

Antibiotic Prophylaxis in Dentistry and Oral Surgery: Use and Misuse

Zuhir Abdullah Ashour Hassani¹, Batool Abdullah Albahrani², Abdulla Salim ALShehry³, Nouf Mohammed Saleh Alhoshani⁴, Salem Sager Alsulami⁵, Abdulrahman Abdulaziz Abdulrahman Alhwhshani⁶, Bayader Abdulaziz Abdurhman Alhwhshani⁷, Majed Saeed Saad Alqahtani⁸, Abdulsalam Ahmed Alsulayyim⁹, Husam Dhafir Alqahtani¹⁰, Hamad Abdullah Alnasser¹¹, Khaled Saleh Altokhaim¹², Adel Moteb Alotaibi¹³, Naif Mohammed Alhassan¹⁴

1. General Dentistry, Altholithiah primary Health Care, Ministry of Health, kingdom of Saudi Arabia. dr.zuhir1990@hotmail.com
2. Dental Assistant, Almoalmeen PHC, Ministry of Health, kingdom of Saudi Arabia. Be2bahrani@gmail.com
3. General Dentist, Alhi ALjaded PHCC, Khamis Mushayt, Aseer region, Ministry of Health, kingdom of Saudi Arabia. Ab-s-92@hotmail.com
4. General Dentist, Primary Health Care Almuhammdiah, Ministry of Health, kingdom of Saudi Arabia. sarab_15@live.com
5. General Dentist, MOH, Ministry of Health, kingdom of Saudi Arabia. salemm65212@gmail.com
6. Resident General Dentist, Al-fuwailiq primary health care, Ministry of Health, kingdom of Saudi Arabia. a_h989@live.com
7. Resident General Dentist, Khdira Primary Health Care, Ministry of Health, kingdom of Saudi Arabia. bayader.h@outlook.com
8. General Dentist, Prince Abdul Rahman PHCC, Uhud Rafidah, Aseer region, Ministry of Health, kingdom of Saudi Arabia. Mssq91@outlook.com
9. Resident Dentist, Ministry of Health, kingdom of Saudi Arabia. Abdulsalam.Alsulayyim@gmail.com
10. Dentist, Mansourah Dental Complex, Ministry of Health, kingdom of Saudi Arabia. Husamda@moh.gov.sa
11. Dentist at Riyadh First Health Cluster, Ministry of Health, kingdom of Saudi Arabia. hamad.alnasser94@gmail.com
12. General dentist at ministry of health- Al Baha city, Ministry of Health, kingdom of Saudi Arabia. Khaleed.st@gmail.com
13. General Dentist, Minsters of health, kingdom of Saudi Arabia. aallotaibi155@moh.gov.sa
14. General Dentist, Prince Sultan Bin Abdulaziz Center (Ahmadiyya), Ministry Of Health, Kingdom Of Saudi Arabia. nmalhassan@Moh.gov.sa

ABSTRACT

Antibiotics used in dentistry are frequently used and abused. Antibiotic prescriptions in dentistry can be either preventative or therapeutic. Because of their selective toxicity, which allows them to injure or destroy microorganisms without harming the host cells, they are useful against infections. Eliminating antibiotic misuse has received a lot of attention since it may be achieved by choosing antimicrobial agents wisely, being well-informed about the location of infections, patient characteristics,

and the microorganism's resistance to a particular antibiotic. Finding the reasons behind the use of antibiotics in dentistry is necessary for a complete comprehension of the dentist's role in this worldwide health concern. This study emphasizes antibiotic prescription strategies, identifies factors linked to dental patients' appropriate and inappropriate use of antibiotics, offers insights into the importance of antibiotic indications in the dental field, and encourages dentists to reevaluate the prescriptions they write. Antibiotic-resistant infections are a major danger to world health because they make it more difficult to treat common infections and perform intricate medical procedures. Misuse of antibiotics, especially in low- and middle-income nations, is making the issue worse. Aim: The aim of this study is to investigate the use and misuse of antibiotics in dentistry. To describe antibiotic prescribing behaviors in dentistry, including clinical and nonclinical indications for their use, the type and regimen of antibiotics prescribed, and factors influencing their prescription.

KEYWORDS: Antibiotic, prophylaxis, dentistry, oral surgery, misuse, resistance.

1. Introduction

Antimicrobial-resistant organism infections claim the lives of at least 700,000 people annually and, if unchecked, might result in 10 million fatalities by 2050, a loss of 100 trillion US dollars to the world economy, and a 2-3.5% decline in global GDP. As a result, they pose a major threat to international health and make it difficult to provide complicated medical treatments and cure common illnesses. The extensive use of antibiotics accelerates the evolution of resistance in microbes, despite it being a normal process. There appears to be a direct correlation between the amount of antibiotics used and the emergence of antibiotic resistance (Bhuvanaghan et al., 2021).

Approximately 7% to 10% of all antibiotics prescribed in healthcare come from prescriptions for dental use in affluent nations. It has been discovered that a sizable percentage of antibiotic prescriptions are incorrect. Since toothaches are localized disorders best treated by dental intervention such as evacuation of the tooth or removal of the dental pulp, conditions like those resulting from pulpal or periapical inflammation do not require systemic antibiotics. Furthermore, it is no longer advised to utilize prophylactics for dental treatments on a regular basis. A wrong prescription increases the patient's risk of side effects like allergy and colitis brought on by antibiotics, as well as the population's potential for developing drug-resistant illnesses in the future (Bhuvanaghan et al., 2021).

In India, antibiotics are frequently used in dental procedures. Numerous investigations conducted throughout India to assess the knowledge and prescription practices of dental practitioners revealed the incorrect prescription of antibiotics. India has a poor dentist to population ratio, which is exacerbated by the uneven distribution of the dental workforce. As a result, non-dental practitioners, such as informal healthcare providers (IHCP), typically offer healthcare, especially in rural areas. About 90% of all prescriptions for dental/oral disorders contained antibiotics, according to recent IHCP research on antibiotic prescriptions. This rate was higher

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than that of prescriptions for any other health issue. Unfortunately, because over-the-counter antibiotic use is not included in the rate of antibiotic use, it may be underestimated (Bhuvaraghan et al., 2021).

Antibiotic use has transformed healthcare by saving lives and averting major health issues; yet, overuse of antibiotics has detrimental impacts on individual and community health. Adverse medication reactions from antibiotics can range in severity from mild and reversible to extremely crippling or lethal. The normal flora of an individual might be upset by antibiotics, which can lead to potentially fatal opportunistic bacterial infections like *Clostridium difficile*. Antibiotic-resistant bacteria are the main cause for concern since they put patients at higher risk of worsening clinical outcomes and even dying. Because of the abuse of antibiotics, resistant bacteria are now widely recognized as a major public health concern (Stein et al., 2018).

Antibiotic prescriptions are either therapeutic or prophylactic in the dental field. Prophylactic antibiotics, which are categorized as primary or secondary, are prescribed by dentists to avoid infection. Secondary prophylaxis is used to prevent an infection at a different site; for instance, antibiotics given to patients with a high-risk cardiac condition to prevent infective endocarditis (IE). Primary prophylaxis is the prevention of an initial infection, such as antibiotics administered to prevent surgical site infections (Stein et al., 2018).

In the field of oral health, therapeutic antibiotics are used as primary or supplementary treatments for both odontogenic and nonodontogenic infections. In dentistry, primary therapy is the initial course of treatment for an infection and is not frequently utilized. When a patient seeks care, it can be used, for instance, if decisive care is not possible due to medical issues or case complexity that prevents effective local therapy at that moment. Adjunctive antibiotics, such as those used in connection with surgery, are more frequently used by dentists in addition to oral health care (Stein et al., 2018).

2. Literature review

Dental practices frequently employ antibiotics. 10% of all antibiotic prescriptions are for infections originating in the teeth. They are indicated in dentistry to treat nonodontogenic and odontogenic oral infections as well as to prevent local infections from spreading to nearby tissues and organs. Since antibiotic misuse is thought to be the primary driver of antibiotic resistance, it is a developing issue. As a result, choosing whether to prescribe antibiotics is crucial, and the benefits and drawbacks must be considered. Taking into account the fact that antibiotics can cause modest to severe adverse medication responses that are reversible or even deadly (Al-Mashhadane, 2020).

Antibiotics are typically prescribed by dentists as preventive or therapeutic measures. Primary antibiotics are used to "prevent an initial infection, such as antibiotics administered to prevent surgical site infections," whereas secondary antibiotics are

used to "prevent infection at a distant site." Conversely, antibiotic therapy is used to treat infections and is classified as either adjunctive care, which is provided in addition to oral health treatment, or primary care, which is the first-line treatment for an infection and is uncommon in dentistry. Research has indicated that dentists may frequently use inappropriate antibiotics, and there is proof of both inappropriate prescriptions and improper use of antibiotics for dental infections (Al-Mashhadane, 2020).

To treat a range of oral illnesses and ailments, dentists prescribe a number of different types of drugs. Infections caused by bacteria, fungi, and viruses are among these ailments. The most often given medications for both adults and children are still antibiotics. The majority of antibiotics are prescribed to individuals who show no symptoms or indicators of an infection, primarily in an effort to "prevent" illnesses and ensure that "everything was done". Five classes of antibiotics are typically used by dentists to treat dental and oral infections. These include "beta-lactams (mainly Phenoxymethyl penicillin, amoxicillin, and co-amoxiclav), macrolides, lincosamides, tetracyclines, & metronidazole". Prescription writing practices for treating dental and oral infections will vary depending on the patterns of dental illnesses, including the sensitivity and resistance profile of oral microorganisms. Amoxicillin was regarded as the cornerstone medication for dental care. When treating an acute apical abscess or apical periodontitis, it is the top choice for periodontists and oral surgeons both alone and in conjunction with clavulanic acid and metronidazole (Bhuvrughan et al., 2021).

There were found to be 32 distinct prescription patterns. Many of them were in the WHO Watch category, which contains some very important medications with a higher risk of resistance. Because it is not supported by evidence, the WHO advises against using fixed dose combinations of several broad-spectrum antibiotics. This category of "not recommended" antibiotic combinations included seven of the nine combinations that we found in our investigation. Furthermore, in our research, fixed dose medication combinations (FDCs) were found in more than 25% of prescriptions for antibiotics. Between 2007 and 2017, the overall sales of antibiotics in India increased by 26%; of this, FDCs accounted for a significant portion, increasing by 38% as opposed to a 20% increase in single drug formulations. While FDCs aid in treatment adherence for some common conditions in India, like HIV infection, malaria, and tuberculosis, their usage for dental issues is not warranted, especially when the proportions are so high (Bhuvrughan et al., 2021).

Antibiotic prophylaxis was advised prior to a dental appointment for patients with specific conditions (such as those who had recently had prosthetic joint implants). Patients with these disorders are more likely to develop significant distant site infections (such infective endocarditis and prosthetic joint infections) as a result of bacteremia that is introduced during dental care, which is the rationale behind prophylaxis. Nonetheless, in 2007 and 2013, respectively, recommendations for the use of antibiotics to prevent infective endocarditis and infections in prosthetic joints were updated (Suda et al., 2019).

The lack of evidence supporting the efficacy of antibiotic prophylaxis, the possibility of antibiotic-associated side effects, and the lack of a connection between

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endocarditis and joint infections and dental care were the main reasons for these revisions. Any possible benefit—which is probably minimal—is outweighed by antibiotic resistance, the chance of contracting *Clostridium difficile* infection, and general negative effects. Antibiotics are therefore only advised prior to invasive dental treatments in patients with heart problems who are most at risk of suffering a negative outcome from infective endocarditis (Suda et al., 2019).

One significant contributing factor to the failure of dental implants is infection. The crestal bone level surrounding the dental implant, the results of grafting treatments, and the implant's success rate can all be negatively impacted by infection that occurs after implant surgery. Antibiotics are frequently used during dental implant surgery, however occasionally they are administered incorrectly. Five categories can be used to categorize the variables influencing the initial success rate after implant surgery:

1) the dental implant; 2) biomechanical factors; 3) patients' local factors, such as insufficient bone quantity and quality in the edentulous area; 4) systemic host factors when patients fall into the ASA 3 or ASA 4 categories or possess characteristics that could raise the infection rate, such as being elderly, obese, on steroid or immunosuppressive medication, malnourished, or suffering from diabetes mellitus; and 5) surgical factors. The peri-implantitis risk factors that are linked to implant failure are in line with these. Instead of using antibiotics, oral hygiene plays a major role in peri-implantitis (Kamolratanakul & Jansisyant, 2018).

Surgical trauma, length of procedure, overheating the bone during implant surgery (due to blunt drill, excessive force and pressure, or incorrect drill speed), and bacterial contamination during the surgery from saliva, perioral skin, gloves, or the air in the operating room are surgical factors that can increase the infection rate (operating room Kamolratanakul & Jansisyant, 2018).

Situations that may not need antibiotic prophylaxis

The following circumstances may not require antibiotic prophylaxis: 1) The implant procedure is brief and straightforward; 2) The patients are well and free of any systemic diseases that could compromise osseointegration, such as diabetes, osteoporosis, smoking, radiation therapy history, or steroid or chemotherapy medication use (Kamolratanakul & Jansisyant, 2018).

Situations requiring antibiotic prophylaxis

In the following situations, antibiotic prophylaxis should be taken into consideration: One procedure will involve placing multiple implants, another will involve placing implants and grafting material simultaneously, a reconstructive procedure will be carried out, the recipient bone quality will be poor, the patients will be ASA 3 or 4 or have systemic conditions that interfere with or compromise the osseointegration process, the surgeons will be less experienced and skilled, and the procedure will involve bacterial contamination or bone necrosis (Kamolratanakul & Jansisyant, 2018).

The oral cavity contains the highest concentration of microorganisms in the body. Nevertheless, it is also the most accessible area for the application of antimicrobial

elements, enabling the use of substitutes like antimicrobial mouth rinses, such as chlorhexidine, an antiseptic that has demonstrated efficacy in reducing the local bacterial load and halting the progression of the infection process. Alternatively, a recent suggestion involves the use of antimicrobial peptides, which have the ability to modify their impact on microorganisms based on their structure, hydrophobicity, or amphiphilic traits (Cuevas-Gonzalez et al., 2023).

Their modes of action can be classified as either immune system-related or as having a direct impact on the microorganism's structure. Peptides can cause a bacterial cell membrane to rupture or permeabilize, altering the cell structure at many levels. This is one way that peptides contribute to the mechanism pertaining to bacterial structure. Furthermore, the peptides can activate the immune system by attracting pro- and anti-inflammatory cytokines. Clinically, it is possible to achieve this option. The two biggest obstacles at the moment are the investigation of potential long-term negative effects in host cells and commercial development (Cuevas-Gonzalez et al., 2023).

Antibiotic misuse

The phrase "misuse" refers to the use of antibiotics without a prescription from a doctor or when one is prescribed by one but does not follow the doctor's directions about the timing, dose, and length of therapy. It is a major issue everywhere, regardless of the economics and riches of the nation. Antibiotic resistance is a widespread public health issue with significant socioeconomic and clinical costs that has been brought about by antibiotic abuse (Mallah et al., 2021). Antibiotic abuse is also common in high-income nations, such as the US, where the percentage of people who use antibiotics without a prescription varies from 14 to 48% and can reach as high as 66% in certain cases. There are a number of factors that have been linked to antibiotic overuse. The majority of these are sociodemographic, involving female gender, young individuals and the elderly, low educational attainment, challenges in accessing the healthcare system, the high expense of doctor visits, and the availability of antibiotics (Grigoryan et al., 2019).

In underdeveloped nations, safe healthcare-seeking behavior is hindered by limited household income; this was a significant obstacle for our community. Inadequate knowledge regarding the significance of appropriate antibiotic indications and dosages in our community has contributed to supplier-shopping in other communities. Neither the home visiting nurses nor the pharmacists were able to stop the habit of buying one or two doses of antibiotics, despite the fact that ignorance made it easier. In all of Cambodia, there are thought to be 13,000 rural pharmacies that sell antibiotics without a prescription. We sent in a mystery shopper during our fieldwork, and he quickly bought a combination of medications to treat his frequent cold symptoms. For his symptoms, our mystery shopper was prescribed various unidentified drugs in addition to two doses of 500 mg amoxicillin (Om et al., 2017). The Chinese health system's widespread overuse of antibiotics for self-limiting illnesses can be linked to supply and demand-side issues. Hospitals and community health centers overprescribed antibiotics as a result of health practitioners' heavy reliance on prescription sales as a source of income. Lack of strict laws governing the distribution of OTC antibiotics has also made medicines

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readily available in pharmacies. On the demand side, practices like self-medication with antibiotics and storing leftover medications at home have emerged from a lack of public awareness regarding optimal antibiotic use. Because of the disparities in social, economic, and governance capacities between China's more and less developed regions, the effects of the aforementioned elements on antibiotic abuse behaviors varied (Peng et al., 2018).

Antibiotic drug-resistance

Antibiotic resistance poses a global threat to human health. The pharmaceutical sector, several national health agendas, and the World Health Organization (WHO) all place a high premium on reducing the occurrence of drug-resistant diseases. The widespread overuse of antibiotics around the world is a key cause of drug resistance. Misuse plays a role in the spread of organisms that are resistant to multiple drugs (MDROs; 2). MDRO infections lead to increased morbidity and mortality as well as lengthier hospital stays (Barker et al., 2017).

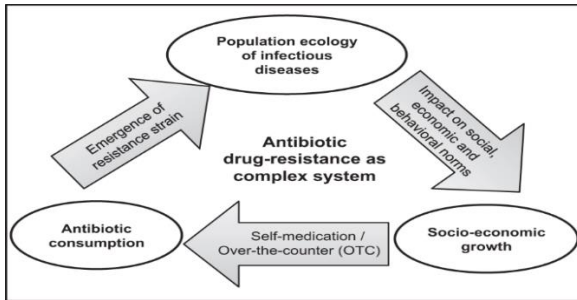


Figure1. Antibiotic drug-resistance as an integrated system driven by population ecology of infectious disease, socio-economic growth of population and antibiotic consumption by individuals in the population (Malik & Bhattacharyya, 2019).

The relationship between the usage of antibiotics and the development of resistance is nuanced. Although the majority of current research focuses on comprehending the microbiology of drug resistance, there aren't many modeling studies that highlight the coexistence of strains and the dynamics of transmission under high antibiotic use (Malik & Bhattacharyya, 2019).

3. Conclusion

The purpose of this scoping review was to give oral health care providers and other interested parties an overview of how dentists in different specializations prescribe antibiotics in order to direct future research in this area. Future research is necessary, for example, if it focuses on a single dental specialty (such as antibiotic use in periodontics) and has a defined clinical research topic and outcome measure. This type of research should be conducted in a methodical manner. Researchers advise that investigators do a thorough review of antibiotic prescriptions written by dentists in local jurisdictions where data sources are accessible to track antibiotic

prescriptions. In order to promote case selection and convenience of use, researchers urge the creation of comprehensive, workable recommendations for prescription antibiotics that include detailed descriptions of indications and regimens. Inappropriate use of antibiotics by both dental and non-dental healthcare providers is a major worldwide risk. It was also concerning that people were using combination antibiotics and self-medication for tooth issues. Given the grave issue of antibiotic resistance, it is imperative to address India's misuse of antibiotics for dental and oral health issues. To facilitate a national shift in this area, initiatives aimed at both the general population and healthcare professionals should be implemented.

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