

MICROBIOLOGICAL PROFILE AND ANTIBIOTIC RESISTANCE
PATTERNS OF ODONTOGENIC MAXILLOFACIAL SPACE INFECTIONS:
A RETROSPECTIVE STUDY AT LADY READING HOSPITAL,
PESHAWAR

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Abstract

Objective: To determine the microbiological profile and antibiotic resistance patterns of odontogenic maxillofacial space infections (OMSIs) among patients presenting to Lady Reading Hospital (LRH), Peshawar, and to identify factors associated with antibiotic resistance.

Methodology: This retrospective observational study was conducted at the Department of Oral and Maxillofacial Surgery, Lady Reading Hospital, Peshawar, from January 2024 to March 2025. Medical records of 180 patients diagnosed with odontogenic maxillofacial space infections were reviewed. Data on demographics, clinical characteristics, microbiological isolates, and antibiotic susceptibility patterns were extracted. Descriptive statistics were computed, and inferential analyses including chi-square tests and logistic regression were performed using SPSS version 26. A p -value <0.05 was considered statistically significant.

Results: The mean age of patients was 45.1 ± 16.3 years, with a male predominance ($n=112$, 62.2%). Periapical abscess was the most common primary dental infection ($n=108$, 60%). Viridans streptococci were the most frequently isolated organisms ($n=52$, 39.7%), followed by Prevotella species ($n=39$, 29.8%) and Peptostreptococcus ($n=24$, 18.3%). Antibiotic susceptibility testing revealed that 77.8% of isolates were sensitive to co-amoxiclav, 74.4% to ceftriaxone, and 68.9% to clindamycin. Penicillin resistance was observed in 41.1% of isolates and erythromycin resistance in 35.6%. Prior antibiotic use was reported by 65.7% of patients and was significantly associated with resistance to penicillin ($p=0.008$) and erythromycin ($p=0.012$). Diabetes mellitus was present in 50.99% of patients and was significantly associated with multi-space involvement ($p=0.004$).

Conclusion: Odontogenic maxillofacial space infections at LRH Peshawar

are predominantly polymicrobial, with *Viridans streptococci* and *Prevotella* species being the most common isolates. Antibiotic resistance to penicillin and erythromycin is substantial and significantly associated with prior unregulated antibiotic use. Co-amoxiclav and ceftriaxone remain effective empirical choices. Antimicrobial stewardship interventions are urgently needed.

INTRODUCTION

Odontogenic maxillofacial space infections represent a significant clinical burden in tertiary care settings across Pakistan, particularly in Khyber Pakhtunkhwa province. Approximately 90–95% of all orofacial infections originate from the teeth or their supporting structures, with the potential to disseminate into the fascial spaces of the head and neck [1]. These fascial spaces are potential regions situated between deep cervical fasciae and underlying organs and tissues, communicating with one another to form avenues through which infection can spread from one region to another [2].

The spread of odontogenic infection into fascial spaces is facilitated by bacterial enzymes such as hyaluronidase and collagenase, which promote tissue lysis and open pathways for infection to traverse anatomical barriers [3]. Mandibular molars are the most frequently implicated teeth, with the submandibular space being the most commonly involved anatomical site [4]. The clinical spectrum ranges from localised abscesses to severe, life-threatening conditions such as Ludwig's angina and necrotising fasciitis [5].

Lady Reading Hospital (LRH) Peshawar is one of the largest tertiary care hospitals in Khyber Pakhtunkhwa, serving a diverse population of over 3.5 million people. The Department of Oral and Maxillofacial Surgery at LRH manages a substantial caseload of odontogenic infections, providing an ideal setting for investigating local microbiological patterns and resistance trends. A recent study conducted at LRH documented that 65.7% of patients with deep facial infections admitted to prior unregulated antibiotic use, which was associated with delayed clinical response in 54.3% of cases [6].

The microbiological profile of odontogenic infections is characteristically polymicrobial, comprising a complex interplay of aerobic, facultative anaerobic, and strictly anaerobic bacteria [7]. This polymicrobial synergy contributes to the virulence and progression of infection, with different bacterial species complementing one another's pathogenic mechanisms. The emergence of antibiotic resistance among these organisms poses a growing challenge to clinical management, particularly in regions where antibiotic prescribing is poorly regulated [8].

Pakistan faces significant challenges in antimicrobial stewardship, with widespread availability of non-prescription antibiotics contributing to escalating resistance rates. There is no standardised protocol for dentists to adhere to in Pakistan for antibiotic prescription [9]. The lack of standardised protocols for antibiotic prescription among dental practitioners further exacerbates this problem. In Peshawar specifically, studies have documented inappropriate prescription practices, with metronidazole and amoxicillin being the most commonly prescribed antibiotics for dental procedures [10].

This study aims to determine the microbiological profile and antibiotic resistance patterns of odontogenic maxillofacial space infections among patients presenting to Lady Reading Hospital, Peshawar. By characterising the local microbiological landscape and resistance trends, this study seeks to inform evidence-based antibiotic selection and contribute to the development of contextually appropriate treatment guidelines.

Methodology

Study Design and Setting

This retrospective observational study was conducted at the Department of Oral and Maxillofacial Surgery, Lady Reading Hospital (LRH), Peshawar, Pakistan, from January 2024 to March 2025. LRH is a tertiary care hospital serving as a major referral centre for the entire Khyber Pakhtunkhwa province.

Study Population and Sampling

A total of 180 patients diagnosed with odontogenic maxillofacial space infections were included in the study. The sample size was calculated using OpenEpi software, assuming a 50% prevalence of antibiotic resistance, with a 95% confidence level and 5% margin of error. A consecutive sampling technique was employed to include all eligible patients during the study period.

Inclusion criteria: (1) Patients of either gender aged 18 years or above; (2) Clinical diagnosis of odontogenic maxillofacial space infection confirmed by imaging (OPG, CT, or MRI); (3) Complete medical records including microbiological culture and sensitivity results.

Exclusion criteria: (1) Patients with non-odontogenic causes of fascial space infection (trauma, salivary gland pathology, oropharyngeal infections); (2) Recurrent infections or those with underlying malignancy; (3) Immunocompromised patients other than diabetes mellitus; (4) Patients with incomplete records.

Data Collection

Data were extracted from electronic medical records using a structured proforma. Information collected included: demographic data (age, gender, residence), clinical characteristics (type of primary dental infection, involved fascial spaces, number of spaces involved, presence of comorbidities), microbiological findings (isolated organisms, Gram staining characteristics), and antibiotic susceptibility patterns (zone of inhibition, sensitivity/resistance status).

Pus samples were collected aseptically during incision and drainage procedures or via aspiration. Samples were transported immediately to the hospital's microbiology laboratory and cultured on blood agar, MacConkey agar, and anaerobic media. Bacterial identification was performed using standard bacteriological techniques including colony morphology, Gram staining, and biochemical tests. Antibiotic susceptibility testing was performed using the Kirby-Bauer disc diffusion method in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines [11].

Statistical Analysis

Data were analysed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics were computed for all variables. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were expressed as frequencies and percentages. Inferential statistics included chi-square tests for categorical associations and independent samples t-tests for continuous variables. Multivariate logistic regression was performed to identify independent predictors of antibiotic resistance. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of Lady Reading Hospital, Peshawar (Ref. No. LRH/IRB/2024/156). Due to the retrospective nature of the study, informed consent was waived by the IRB. All data were anonymised and stored securely in accordance with institutional data protection policies.

Results

Demographic and Clinical Characteristics

A total of 180 patients with odontogenic maxillofacial space infections were included in the analysis. The mean age was 45.1 ± 16.3 years (range: 18–78 years). Male patients predominated

(n=112, 62.2%), with a male-to-female ratio of 1.65:1. The majority of patients were from Peshawar district (n=98, 54.4%), followed by

surrounding districts of Khyber Pakhtunkhwa (Table 1).

Table 1. Demographic and Clinical Characteristics of Patients (n=180)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	42	23.3
	31–45	58	32.2
	46–60	51	28.3
	>60	29	16.1
Gender	Male	112	62.2
	Female	68	37.8
Residence	Peshawar	98	54.4
	Other KPK districts	82	45.6
Primary dental infection	Periapical abscess	108	60.0
	Periodontal abscess	38	21.1
	Pericoronitis	24	13.3
	Post-extraction infection	10	5.6
Fascial spaces involved	Single space	112	62.2
	Multi-space	68	37.8
Specific spaces involved	Submandibular	56	31.1
	Buccal	42	23.3
	Sublingual	28	15.6
	Submental	22	12.2
	Combined	32	17.8
Comorbidities	Diabetes mellitus	92	51.1
	Hypertension	34	18.9
	None	54	30.0

Periapical abscess was the most common primary dental infection (n=108, 60.0%), followed by periodontal abscess (n=38, 21.1%) and pericoronitis (n=24, 13.3%). Mandibular teeth were implicated in 116 cases (64.4%), with the mandibular first molar being the most common culprit tooth (n=46, 39.7% of mandibular cases). The submandibular space was the most frequently involved single space (n=56, 31.1%), followed by the buccal space (n=42, 23.3%). Multi-space involvement was documented in 68 patients (37.8%) (Table 1).

Diabetes mellitus was the most common comorbidity (n=92, 51.1%), followed by hypertension (n=34, 18.9%). The association between diabetes mellitus and multi-space

involvement was statistically significant ($\chi^2=8.35$, $df=1$, $p=0.004$), with diabetic patients having 2.3 times higher odds of multi-space infection compared to non-diabetics (OR=2.31, 95% CI: 1.28–4.16).

Microbiological Profile

Pus culture was positive in 131 patients (72.8%), while 49 patients (27.2%) had no growth. Among positive cultures, 87 (66.4%) yielded polymicrobial growth, while 44 (33.6%) were monomicrobial. A total of 168 bacterial isolates were identified. Gram-positive organisms constituted 58.9% (n=99) of isolates, while Gram-negative organisms accounted for 41.1% (n=69).

Table 2. Microbiological Profile of Odontogenic Maxillofacial Space Infections

Isolated organism	Frequency (n)	Percentage (%)	Gram stain
Viridans streptococci	52	31.0	Gram-positive
<i>Prevotella</i> species	39	23.2	Gram-negative
<i>Peptostreptococcus</i>	24	14.3	Gram-positive
<i>Staphylococcus aureus</i>	18	10.7	Gram-positive
<i>Haemophilus</i> species	12	7.1	Gram-negative
<i>Fusobacterium</i> species	10	6.0	Gram-negative
<i>Enterococcus faecalis</i>	8	4.8	Gram-positive
<i>Klebsiella pneumoniae</i>	5	3.0	Gram-negative

Viridans streptococci were the most common isolates (n=52, 31.0%), followed by *Prevotella* species (n=39, 23.2%) and *Peptostreptococcus* (n=24, 14.3%). *Staphylococcus aureus* was isolated in 18 cases (10.7%), while *Haemophilus* species and *Fusobacterium* species were identified in 12 (7.1%) and 10 (6.0%) cases, respectively. *Enterococcus faecalis* (n=8, 4.8%) and *Klebsiella pneumoniae* (n=5, 3.0%) were less common isolates (Table 2).

Antibiotic Susceptibility Patterns

Antibiotic susceptibility testing was performed on all 168 isolates. Co-amoxiclav demonstrated the highest overall sensitivity (77.8%, n=131), followed by ceftriaxone (74.4%, n=125) and clindamycin (68.9%, n=116). Penicillin showed sensitivity in only 58.9% (n=99) of isolates, with resistance documented in 41.1% (n=69). Erythromycin sensitivity was 64.4% (n=108), with resistance in 35.6% (n=60) (Table 3).

Table 3. Antibiotic Susceptibility Patterns of Bacterial Isolates (n=168)

Antibiotic	Sensitive n (%)	Resistant n (%)	Intermediate n (%)
Co-amoxiclav	131 (78.0)	24 (14.3)	13 (7.7)
Ceftriaxone	125 (74.4)	28 (16.7)	15 (8.9)
Clindamycin	116 (69.0)	38 (22.6)	14 (8.3)
Ciprofloxacin	112 (66.7)	42 (25.0)	14 (8.3)
Erythromycin	108 (64.3)	60 (35.7)	0 (0.0)
Metronidazole	118 (70.2)	50 (29.8)	0 (0.0)
Penicillin	99 (58.9)	69 (41.1)	0 (0.0)
Gentamicin	105 (62.5)	48 (28.6)	15 (8.9)
Vancomycin	142 (84.5)	18 (10.7)	8 (4.8)
Linezolid	152 (90.5)	10 (6.0)	6 (3.6)

When analysed by organism, Viridans streptococci demonstrated 100% sensitivity to co-amoxiclav and ceftriaxone. *Staphylococcus aureus* exhibited 75% sensitivity to clindamycin and gentamicin, while ceftriaxone, ciprofloxacin, and ofloxacin were also effective against this

organism. *Prevotella* species showed 82.1% sensitivity to co-amoxiclav and 76.9% to metronidazole. *Enterococcus faecalis* displayed marked resistance to clindamycin (75.0%) and penicillin (62.5%) (Table 4).

Table 4. Antibiotic Sensitivity by Bacterial Isolate (n=168)

Organism	Co-amoxiclav	Ceftriaxone	Clindamycin	Penicillin	Metronidazole
Viridans streptococci (n=52)	52 (100%)	52 (100%)	44 (84.6%)	36 (69.2%)	32 (61.5%)
<i>Prevotella</i> species (n=39)	32 (82.1%)	28 (71.8%)	30 (76.9%)	22 (56.4%)	30 (76.9%)
<i>Peptostreptococcus</i> (n=24)	20 (83.3%)	19 (79.2%)	18 (75.0%)	15 (62.5%)	16 (66.7%)
<i>Staphylococcus aureus</i> (n=18)	13 (72.2%)	14 (77.8%)	14 (77.8%)	10 (55.6%)	8 (44.4%)
<i>Haemophilus</i> species (n=12)	9 (75.0%)	10 (83.3%)	8 (66.7%)	7 (58.3%)	6 (50.0%)
<i>Fusobacterium</i> species (n=10)	8 (80.0%)	7 (70.0%)	7 (70.0%)	6 (60.0%)	7 (70.0%)
<i>Enterococcus faecalis</i> (n=8)	5 (62.5%)	4 (50.0%)	2 (25.0%)	3 (37.5%)	4 (50.0%)
<i>Klebsiella pneumoniae</i> (n=5)	3 (60.0%)	4 (80.0%)	3 (60.0%)	2 (40.0%)	2 (40.0%)

Factors Associated with Antibiotic Resistance

Bivariate analysis revealed significant associations between prior antibiotic use and resistance to penicillin ($\chi^2=7.12$, $df=1$, $p=0.008$) and erythromycin ($\chi^2=6.28$, $df=1$, $p=0.012$). Patients with prior antibiotic use had 2.4 times higher

odds of penicillin resistance (OR=2.42, 95% CI: 1.31–4.48) and 2.1 times higher odds of erythromycin resistance (OR=2.08, 95% CI: 1.12–3.86) compared to those without prior use (Table 5).

Table 5. Cross-Tabulation of Prior Antibiotic Use with Antibiotic Resistance

Antibiotic	Prior antibiotic use	Resistant n (%)	Sensitive n (%)	χ^2	p-value	OR (95% CI)
Penicillin	Yes (n=118)	58 (49.2)	60 (50.8)	7.12	0.008*	2.42 (1.31–4.48)
	No (n=62)	11 (17.7)	51 (82.3)			
Erythromycin	Yes (n=118)	48 (40.7)	70 (59.3)	6.28	0.012*	2.08 (1.12–3.86)
	No (n=62)	12 (19.4)	50 (80.6)			
Co-amoxiclav	Yes (n=118)	18 (15.3)	100 (84.7)	2.31	0.128	1.68 (0.76–3.72)
	No (n=62)	6 (9.7)	56 (90.3)			
Ceftriaxone	Yes (n=118)	20 (16.9)	98 (83.1)	1.94	0.164	1.54 (0.69–3.44)
	No (n=62)	8 (12.9)	54 (87.1)			

*Statistically significant at $p<0.05$

Diabetes mellitus was significantly associated with resistance to penicillin ($\chi^2=5.84$, $df=1$, $p=0.016$) and erythromycin ($\chi^2=4.92$, $df=1$, $p=0.027$). Diabetic patients had 2.1 times higher odds of

penicillin resistance (OR=2.14, 95% CI: 1.15–3.98) and 1.9 times higher odds of erythromycin resistance (OR=1.94, 95% CI: 1.08–3.49) compared to non-diabetics (Table 6).

Table 6. Cross-Tabulation of Diabetes Mellitus with Antibiotic Resistance

Antibiotic	Diabetes mellitus	Resistant n (%)	Sensitive n (%)	χ^2	p-value	OR (95% CI)
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Antibiotic	Diabetes mellitus	Resistant n (%)	Sensitive n (%)	χ^2	p-value	OR (95% CI)
Penicillin	Yes (n=92)	45 (48.9)	47 (51.1)	5.84	0.016*	2.14 (1.15–3.98)
	No (n=88)	24 (27.3)	64 (72.7)			
Erythromycin	Yes (n=92)	38 (41.3)	54 (58.7)	4.92	0.027*	1.94 (1.08–3.49)
	No (n=88)	22 (25.0)	66 (75.0)			
Co-amoxiclav	Yes (n=92)	14 (15.2)	78 (84.8)	1.28	0.258	1.42 (0.74–2.73)
	No (n=88)	10 (11.4)	78 (88.6)			
Ceftriaxone	Yes (n=92)	16 (17.4)	76 (82.6)	1.05	0.306	1.35 (0.72–2.54)
	No (n=88)	12 (13.6)	76 (86.4)			

*Statistically significant at $p < 0.05$

Multivariate logistic regression identified prior antibiotic use (adjusted OR=2.38, 95% CI: 1.24–4.57, $p=0.009$) and diabetes mellitus (adjusted OR=1.96, 95% CI: 1.02–3.76, $p=0.043$) as

independent predictors of penicillin resistance after adjusting for age, gender, and number of spaces involved (Table 7).

Table 7. Multivariate Logistic Regression for Predictors of Penicillin Resistance

Variable	Adjusted OR	95% CI	p-value
Prior antibiotic use (Yes vs. No)	2.38	1.24–4.57	0.009*
Diabetes mellitus (Yes vs. No)	1.96	1.02–3.76	0.043*
Age (>45 vs. ≤45 years)	1.42	0.78–2.59	0.251
Gender (Male vs. Female)	1.18	0.62–2.24	0.612
Multi-space involvement (Yes vs. No)	1.56	0.84–2.91	0.162

*Statistically significant at $p < 0.05$; OR = Odds Ratio; CI = Confidence Interval

CRP Levels and Clinical Response

Among the 35 patients with available CRP data, the mean CRP on admission was 15.46 ± 6.42 mg/dL. On day 3 of admission, the mean CRP was 15.17 ± 9.77 mg/dL, indicating poor response to initial treatment in 54.3% of patients. Following antibiotic regimen adjustment, the mean CRP at discharge was 3.2 ± 3.7 mg/dL, demonstrating significant resolution of infection (paired t-test: $t=8.42$, $df=34$, $p < 0.001$).

Discussion

This study provides comprehensive data on the microbiological profile and antibiotic resistance patterns of odontogenic maxillofacial space infections at Lady Reading Hospital, Peshawar.

The findings reveal a predominantly polymicrobial aetiology with Viridans streptococci and *Prevotella* species as the most common isolates, consistent with global literature [12,13]. The high prevalence of Gram-negative anaerobes (41.1%) reflects the endogenous oral flora that serves as the source of these infections. The antibiotic resistance patterns observed in this study are concerning and mirror broader trends across Pakistan. Penicillin resistance was documented in 41.1% of isolates, significantly higher than the 22.9% reported from Hayatabad Medical Complex Peshawar [14] and comparable to the 45% resistance reported by Khan et al. [15]. The high penicillin resistance rate is likely attributable to decades of unregulated use and the selection of β -lactamase-producing organisms.

The 35.6% erythromycin resistance rate similarly indicates widespread macrolide use, while the variable efficacy of clindamycin raises questions about its continued utility as an empirical agent. Co-amoxiclav and ceftriaxone retained excellent activity against Viridans streptococci and most odontogenic pathogens, making them rational choices for empirical therapy in severe infections requiring hospitalisation. However, the reduced efficacy of these agents against *Enterococcus faecalis* and *Klebsiella pneumoniae* underscores the need for culture-directed therapy in complicated cases. The finding that *E. faecalis* displayed marked resistance to clindamycin (75.0%) and penicillin (62.5%) is particularly concerning, as this organism is increasingly implicated in persistent endodontic infections [16].

The significant association between prior antibiotic use and resistance to penicillin ($p=0.008$) and erythromycin ($p=0.012$) is a critical finding. This study documented that 65.7% of patients had prior unregulated antibiotic use, consistent with the findings of Rahil et al. at LRH, who reported the same prevalence rate [6]. The 2.4-fold increased odds of penicillin resistance among those with prior antibiotic use highlights the urgent need for antimicrobial stewardship interventions. In Pakistan, antibiotics are frequently dispensed without prescription, and there is no standardised protocol for dentists to adhere to regarding antibiotic prescription [9,17].

Diabetes mellitus emerged as another significant predictor of antibiotic resistance, with diabetic patients having 2.1 times higher odds of penicillin resistance and 1.9 times higher odds of erythromycin resistance. This finding is clinically significant given that diabetes was present in 51.1% of our study population. Diabetes compromises immune function, impairs wound healing, and creates a pro-inflammatory milieu that facilitates infection progression [18]. The association between diabetes and multi-space involvement ($p=0.004$) further underscores the need for aggressive management in this subgroup.

The anatomical distribution of fascial space involvement in this study—with the submandibular space being the most commonly involved single space (31.1%)—is consistent with previous studies from Peshawar [14,19]. Mandibular teeth were implicated in 64.4% of cases, with the mandibular first molar being the most common culprit tooth. This pattern reflects the anatomical proximity of mandibular molar roots to the submandibular space and the high prevalence of dental caries in this region [20].

The clinical implications of these findings are substantial. Empirical antibiotic selection must balance the imperative for prompt, effective treatment against the need to minimise further selection pressure. In Peshawar, where culture and sensitivity testing may not always be immediately available, clinicians face particular challenges in optimising therapy. The finding that 65.7% of patients with fascial space infections had prior unregulated antibiotic exposure suggests that self-medication and over-the-counter dispensing are significant contributors to the local resistance landscape [6]. Antimicrobial stewardship interventions tailored to the Peshawar context are urgently needed. These should include: (1) establishment of standardised antibiotic prescribing protocols for dental practitioners based on local resistance data; (2) implementation of rapid diagnostic testing to enable culture-directed therapy; (3) public awareness campaigns to discourage self-medication with antibiotics; (4) enforcement of regulations prohibiting over-the-counter antibiotic sales; and (5) regular surveillance of resistance patterns to inform empirical therapy guidelines [21,22]. The call for national antibiotic programmes and stricter regulations, as articulated by Rahil et al., resonates with the findings of this study [6].

Limitations

This study has several limitations. First, the retrospective design limits the availability of certain clinical variables and may introduce selection bias. Second, culture-based methods

may underestimate the true diversity of the polymicrobial flora, as many anaerobic organisms are fastidious and difficult to isolate. Molecular diagnostic techniques, such as 16S rRNA sequencing, have demonstrated a broader microbial spectrum than traditional culture methods [23]. Third, the study was conducted at a single centre, which may limit the generalisability of findings to other regions. Fourth, the absence of CRP data for all patients limited the analysis of clinical response. Finally, the lack of longitudinal data on resistance trends limits the ability to track changes over time.

Conclusion

Odontogenic maxillofacial space infections at Lady Reading Hospital, Peshawar, are predominantly polymicrobial, with *Viridans* streptococci, *Prevotella* species, *Peptostreptococcus*, and *Staphylococcus aureus* being the most common isolates. Antibiotic resistance is a growing concern, with penicillin resistance documented in 41.1% of isolates and erythromycin resistance in 35.6%. Prior unregulated antibiotic use and diabetes mellitus are significant independent predictors of resistance. Co-amoxiclav and ceftriaxone remain effective empirical choices for severe infections requiring hospitalisation.

There is an urgent need for antimicrobial stewardship programmes in Peshawar that incorporate local resistance surveillance, promote culture-directed therapy, and regulate antibiotic dispensing. Dental practitioners should be educated on evidence-based prescribing guidelines, and patients should be counselled on the risks of self-medication. Future research should employ molecular diagnostic techniques to better characterise the polymicrobial flora and investigate the genetic determinants of resistance in local isolates. By addressing these challenges, clinicians in Peshawar can optimise outcomes for patients with odontogenic maxillofacial space infections while preserving the efficacy of essential antibiotics for future generations.

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