issue, clinicians are increasingly relying on broad-spectrum antibiotics, including higher generations of carbapenems, cephalosporins, and polymyxins, which may lead to systemic toxicity, particularly in children. Furthermore, MDR bacteria are responsible for prolonged infections, secondary health complications, higher health care expenditures, and longer hospital stays [2-8]. Therefore, the outcomes of this study will highlight the need for awareness and changes in treatment policies for MDR infections and will help integrate alternative therapies into existing treatment regimens.

As MDR CSOM cases are on the rise, along with other MDR infections, there is an increased search for alternative drugs and treatment policies. Herbal drugs have become a choice due to their complex chemical composition, which is usually not degraded by MDR bacteria [9]. These plant-based drugs have a rich history of use against many infections, including ear infections [10]. Various plant parts, such as neem, turmeric, and olive, have been widely used in traditional medicinal systems, including Ayurveda, Unani, and Chinese medicine, to treat ear infections and related diseases. Moreover, in Indian folkloric medicine, basil leaves, garlic, aloe vera, and betel leaves are widely used to treat CSOM and other ear-related infections [11-13]. These drugs are considered to be safe, cost-effective, and easily accessible, which makes them a potential alternative treatment option. Even though the use of herbal drugs in the current medical system has often been questioned due to many scientific and economic reasons, these drugs have demonstrated significant antibacterial activity in many scientific studies. Therefore, if not the primary choice of treatment, herbal drugs can serve as a complementary or alternative treatment for MDR bacteria causing CSOM [14, 15].

The successful integration of herbal drugs into the modern medical system requires understanding and acceptance from both healthcare professionals (HCPs) and patients. It is known as “Integrative Otology” in Otolaryngology [16]. Patients' knowledge, attitudes, and practices strongly influence their treatment-seeking behaviour and acceptance of new treatment regimens. At the same time, doctors (ENT specialists) and other HCPs play a crucial role in prescribing these herbal drugs along with the routine antibiotic therapy. The collective opinion and efforts of patients and healthcare professionals can guide society in integrating herbal medicines into the modern healthcare system, particularly to address antimicrobial resistance [17, 18].

From this perspective, the current study was undertaken to evaluate knowledge, attitudes, and practices regarding antibiotics and herbal therapy for treating MDR bacteria causing CSOM among patients and HCPs. The findings of this study are expected to highlight the existing knowledge and scientific gaps to support the integration of herbal therapies into the treatment of CSOM.

2. METHODS

2.1. Study Design and Settings

The cross-sectional KAP study was conducted after approval from the institutional ethics committee of the Department of Otorhinolaryngology at a tertiary-care multispecialty hospital in the capital city of an Eastern Indian state that serves populations across all socioeconomic categories. The study duration was 6 months (November 2024 - April 2025).

2.2. Study Population & Sample Size

Patients were consecutively recruited from the ENT outpatient clinic during the study period. Healthcare professionals were proportionally sampled by category, but participation depended on availability during academic sessions or on electronic survey circulation, reflecting a convenience sampling design [19]. Further, the participants were categorised into two groups. The first group consisted of adult patients (≥18 years) diagnosed with CSOM by the department. The second group comprised HCPs (Otorhinolaryngologists, general practitioners, and pharmacists). Patients and HCPs who were unwilling to participate in the study were excluded. The required sample size for the patient group was calculated using the formula for estimating a single population proportion. Assuming a 50% prevalence of adequate knowledge, a 95% confidence level, and a margin of error of 7.5%, the minimum required sample size was 171. To account for possible non-response and incomplete data, the final sample size was increased to 180 patients. Likewise, a total of 60 HCPs, including ENT specialists, general practitioners, and pharmacists, were finalised to ensure their representation in the study.

2.3. Questionnaire Development and Validation

Two structured questionnaires (Table **1**) were developed-one for patients and another for healthcare professionals. The questionnaires were prepared following a review of published studies on antibiotic use, antimicrobial resistance, and herbal medicine in ear infections. An ENT specialist, a public health expert, and a microbiologist validated the questionnaire. Following questionnaire validation, a pilot study was conducted with 15 CSOM patients and 10 HCPs to assess the questionnaire's clarity, sequencing, and ease of understanding. The feedback from the validators and the results of the pilot study were carefully assessed and incorporated to refine the questionnaire. Internal consistency was assessed using Cronbach's alpha, yielding 0.78 for the patient questionnaire and 0.82 for the provider questionnaire, indicating acceptable reliability [20].

Table 1. Domains and sample items in the patient and healthcare-professional questionnaires.

Target Group	Domain	Sample Items (Response Options)
Patients	Consent & demographics	Participation consent (Yes/No); Age; Sex; Education; Residence
	Knowledge	"Bacteria mainly cause CSOM" (True/False/Don't know); "Overuse of antibiotics can make them less effective" (True/False/Don't know); Awareness of herbal/plant-based remedies (Yes/No)
	Attitude	"Antibiotics are always the best treatment for CSOM"; "I trust herbal remedies if suggested by a doctor"; "I would be willing to try a safe, clinically tested herbal ear medicine" (Agree/Neutral/Disagree)
	Practice	Past-year antibiotic use (Yes/No); Stopping antibiotics early (Yes/No); Use of herbal/home remedies (Yes/No); First consultation source (Doctor/ENT, Pharmacist, Traditional healer, Family/friends, Self)
Healthcare professionals	Consent & demographics	Participation consent (Yes/No); Profession; Years in practice (<5, 5–10, >10)
	Knowledge	"Antibiotic resistance is a significant problem in CSOM" (True/False); "Some plant extracts show antibacterial activity against MDR bacteria" (True/False/Don't know); Common CSOM pathogens (multiple choice)
	Attitude	"I am concerned about antibiotic overuse in CSOM"; "I would consider prescribing a herbal product if proven safe and effective"; "Traditional beliefs strongly influence patient treatment choices" (Agree/Neutral/Disagree)
	Practice	Frequency of empirical antibiotic prescription; Culture & sensitivity request; Frequency of patient herbal use; Willingness to prescribe standardised herbal product

Abbreviation: CSOM = chronic suppurative otitis media; MDR = multidrug-resistant.

2.4. Data Collection

Face-to-face interviews were conducted in both English and the local language to collect patient data. The HCPs were provided with the questionnaires in either paper or electronic format, depending on their preferred data collection method. It was ensured that the questionnaires were collected only after they were fully completed.

2.5. Statistical Analysis

The data collected were entered into Microsoft Excel, and SPSS version 25 was used for statistical analysis. For demographic data and KAP components, descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated. Knowledge scores were calculated by assigning one point for each correct response. Patient knowledge scores ranged from 0 to 9 and were categorised into tertiles: poor (0–3), moderate (4–6), and good (7–9). Healthcare professional knowledge scores ranged from 0 to 7 and were categorised as poor (0–2), moderate (3–5), and good (6–7). A five-point Likert scale was used to evaluate attitudes, which were grouped into positive, neutral, or negative categories. A further chi-square test was used to assess the association between demographic characteristics and KAP levels. The final differences in mean scores among the groups were statistically evaluated using one-way ANOVA or an independent T-test, as appropriate. A *p*-value less than 0.05 was considered statistically significant.

3. RESULTS

3.1. Demographic Characteristics

The majority of patients (52.8%) were aged 20-40 years, and 56.7% were male. Nearly one-third (32.2%) had attained a graduate degree or higher, and 45.6% resided in rural areas. Among HCPs, ENT specialists accounted for 30.0%, general practitioners for 23.3%, pharmacists for 20.0%, and dentists for 16.7%. More than one-third (36.7%) of HCPs had over 10 years of clinical experience (Table **2**).

Table 2. Demographic characteristics of study participants.

Variable		Patients (n = 180), n (%)	HCPs (n = 60), n (%)
Age (years)	<20	28 (15.6)	–
	20–40	95 (52.8)	18 (30.0)
	41–60	42 (23.3)	24 (40.0)
	>60	15 (8.3)	18 (30.0)
Male sex		102 (56.7)	38 (63.3)
Education ≥ graduate		58 (32.2)	46 (76.7)
Years in practice		–	<5: 16 (26.7); 5–10: 22 (36.7); >10: 22 (36.7)

Abbreviation: HCPs = healthcare professionals.

3.2. Knowledge about CSOM, Antibiotics, Herbal Remedies, Causative Bacteria, and Multidrug Resistance

Most patients (66.7%) correctly identified bacteria as the cause of CSOM, and 76.7% were aware that antibiotic overuse could lead to antibiotic resistance (Table 3). More than half (57.8%) had heard of herbal remedies for ear infections, but only 34.4% had heard of MDR bacteria. Awareness of causative organisms was low: 32.2% recognised *Pseudomonas aeruginosa*, whereas fewer identified *Staphylococcus aureus* (25.6%), *Klebsiella pneumoniae* (16.7%), *Proteus mirabilis* (12.2%), or *Escherichia coli* (10.0%).

Table 3. Knowledge regarding CSOM, antibiotics, herbal remedies, causative bacteria, and MDR.

Knowledge Item	Patients Correct n (%)	HCPs Correct n (%)
CSOM is mainly caused by bacteria	120 (66.7)	–
Antibiotic overuse causes resistance	138 (76.7)	56 (93.3)
Heard of herbal remedies for ear infections	104 (57.8)	–
Some plant extracts are active against MDR bacteria.	–	38 (63.3)
Heard of MDR bacteria causing treatment failure	62 (34.4)	54 (90.0)
Pseudomonas aeruginosa implicated in CSOM	58 (32.2)	52 (86.7)
Staphylococcus aureus implicated in CSOM	46 (25.6)	44 (73.3)
Klebsiella pneumoniae implicated in CSOM	30 (16.7)	30 (50.0)
Proteus mirabilis implicated in CSOM	22 (12.2)	28 (46.7)
Escherichia coli implicated in CSOM	18 (10.0)	20 (33.3)

Abbreviation: MDR = multidrug-resistant.

3.3. Attitudes toward Antibiotics, MDR Bacteria, and Herbal Remedies

A total of 51.1% of the patients believed that antibiotics are always the best treatment, whereas 77.8% agreed that MDR bacteria make the treatment difficult. A relatively high proportion of patients (68.9%) trusted herbal remedies when recommended by a doctor, whereas 84.4% were willing to try herbal drugs when clinically certified. Likewise, 96.7% of HCPs believed that MDR bacteria complicate CSOM treatment, and 83.3% were concerned about antibiotic overuse. 70% of the HCPs were willing to prescribe a validated herbal product, whereas 76.7% agreed that traditional beliefs influence patients' treatment choices (Table 4).

3.4. Practices Related to Antibiotics, MDR bacteria, and Herbal Remedies

Among patients, 73.3% had used antibiotics in the past year, and 32.2% reported stopping therapy prematurely. Herbal or home remedies were used by 42.2%. When seeking care, 56.7% consulted a physician or an ENT first, whereas others turned to pharmacists (15.6%), traditional healers (14.4%), or self-care. Among HCPs, 56.7% reported empirically prescribing antibiotics for CSOM, whereas only 46.7% routinely requested culture and sensitivity testing in cases of resistance. Two-thirds (66.7%) reported encountering MDR bacteria in their clinical practice. Regarding herbal interventions, 60.0% reported that they would prescribe a standardised herbal product, and 23.3% would use it selectively (Table 5).

Table 4. Attitudes toward antibiotics, MDR bacteria, and herbal remedies.

Attitude Statement	Patients Agree n (%)	HCPs Agree n (%)
Antibiotics are always the best treatment for CSOM	92 (51.1)	–
MDR makes ear infections more difficult to treat	140 (77.8)	58 (96.7)
Trust herbal remedies if suggested by a doctor	124 (68.9)	–
Willing to try/prescribe clinically tested herbal therapy	152 (84.4)	42 (70.0)
Concerned about antibiotic overuse	–	50 (83.3)
Traditional beliefs influence treatment choices.	–	46 (76.7)

Abbreviation: MDR = multidrug-resistant.

Table 5. Practices related to antibiotics, MDR bacteria, and herbal remedies.

Practice	Patients n (%)	HCPs n (%)
Used antibiotics in the past year	132 (73.3)	–
Stopped antibiotics early	58 (32.2)	–
Used herbal/home remedies	76 (42.2)	22 (36.7)
Consult a doctor/ENT first for ear problems	102 (56.7)	–
Empirically prescribe antibiotics for CSOM.	–	34 (56.7)
Request culture in recurrent/failed CSOM	–	28 (46.7)
Encounter MDR bacteria in practice.	–	40 (66.7)
Would prescribe a standardised herbal product	152 (84.4)	36 (60.0)

Abbreviation: MDR = multidrug-resistant; ENT = ear, nose, and throat specialist.

3.5. Composite KAP Scores

Overall, 26.7% of patients had poor knowledge, 41.1% had moderate knowledge, and 32.2% had good knowledge. Attitudes were more favourable, with 45.6% positive, whereas practices were inconsistent, with 30.0% poor. In comparison, HCPs displayed higher levels: 46.7% had good knowledge, 60.0% had positive attitudes, and 43.3% demonstrated good practices; however, 23.3% had poor practice scores, primarily due to the use of empirically prescribed medications without cultural context (Table 6).

Table 6. Composite KAP scores of patients and healthcare professionals.

Domain	Category	Patients n (%)	HCPs n (%)
Knowledge	Poor	48 (26.7)	10 (16.7)
	Moderate	74 (41.1)	22 (36.7)
	Good	58 (32.2)	28 (46.7)
Attitude	Negative	36 (20.0)	8 (13.3)
	Neutral	62 (34.4)	16 (26.7)
	Positive	82 (45.6)	36 (60.0)
Practice	Poor	54 (30.0)	14 (23.3)
	Moderate	70 (38.9)	20 (33.3)
	Good	56 (31.1)	26 (43.3)

Abbreviation: KAP = knowledge, attitude, and practice.

3.6. Association between Demographics and Knowledge Levels

A significant relationship was observed between education and patient knowledge. Among patients without formal schooling, 70.0% had poor knowledge, while 44.8% of graduates and above had good knowledge ($p < 0.001$). Among HCPs, years of practice influenced knowledge: 72.7% of those with over 10 years of experience demonstrated good knowledge, compared with 25.0% of those with less than five years ($p = 0.045$) (Table 7).

Table 7. Association between demographics and knowledge levels.

Variable		Poor Knowledge (%)	Moderate Knowledge (%)	Good Knowledge (%)	χ^2, *p*-value
Patients – Education	No schooling (n=20)	14 (70.0)	4 (20.0)	2 (10.0)	<0.001
	Graduate+ (n=58)	8 (13.8)	24 (41.4)	26 (44.8)	
HCPs – Years in practice	<5 years (n=16)	4 (25.0)	8 (50.0)	4 (25.0)	0.045
	>10 years (n=22)	2 (9.1)	4 (18.2)	16 (72.7)	

Note: χ^2 test used to assess the association between demographic variables and knowledge level; HCPs = healthcare professionals.

4. DISCUSSION

This case study was primarily designed to evaluate knowledge gaps, attitudes, and practices regarding antibiotic use, MDR bacteria, and the use of herbal remedies in managing CSOM among patients and HCPs. These included participants and their responses to the questionnaire, which provided detailed insights into current antibiotic-use policies, as well as various obstacles and opportunities for using herbal drugs in mainstream treatment regimens, particularly against MDR bacteria. It was clear from the study that most patients and HCPs were aware of MDR bacteria; however, they lacked knowledge of the specific bacteria causing them. Among patients, 32.2% reported not having completed the prescribed antibiotic course, and 42.2% used herbal remedies at home to treat CSOM. By contrast, HCPs demonstrated strong knowledge across all aspects of microbiology related to CSOM; 90% acknowledged that antibiotic resistance is a global clinical concern, and 86.7% were aware of the bacteria that cause CSOM. Surprisingly, 56.7% of HCPs continued empirical antibiotic therapy, and 46.7% obtained routine microbial culture only when indicated. However, a high percentage of HCPs (70%) and patients (84.4%) had a positive attitude towards the use of herbal drugs for treating CSOM and otitis media. These findings align with previous KAP studies in otolaryngology and antimicrobial stewardship, which report variable patient awareness of antibiotic resistance and persistent empirical prescribing among clinicians.

The role of MDR bacteria reported in the study is consistent with findings from similar studies, which show *P. aeruginosa* and *S. aureus* as the most frequently isolated organisms in patients with CSOM [21-23]. Similar KAP studies have also reported awareness of the role of empirical therapy and discontinuation of prescribed antibiotic courses in the escalation of multidrug resistance, as reported in our study [24, 25]. Likewise, a favourable attitude towards herbal drugs has been reported in many similar studies. Many clinicians and other healthcare professionals have suggested integrating standardised, safe herbal medicines into contemporary treatment systems [26, 27]. From a patient's economic perspective, integrating herbal formulations into conventional CSOM management can stimulate the Indian herbal and Ayush sector, promote domestic production, and reduce dependence on essential antibiotics [28-30]. The positive attitude of HCPs in the study suggests that standardised and safe herbal formulations offer substantial economic benefits, potentially reducing antibiotic use and healthcare expenses for economically marginalised patients in India [31-33]. Our study was also primarily focused on the advocacy of the hypothesis that herbal drugs can become a complementary therapeutic option alongside conventional antibiotic therapy.

Based on this and similar studies, regular KAP studies across multiple sites and populations should be conducted in the future to document more generalizable outcomes and reduce the knowledge gap. Additionally, scientific evidence and clinical trial data on herbal drugs should be provided to facilitate clinicians' assessment of integrating herbal therapy into current treatment regimens. Such studies should not be restricted to CSOM only, but also should be conducted in other MDR-related infections, where herbal drugs can play an important role in reducing antibiotic dependency, along with healthcare expenses

5. LIMITATIONS

There were a few limitations in this study. Firstly, the data reported in this study are from a single centre and may not reflect the knowledge, attitudes, and practices reported in other parts of the world. Furthermore, the inclusion of HCPs through partially convenience-based

recruitment may limit representativeness and generalizability to practitioners across the region. Moreover, knowledge of the microbiology of CSOM introduces significant bias, particularly among patients, who may not be aware of rising antibiotic resistance. Also, the cultural practices of different populations, particularly in India, restrict their knowledge of the use of herbal drugs. Lastly, although both groups advocated the use of herbal drugs, the lack of scientific evaluation of their efficacy and safety restricts their worldwide use as an adjunct therapeutic drug against CSOM.

CONCLUSION

Our study highlights societal awareness of the prevalence of MDR bacteria in CSOM and of antibiotic misuse. In contrast, there is a major knowledge gap regarding the rational treatment of MDR pathogens. Clinicians' reliance on empirical antibiotic therapy warrants attention, and strong efforts within an antimicrobial stewardship program are needed to address the rising burden of MDR bacteria and their associated economic challenges. Even though herbal drugs emerge as an alternative drug, they cannot replace antibiotics completely. However, with proper scientific validation and clinical trials, it can reduce the dependency on expensive antibiotics. Last but not least, to counter the global problem of antibiotic resistance, education and awareness programs must be expanded for patients and clinicians to prevent an era in which antibiotics become ineffective.

AUTHORS' CONTRIBUTIONS

The authors confirm contribution to the paper as follows: D.S. and S.R.: Conceptualized the study; D.S.: Collected the data, and S.R.: Interpreted the results; S.R.D.: Validated the results; D.S. & S.R.: Drafted the manuscript; S.R.: Finalized the manuscript and is responsible for communication. All authors critically reviewed the manuscript before final communication.

LIST OF ABBREVIATIONS

CSOM	=	Chronic suppurative otitis media
MDR	=	Multidrug resistant
HCPs	=	Healthcare professionals
KAP	=	Knowledge, attitude, and practice
ENT	=	Ear, nose, and throat

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical clearance was obtained from the Institutional Ethical Committee of the Institute of Dental Sciences, Siksha O Anusandhan (Deemed to be) University vide IEC/IDS/IDS-SOA/2024/III-33 dated 15.11.2024.

HUMAN AND ANIMAL RIGHTS

All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Written consent was obtained from the study participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data and supportive information are available within the article.

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None.

CONFLICT OF INTEREST

The author, Shakti Rath, is the Editorial Advisory Board member of The Open Microbiology Journal.

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