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# Antibiotic Resistance Patterns In Oral Bacterial Infections Among Dental Patients In Saudi Arabia

**Fahad Hamad Alayed , Hassan Qasem Qtudi , Rasheed Mohammed Alshehri , Mohammed Ali Al Maqutf , Ahmed Abdullah Alotaibi**

*Affiliate, to King Abdulaziz University Dental Hospital and Armed Forces Hospital in Jazan, Prince Sultan Cardiac Center.*

## Introduction

The emergence of antibiotic resistance in oral bacterial infections represents a significant challenge to contemporary dental practice, particularly in Saudi Arabia where inappropriate prescribing patterns have been extensively documented. The present critical review discusses the perplexing scenario of antimicrobial resistance of oral pathogens in Saudi dental clinics, discussing the current trends, clinical significance and the possible strategies to counter this impending menace. As a region within the Gulf Cooperation Council, the Kingdom of Saudi Arabia has specific difficulties with antimicrobial stewardship because of cultural peculiarities, the pattern of healthcare access, and prescribing practices, which promote the emergence of resistant strains. Researchers have shown that a weak implementation on dental antibiotics prescribing routine is common among Saudi dentists and dental students and unnecessary prescription of the antibiotic is of great concern. The knowledge on these resistance patterns will be very important in coming up with effective intervention strategies and ensuring the effectiveness of the current therapeutic alternatives in the provision of oral healthcare services to the region.

## Prevalence and Demographics of Oral Bacterial Infections in Saudi Dental Practice

The epidemiology of oral bacterial diseases in Saudi Arabian dental practice is very complicated and is characterized by the interaction of certain demographic variables, cultural traditions and medical service seeking behaviour. Distribution of infections that need to be treated using antibiotics differs a lot in the various parts of the Kingdom with those in the urban centres showing a higher rate than the rural ones. Demographics of patients indicate that most of the patients who need antimicrobial treatment are adults in mid-stages of the lifespan, although paediatric population and older people have different modes of infection due to their age. Typical examples of clinical manifestations are periapical abscesses, periodontal diseases, and post-surgical complications, and the periodical changes in the level of infections are associated with changes in the environmental and behavioural habits of patients.

This demographic profile of oral infection exhibits sizable gender variation to some infection conditions being more prevalent in some age groups. Periodontal disease is one of the major oral health diseases of the world and is extremely high in developing nations, which covers many of the aspects of oral health challenges in the Arab World. Such aspects as the diet, oral health care, and the access to health care are cultural mechanisms of infections distribution among various socioeconomic classes (El-Kholey et al., 2018). The urban population shows increased prevalence rates of complex infections wherein more multidrug therapy is needed as compared to rural communities whose cases tend to be more advanced because of time delay in treatment seeking. Unfortunately, there are peculiarities of managing bacterial infections and applying proper antimicrobial treatments, considering the mixture of modern dental health care and traditional methods of healing.

## Bacterial Species Identification and Distribution in Oral Infections

The microbial profile of oral infections in Saudi Arabia includes wide range of both aerobic and anaerobic species of bacteria and seen individual patterns are based on the environmental part of the country and the characteristics of the patients. The most prevalent types of aerobic pathogens are those of Streptococcus, Staphylococcus and Enterococcus, although anaerobic organisms are mainly Prevotella, Porphyromonas, and Fusobacterium (Alzahrani et al., 2020). These organisms are at different proportions among different oral infections and endodontic infections exhibit different microbial patterns as opposed to periodontal diseases. New considerations are the spread of patho-opportunistic organisms and generally unusual bacterial species, that reflect possible immune system compromising activity or are specific to the environment in the gulf region.

These microbiological investigations have shown alarming patterns in the distribution pattern of bacterial species, especially the increase in which some pathogens that were not found before having turned up frequently in ordinary dental infections. Microbial community with the cooperation of aerobic and anaerobic bacteria is gaining popularity and leads to the adjacency of treatment decisions and therapeutic failures. Identification of special bacterial strains also became more complex and sensitive using more complex methods of diagnosis and it shows that there are geographic variations in bacterial strain distribution among the different provinces of Saudi Arabia. This has significant implications on the choice of empirical antibiotics and in the prescription of localized treatment. The determination of the molecular features of the most common bacterial species can be of great importance to study the virulence phenomena, the transmission structure of the bacteria, as well as the possible means of antiviral treatment.

**Current Antibiotic Prescribing Patterns and Practices Among Saudi Dentists**

The prescriptions made by dentists in Saudi Arabia show a considerable difference in contrast with the international standards, and there are disturbing tendencies suggesting the wrongful antibiotics usage and a sub-par application of the evidence-based protocols. Antibiotics are also used by dentists as an alternative in both the therapeutic and prophylactic situations, to regulate oral and dental infections, however, antibiotic prescriptions may present side effects that are negative and resistance. Some of the practices commonly in use comprise inappropriate extent of usage of broad-spectrum antibiotics on minor infections, inappropriate length of treatment, and poor consideration of individual factors like allergies, other medicines used by the patients. Some classes of antibiotics, however, are preferred over others by practitioners in different dental specialities and some prescribing practices are different among general practitioners and specialist practitioners in oral surgery, endodontics and periodontics.

Antimicrobial stewardship education gaps are an influential factor in poor prescribing habits because most practitioners do not have up-to-date information on resistance patterns and effective treatment regimens. In Saudi Arabia, dental students who are undergoing clinical training are permitted to prescribe antibiotics, yet they can incur subsequent side effects in addition to the development of bacteria resistance in the event of inadequate prescription. The role of patient expectations, marketing forces and defensive medicine compound the rational use of antibiotics in the dental practice further (Abdullah et al., 2024). Prescribing patterns differ by region which is attributable to discrepancies in the level of specialist, access to continuing education, and the healthcare infrastructure in a locality. Overcoming these patterns of prescription should be achieved with the help of profound educational courses, the use of clinical decision support systems, and monitoring of the use of antibiotics in various settings of dental practices.

**Resistance Profiles of Common Oral Pathogens to First-Line Antibiotics**

The resistance pattern of oral pathogens in Saudi Arabia provides highly disturbing tendencies across the commonly used first-line antibiotics, and the efficacy of amoxicillin, metronidazole, clindamycin and azithromycin is of special consideration. Streptococcal species exhibit growing non-susceptibility to the penicillin-derivative antibiotics, which are described as the gold standard therapy in case of oral infections and anaerobic bacteria exhibit dissimilar resisting patterns on metronidazole that make the therapy of the periodontal infections difficult (Iyer et al., 2025). The resistance to clindamycin especially in cases of Staphylococcus aureus isolates has become a serious issue and has reduced the ability of patients with allergic reactions to penicillin to have any treatment available. The emergence of resistance to macrolides, which comprise azithromycin, exemplifies wider trends in the antimicrobial resistance observed commonly in different bacterial species in each region.

Extensive review on resistance strategies illustrates innate and acquired patterns on resistance, were horizontal gene transfer leads to rapid spread of resistance to oral bacterial population. Outbreak of extended-spectrum beta-lactamase producing bacterial infections in the mouth is a very worrying trend that has greatly restricted the treatment choices (Al-Hammadi et al., 2025). The widespread pathogens in the Middle East environment are E. coli, S. aureus, Acinetobacter spp. and K. pneumoniae, but the oral specific pathogens present with varied resistance pattern. Research on specific resistance genes associated with Saudi oral bacterial isolates gives evidence not only of the genetic background of antimicrobial resistance, but also a possible point of attack. Frequency of resistance patterns results in need to have common surveillance programs and adjustment of protocols of empirical therapies to sustain effectiveness of the treatments.

**Emerging Multidrug-Resistant Strains and Their Clinical Implications**

The emergence of multidrug-resistant (MDR) strains in oral bacterial infections represents a critical challenge to Saudi dental practice, with implications extending beyond individual patient care to broader public health concerns. The MDR pathogens characterized by the presence of bacteria resistant to multiple antibiotics classes are also widespread in the routine cases of oral infections and cause the absence of a simple therapeutic solution to what was otherwise a simple case. Such strains are resistant to 3 or more classes of antibiotics, which critically reduces the possibility of treatment and requiring other treatment methods. Clinical implication will be long treatment time, treatment failures, added healthcare expenses, and a high possibility of developing severe disorders that can admit people to hospitalization or special procedures.

MDR oral pathogens may have additional effects on public health, though, since the consequences of the presence of MDR pathogens are not limited to forcing changes in the dental practice but extending to effecting changes in health care systems as a whole and in patterns of local transmission. Antimicrobial resistance happens when bacteria, viruses, fungi and parasites evolve with time and become unresponsive to drugs thus making infections more difficult to cure and further expose individuals to spread of diseases, severe infections and incapacitation (Alamri et al., 2025). Such resistant strains have the capability of being reservoirs of resistance genes that can be passed on to other species of bacteria thereby adding to the burden of antimicrobial resistance in a healthcare facility.

The fact that the MDR strains have appeared in the oral infection area is another concern in the context of standardization of care since customary patterns are ineffective and specialists will need to resort to alternative and more costly options, some of which can prove to be poisonous. This is a challenge that must be dealt with in an inter-connected way with providing surveillance systems, infection control issues, and not least in the development of new treatment methods that specifically addresses the resistant oral pathogens.

**Risk Factors Contributing to Antibiotic Resistance Development**

Multiple interconnected risk factors contribute to the development of antibiotic resistance in oral bacterial infections within the Saudi Arabian context, creating a complex web of influences that promote resistance emergence and dissemination. Such patient-specific factors can be partial compliance with the prescribed regimens of antibiotics, the use of self-medication and routine exposure to antibiotics to treat various medical problems. Misuse of antibiotics is also promoted by lack of prescription of some antibiotics and giving out medications to the members of the family unit of people in the cultural setting. The problems related to the lack of accessibility of healthcare, such as geographical exposure to specialist medical care and financial limitations, tend to result in delayed and/or insufficient treatment that encourages the development of resistance.

Among the factors that are key to resistance development are environmental and healthcare-related issues such as lack of proper infection control procedure in dental clinics, lack of proper storage and disposal of antibiotics, and a poor resistance surveillance system to oversee resistance pattern changes. Indiscriminate use of antibiotics was supported by around 89 % of students, interns and residents and 98.4 % of specialists and thus was in evidence throughout different stages of dental education and practice (Almutairi et al., 2024). The source of further challenges is rapid urbanization and population growth in Saudi Arabia, which adds the increased population density and environmental pollution to alteration in dietary habits that might affect the composition of the oral microbiome. Proper awareness of such risk factors will help to devise effective strategies that can be used towards mitigating the occurrence of resistance development caused by such factors as well as ensuring that sufficient and effective treatment options remain available to cure oral infections.

**Comparison with Regional and Global Antibiotic Resistance Trends**

The distribution of antibiotic resistance among oral bacterial infections of Saudi Arabia shows a picture of a more regional trend in the Gulf Cooperation Council countries in stating its kind but confers with regional peculiarities of the healthcare setting in the Kingdom. The problem of antimicrobial resistance is one of the debatable questions in the world that can influence the effectiveness of designed antimicrobial therapy, especially in the Arab countries of the Middle East, where a variety of major Gram-negative pathogens are problematic to effective therapy. Regional studies indicate that antibiotic stewardship issues in the gulf countries are similar as the antibiotic resistance rates to common motor pathogens are comparable and inappropriate antibiotic use is an issue of concern. Nevertheless, the differences between healthcare systems, regulatory factors and culture form unique patterns of resistance formation and spread.

Comparison of Saudi Arabia to the rest of the world would make it fit in a larger context with other emerging economies, which share certain common issues regarding the control of antimicrobial resistance. In the Gulf region, the rates of carbapenem resistance in Pseudomonas aeruginosa, Acinetobacter baumannii and Klebsiella pneumoniae were more than 30 %, which shows that they face severe problems in dealing with resistant pathogens. Saudi oral infections demonstrate the same pattern of resistance to different antibiotics as has been observed worldwide, with an overall resistance to first-line drugs continually increasing, but the local species of resistance and the resistance mechanisms may differ with local epidemiological changes (Alsultan et al., nd). International data related to surveillance contain useful benchmarks in evaluating the relative burden of the resistance issues in Saudi Arabia and best-practices viewpoint in the countries that have achieved success in the implementation of their antimicrobial stewardship programs. Based on these comparisons, effective strategies to deal with resistance challenges emerge and pay attention to local contextual issues that could impair implementation success.

**Strategies for Antimicrobial Stewardship and Resistance Prevention in Dental Practice**

Multi-level, comprehensive interventions that focus on education, practice procedures as well as regulations are necessary to promote a successful antimicrobial stewardship in Saudi dental practice as a means of fighting the rising antibiotic resistance threat. Some of the evidence-based solutions constitute adopting standardized prescribing rules, specific to oral infections, constructing clinical decision support systems, which help the practitioners with proper antibiotic choice, as well as setting up regular surveillance systems to check on the state of resistance and correct prescribing habits (Alzouri et al., 2020). Academic programs should be focused on practicing dentists and students to focus on rational antibiotics use, the knowledge of resistance mechanisms and the possibility to focus on alternative methods of dealing with oral infection. The merging of the rapid testing devices and the ability to grow bacterial in the dental practice can facilitate directed therapy and spare the use of the empirical broad-spectrum antibiotics.

Regulatory and institutional methods are important in fostering antimicrobial stewardship efforts via policy formulation, quality improvement efforts and professional accountability efforts. Efforts to create awareness on the rational use of antibiotics in the field of dentistry are necessary but they should be done after an appropriate identification of the knowledge gaps of dentists. Harmonious response to resistance issues cannot be formed unless there is collaboration between dental professional organisations, health care institutions and the public health agencies.

The use of antimicrobial stewardship programs must involve frequent auditing of the use of antimicrobial prescribing, the provision of feedback to practitioners, and the ongoing quality improvement procedures. Other long-term measures necessary to retain the existence of effective treatment and achieve this goal with selective pressure on the development of resistance is the design of alternative treatment methods, both adjunctive and preventive, and new antimicrobial agents.

## Conclusion

The landscape of antibiotic resistance in oral bacterial infections among Saudi dental patients represents a complex and evolving challenge that requires immediate and sustained intervention to preserve therapeutic efficacy and protect public health. The recorded trends of inappropriate prescribing, the development of multidrug resistant strains, and poor stewardship behaviours are some of the myriads of factors that are jeopardizing the future of antimicrobial treatment in dental practice. The evidence makes it obvious that the present-day practices cannot be sustained and further contributes to the overall antimicrobial resistance crisis that is experienced by healthcare systems around the globe. To overcome such difficulties a unified approach should be provided based on the education, regulations, surveillance, and innovation mechanisms to create the complex solution that will enable both targeting current clinical issues and future sustainability of antimicrobial treatment.

The availability of such measures as the use of evidence-based stewardship methods as well as the continuous research of new treatment methods and means of development of resistance give hope to keep most of effective treatment methods without increased risks of development of further resistance. To achieve success in this adventure, the dental professionals, care institutions, control agencies and healthcare community, at large, will need to maintain their devotion to the policy of antimicrobial stewardship as an essential unit of quality dental care in Saudi Arabia.

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