

Antimicrobial Resistance and the Dentist: A review of literature

SADJ JULY 2025, Vol. 80 No.6 P318-P321

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The practice of medicine was revolutionised by the discovery of penicillin by Alexander Fleming in 1928, and by 1945 antibiotics were readily available as a therapeutic agent. Since then antibiotics have become the most commonly used medication to treat and prevent bacterial infections. The use of antibiotics has prevented many deaths, transformed healthcare and allowed the public health sector to better manage communicable diseases.

As early as 1947 Hoffman emphasised the ease of use of penicillin, with little regard for correct diagnosis and dosage; and thus, overlooking general principles of medicine, surgery and dentistry in the management of disease. As antibiotic prescribing has increased and the overuse and misuse of antibiotics has increased, so too has the ability of bacteria to adapt as a protective mechanism, thereby rendering the antibiotic ineffective. Since the introduction of penicillin there has been an increase in antibiotic prescribing among both medical and dental practitioners. Excessive and incorrect use of antibiotics encourages bacterial resistance which leads to complex treatment strategies for infectious diseases and possible failure of treatment. In addition, the increased antimicrobial resistance rates place a burden on healthcare costs and thus, antimicrobial resistance is evident globally as a major public health concern.

Aim of Review

To offer an overview of existing literature on antimicrobial resistance, antibiotic prescribing and antimicrobial stewardship in dentistry.

Key words

antimicrobial resistance, antibiotic prescribing, dentistry

ANTIMICROBIAL RESISTANCE

What is Antimicrobial Resistance?

The phenomenon of antimicrobial resistance (AMR) occurs when microorganisms (which include bacteria, viruses, fungi, and parasites) are able to adapt and grow in the presence of medication/s that previously affected them.¹ Antimicrobial

resistance is an inherent characteristic of microorganisms, however the occurrence of AMR in healthcare has been intensified by the misuse and inappropriate use of antimicrobial medication, such as antibiotics. Subsequently, a reduction in the effectiveness of an antibiotic against an infectious strain at minimum inhibitory concentration is seen. The lowest concentration at which an antibiotic is effective to inhibit bacterial growth is the minimum inhibitory concentration, which highlights this important concept when confronted with therapeutic failure.^{2,3} Although the drivers of AMR are varied, inappropriate antibiotic prescribing by healthcare professionals are highlighted as a serious contributor to AMR.³

Dental outpatient antibiotic prescriptions and hospital inpatient prescriptions account for the most commonly prescribed medications; with dentists accountable for an approximate 10% of all antibiotics prescribed globally.^{4,5}

Antibiotic prescribing in Dentistry

The management of pain and swelling by correct diagnosis and eradication of oral infection falls within the ambit of the dental practitioner. This management involves correct diagnosis, treatment of disease and if required prescribing of antibiotics and analgesics.^{6,7,8} The prescribing of antibiotics when managing dento-alveolar infections should only be considered when there is indication of an increased risk of systemic involvement.^{9,10,11}

Dental practitioners often deem the prescribing of antibiotics fitting to relieve pain symptoms, in the treatment of acute infections and also to prevent infections when patients receive dental treatment.¹²

The treatment of dental pain without the presence of infection has been extensively reported in literature.^{13,14} The prescribing of antibiotics during dental treatment should be limited, as most dental infections respond well to clinical operative intervention. The supplementary use of antibiotics is only required in a limited number of situations.^{15,16,17,18,19}

Prescribing trends in Dentistry

Antibiotic prescribing in dentistry has either prophylactic or therapeutic benefit. The prophylactic antibiotic treatment regime can be either primary (to prevent surgical site infections) or secondary (to prevent an infection elsewhere in the body, e.g. infective endocarditis in high risk cardiac patients). Therapeutic antibiotics is used to manage odontogenic and non-odontogenic infections which are either primary or adjunctive. Primary therapeutic antibiotic treatment is the standard practice when there is an infection, however this is rarely used in dentistry. Adjunctive antibiotic treatment together with clinical (operative and surgical) interventions is most commonly used in dentistry.^{8,15,20}

The decision to prescribe antibiotics should be based on

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the following factors: clinical indications for an antibiotic regimen, the oral health status of the patient, medical history and current medication information. This information will be useful in making an informed evidence-based decision and therefore preventing the misuse of antibiotics. In clinical dentistry, antibiotics are only indicated in the event of systemic involvement or during treatment measures in which the patient's immune system is unable to fight infection. In most clinical situations where antibiotics are required, a short effective course of a narrow-spectrum antibiotic is advocated.^{4,8,21,22} The practice of routinely using antibiotics as an aide to treating dental infections or in combination with dental surgical procedures was formed before the current crisis period of antimicrobial resistance; and thus, contributes to the global concern surrounding AMR.¹⁶

The prescribing of antibiotics is common in both general and specialist dental practices, with the foremost prescribed antibiotic by dental practitioners is amoxicillin, and the combination of amoxicillin and clavulanic acid is the second most prescribed antibiotic. Although azithromycin has a greater risk of being associated with AMR, it ranks third in the prescribing order.²⁴ Dental practitioners appear to favour a broad-spectrum amoxicillin, whereas the narrow-spectrum antimicrobial agents such as penicillin V are less likely to be prescribed.⁸ This development is of concern as narrow spectrum antimicrobial agents do not easily lead to resistant bacteria. Antibiotic resistant bacteria are of concern in healthcare as these infections can result in greater adverse clinical consequences and death.^{8,25,26} A scoping review by Stein et al. (2018) demonstrated that antibiotics were routinely prescribed prophylactically to healthy patients when undergoing invasive clinical treatment, such as implant placement, root canal treatment and surgical removal of teeth. The majority of dental conditions for which antibiotics are recommended by dental practitioners, should in fact be treated by clinical intervention procedures in order to relieve or remove the inflammation and/or infection associated with the dental condition.^{8,27}

The guidelines and criteria for antibiotic prescribing in dentistry is explicitly stated in various guidelines published globally.^{28,29,30,31} Examples of these guidelines include the American Dental Association guidelines in USA, NICE (National Institute for Health and Care Excellence UK) in the United Kingdom, Scottish Dental Clinical Effectiveness Program in Scotland and UK and the Afssaps (French Agency for the Safety of Health Products) recommendations for good practice of antibiotics in oral practice amongst others and dental practitioners are encouraged to adhere to these guidelines.^{17,18,25,30,32} Antibiotics should be prescribed at the required dosage and length of time to obtain minimum inhibitory concentrations in order to avoid the development of resistant strains.^{2,7}

Factors influencing antibiotic prescribing among dentists

Various factors influence dental practitioners when it comes to determining the prescribing of antibiotics, and this can differ amongst practitioners.¹⁸

Factors include: patients' incapability or reluctance to accept invasive clinical treatment; failure of previous clinical treatment procedure; shortage of treatment time to complete the clinical procedure, and requests for antibiotics by patients.²⁷ Additional clinical factors reported by Sheikh Rezaei et al.

2022, include the total number of teeth being extracted, where multiple extractions warrant antibiotic prescription. Sheikh Rezaei et al. 2022, also reported a greater number of antibiotic prescriptions were provided to younger patients; where this could be due to more complex extractions, compared to older patients with periodontally compromised teeth.³³ Additional factors that drive antibiotic prescribing amongst dental practitioners include concern that the lack of prescribing antibiotics which may be required later, and would be perceived as failure. The possibility of missing an infection also drives antibiotic prescribing amongst dental practitioners. Thus, prescribing antibiotics "just in case".³⁴ A study by Rodríguez-Fernández et al. 2022 revealed that practicing in private practice compared to public health clinics as well as years of experience influenced prescription rates. Dental practitioners with greater years of experience were more likely to incorrectly prescribe antibiotics; as were those in private practice. The greater the time since date of qualification of dental practitioners, there was an increased degree of inappropriate antibiotic prescribing.²¹ Dentists may also base decisions to prescribe antibiotics on influence of peers and colleagues, and often mention requests from non-dental healthcare practitioners (such as orthopaedic and cardiac specialists) as a reason when deciding to prescribe.³⁵ Al Marah et al. (2022) found that dentists in academia adhered to guidelines and correctly prescribed antibiotics, compared to their peers in the clinical sector. This could be attributed to academics being aware of latest developments and updates surrounding antimicrobial resistance (AMR) and antimicrobial stewardship (AMS), as this would be incorporated in dental curricula.³⁶ The slow uptake of reform or new and updated guidelines as well as lack of knowledge by dental practitioners has also been identified as contributor to antibiotic prescribing habits and AMR.⁸

Also included amongst the non-clinical factors surrounding dentists' antibiotic prescribing patterns are: the pressure of the patient and patient preference; and also, the fear of loss of the patient if antibiotics are not prescribed.^{8,37} In addition, often the general public are under the impression that antibiotics are required to treat pain and to avoid invasive treatment such extraction.¹⁴ Access to primary dental care, after hours emergency appointments and concern about inflicting pain on loyal patients can also influence whether a dentist will prescribe antibiotics or not.¹⁸ Inconsistent scientific guidelines, the absence of clinical evidence, fear of malpractice lawsuits and lack of knowledge on consequences of needless antibiotic prescribing further increases inappropriate antibiotic prescribing.³²

Prescribing guidelines

In clinical dentistry, antibiotics are only indicated in the event of systemic involvement or during treatment measures in which the patient's immune system is unable to fight infection. In most clinical situations where antibiotics are required, a short effective course of a narrow-spectrum antibiotic is advocated.^{4,8,21,22} The practice of routinely using antibiotics as an aide to treating dental infections or in combination with dental surgical procedures was formed before the current crisis period of antimicrobial resistance; and thus, contributes to the global concern surrounding AMR.¹⁶

Guidelines are widely available to assist dental practitioners to make evidence-based decisions when it comes to prescribing antibiotics; and most guidelines advise against antibiotic use for the treatment of dento-alveolar infections,

when there is no evidence of spreading infection and systemic symptoms. Regardless of the availability of these guidelines globally, evidence still exists of routine antibiotic prescribing for acute dental conditions without the clinical indicators to justify the decision.^{15,19,27}

In 2019, due to the increased rate of AMR worldwide, the World Health Organization (WHO) created a classification of antibiotics in order to promote antimicrobial stewardship and decrease AMR. The Essential Medicines List: Access, Watch and Reserve (AWaRe) classification is available for hospital and outpatient prescribing and includes antibiotic guidelines for dentistry. The Access collection of antibiotics contains narrow-spectrum antibiotics and which has a lower chance of developing resistance. The Watch collection of antibiotics comprises of a broader spectrum of antibiotics. This group has a higher resistance potential. The Reserve collection of antibiotics comprises of the last recourse antibiotics for targeted use in drug resistant infections.³⁸ By using the AWaRe classification, using the WATCH group of antibiotics should be done with caution in dentistry.²³

Antibiotic stewardship

Currently, research and development of new antibiotics is limited, and this highlights the need to promote appropriate and judicious use of existing antibiotics. It is also necessary to safeguard the efficacy of current antibiotics to allow future use.^{17,39}

Antibiotic stewardship is a coordinated approach to optimize antimicrobial prescribing by selecting the correct drug, at the appropriate dose, for the correct time period, and aims to achieve the best clinical outcomes for patients while minimizing the development of antibiotic resistance.⁴⁰

The key feature of antimicrobial stewardship is to measure the prescribing of antibiotics, improve rational antibiotic prescribing and use by patients, decrease antibiotic resistance, reduce health complications of needless and incorrect antibiotic use and thus improve patients' health status. It also aims to ensure that the correct drug, dosage and dosage time is chosen when an antibiotic is prescribed. Antimicrobial stewardship provides a plan to encourage justifiable antibiotic use.^{41,42}

It therefore describes an integrated and interdisciplinary approach to decrease antibiotic prescription rates. Antibiotic stewardship takes on an all-encompassing purpose and consists of various methods and practices. These include: education (to encourage the appropriate selection, dosage and time period of antibiotics), enhanced surveillance systems (of antibiotic prescribing and use), audit and feedback, implementation of prescribing guidelines and policies.^{17,43,44}

CONCLUSION

Antimicrobial resistance represents a critical global public health crisis, with healthcare practitioners, including dentists, playing a pivotal role in its propagation. The widespread and inappropriate prescribing of antibiotics has contributed significantly to this crisis, with dentists accounting for approximately 10% of antibiotic prescriptions worldwide. Although antibiotic prescribing practices in dentistry are influenced by various factors, both clinical and non-clinical; it is valuable for the dentist to prioritise sound diagnostic principles and evidence based best practice, in addition to adhering to established prescribing guidelines. This highlights

the ethical responsibility for dentists to practice judicious prescribing by adhering to antimicrobial stewardship principles in an effort to mitigate the escalating threat of antimicrobial resistance.

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