

# NEW PERSPECTIVE ARTICLE

Antimicrobial Resistance: What Should Dentists be Doing?

Resistencia antimicrobiana: ¿Que deberían estar haciendo los odontólogos?

Received: 05-IX-2015

Accepted: 15-IX-2015

Published Online First: 26-IX-2015

DOI: <http://dx.doi.org/10.15517/ijds.v0i0.26356>

## ABSTRACT

The purpose of this article is to increase awareness among the dental professionals about the importance of an adequate antibiotic stewardship in the dental setting, in light of the increasing threat that antimicrobial resistance represents to humanity. Updated guidelines for the prescription of antibiotic drugs must be followed by the dentist and patient education for the intake of these drugs are mandatory as part of a global strategy aimed to reduce the burden of disease and death caused by antimicrobial resistant microorganisms.

## KEYWORDS

Antibiotics; Antimicrobial resistance; Antibiotic resistance; Antibiotic prophylaxis;  
Oral infection; Dental pain.

## RESUMEN

El propósito de este artículo es aumentar la conciencia entre los profesionales de la odontología sobre la importancia de un manejo racional de antibióticos utilizados en el consultorio dental, a la luz de la creciente amenaza que la resistencia a los medicamentos antimicrobianos representa para la humanidad. Es deber del odontólogo mantenerse actualizado en los protocolos recomendados para la prescripción de antibióticos y el paciente debe ser educado en cuanto al consumo de este tipo de drogas. Todo esto como parte de una estrategia global dirigida a reducir la carga de enfermedades y muertes causadas por microorganismos resistentes a agentes antimicrobianos.

## PALABRAS CLAVE

Antibiótico; Resistencia antimicrobiana; Profilaxis antibiótica; Infección oral; Dolor dental.

Due to its accelerated incremental ratio, antimicrobial resistance (AMR) will represent one of the major global public health threats of the 21st century. Specific actions, from the various stakeholders, are required in order to lessen this life-threatening menace, and dentists share some responsibility. Worldwide, organizations and dental associations such as the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), American Dental Association (ADA), British Dental Association (BDA), and the Canadian Dental Association (CDA), among others, have developed strategies to raise awareness among oral health professionals to contain the increment of AMR worldwide, and promote adequate antibiotic (AB) stewardship among dentists. A recent estimate has established global AB consumption in nearly 70 billion doses per year (1). Reports from the CDC, have shown that 10% of all AB prescriptions in the United States come from the dental care setting. An equal proportion has been reported for the United Kingdom's population. More importantly, approximately 50% of these prescriptions, may have been inappropriate or even unnecessary (2-4).

Antimicrobial resistance happens when microorganisms (such as bacteria, fungi, viruses, and parasites) change when they are exposed to antimicrobial drugs. These microbes are sometimes referred as "superbugs" and as a result, the medicines become ineffective and infections persist in the body, increasing the risk of spread to others. AMR is present in every country and patients with infections caused by drug-resistant bacteria are at augmented risk of poorer clinical outcomes and death. They also consume more health resources than patients infected with non-resistant strains of the same bacteria (5).

Historically, antibiotics and other antimicrobial drugs have been invaluable in the management of infectious diseases. Regrettably, their value is being jeopardized by the presence of these "superbugs". The first reports of AMR

come from the 1940s, at the start of the antibiotic era, when it was observed that penicillin was not always effective against *Staphylococcus aureus* infections. Since then, new antibiotics are being developed each year, to cope with new mutated bacteria strains that have become resistant to standard AB treatment. This synergic relationship between science (developing new AB drugs) and nature (evolving pathogenic microorganisms) has been a nonstop race through the past 70 years. Although, the menace of AMR has been evident in the last few decades, when the disrupted balance as well as the risk for the reappearance of old diseases (e.g. tuberculosis and malaria) and ineffective drugs to contain them is augmented (6). Without effective antimicrobials for prevention and treatment of infections, medical procedures such as organ transplantation, cancer chemotherapy, diabetes management and major surgery become very high risk (5).

The possible cellular mechanisms of AMR explain that microorganisms may: i) produce an enzyme which destroys the drug, ii) prevent the attachment of the drug, iii) prevent the penetration of the drug, iv) pump out the drug before it can be effective, v) change the metabolic pathway or a combination of various mechanisms. Microorganisms then acquire resistance by random gene mutation or receiving genetic material from other resistant organism.

## ANTIBIOTIC USAGE IN DENTAL PRACTICE

The microorganisms most commonly isolated from the oral and maxillofacial regions are either aerobic, facultative anaerobic, or anaerobic bacteria; and these are responsible for the majority of odontogenic infections, providing the rationale for the use of systemic administration of AB. Nonetheless, dentists are not always aware of the most current clinical guidelines regarding AB prophylaxis and AB treatment for odontogenic infections.

It has been stated that AB prophylaxis for infectious diseases of dental origin is more prevalent than the AB treatment of these infections; and it has become a common practice among dentists to prescribe AB as prophylactic treatment to prevent infections in patients at risk due to systemic conditions such as endocarditis, artificial heart valves, joint replacements, and congenital heart diseases. Although, there is no substantial evidence that oral microorganisms could seed and infect distant tissues after oral procedures (7). The American Heart Association (AHA) 2007 guidelines suggested to clinicians that i) infective endocarditis is much more likely to occur following frequent exposure to random bacteremia associated with daily activities than from bacteremia caused by a dental, gastrointestinal tract or genitourinary tract procedure, ii) prophylaxis may prevent an exceedingly small number of cases of infective endocarditis, if any, in people who undergo the previously mentioned procedures, iii) the risk of antibiotic-associated adverse events exceeds the benefits, if any, from prophylactic AB therapy, and iv) maintenance of optimal oral health and hygiene may reduce the incidence of bacteremia from daily activities and is more important than prophylactic AB for a dental procedure to reduce the risk of infective endocarditis (8).

Also, dentists commonly use AB therapy to treat acute and chronic infections in the oral cavity, but there are examples of the inappropriate use of AB for these conditions (9). As an example, a substantial proportion of pain of dental origin is caused by acute and chronic infections that originate in the pulp, which require operative intervention rather than AB. A recent systematic review of randomized controlled trials on this topic, concluded that systemic AB are not indicated during endodontic treatment to alleviate pain or decrease infection, and an accurate diagnosis paired with an effective endodontic treatment will decrease the number of microbes enough to result in a healing outcome (10). Dry socket, chronic

inflammatory periodontal conditions, and pulpitis are other examples of common clinical situations where ABs are not indicated, although clinicians commonly write an AB prescription (9).

Another use dentists usually give to AB therapy is to prevent local infection and systemic spread among patients undergoing surgical treatment as for example, implant surgery. Although medical device related infections represent nearly half of all US health care-associated infections, it has been stated that 5-10% of fracture fixation devices and dental implants develop infections which mostly are resistant to systemic AB. These infections will continue until the implant is removed, in many cases, associated with substantial morbidity and costs. Research has been guided towards developing antimicrobial medical device combination products, which promise to reduce infection risks by providing high antimicrobial concentrations at the target site while minimizing systemic side effects, such as AMR (11).

## THE DENTIST'S ROLE TO REDUCE AMR

WHO has devoted efforts to establish a global agenda involving governments, health organizations, health providers, food and agriculture organizations, animal health organizations, and the general population to minimize the increment of AMR worldwide. They have strengthened the necessity for monitoring AMR in the local settings in order to measure the impact of interventions aimed to reduce the burden of AMR locally, but also globally. They have called for greater innovation and investment in research and development of new antimicrobial medicines, vaccines, and diagnostic tools (5). The European Union, has started an ambitious multi-sectorial program combining efforts from public resources and the private industries, as they've come to recognize the need for a rapid concerted action to combat this major global public health threat (12).

Like other health professionals, dentists share responsibility in the coordinated global action plan to minimize the emergence and spread of AMR. A multidisciplinary approach is necessary for establishing an effective antimicrobial stewardship in all clinical settings, understanding the relevance of optimizing the indication, selection, dosing, route of administration, and duration of AM therapy (13). It is mandatory that the antimicrobial drugs prescribed to dental patients are well justified and always considering the clinical situation for each individual. Some populations, such as aging populations, are identified as having a higher burden of infection, resulting in subsequent higher antibiotic use or misuse (14). Dentists should improve antimicrobial prescribing practices in an effort to restrain the increasing incidence of AMR and other side effects of AM drug abuse. Three specific actions are proposed for dentists and their teams:

- Stop and think before prescribing AB drugs: will this drug really help the patient's condition? Is the diagnosis of the patient's condition clear? Could an operative intervention (such as abscess drainage, endodontic access, periodontal curettage, restorative treatment, etc.) be conducted instead of prescribing ABs?
- Keep up-to-date: use updated standardized guidelines to prescribe any drug, specially ABs. Dental associations, universities and continuous education providers should offer these guidelines and strengthen actions to ensure adequate training for all dental students and professionals in the diagnosis of the cause of, and treatment planning for, acute dental pain.
- Educate the dental patient: establishing good communication with the patient is needed in order to better explain the importance of following the dentist's instructions when taking ABs. Also, patients must be aware of treatment options if they are in dental pain and that taking ABs is not always ideal. Self-prescribing and drug sharing are practices that should be discouraged among patients.

## REFERENCES

1. Woolhouse M., Waugh C., Perry M.R., Nair H. Global disease burden due to antibiotic resistance – state of the evidence. *J Glob Health*. 2016; 6 (1): 010306.
2. Centers for Disease Control and Prevention (CDC). Outpatient antibiotic prescriptions - United States, 2013. Available via the internet: [http://www.cdc.gov/getsmart/community/pdfs/annual-reports/summary\\_2013.pdf](http://www.cdc.gov/getsmart/community/pdfs/annual-reports/summary_2013.pdf)
3. Centers for Disease Control and Prevention (CDC). Office-related antibiotic prescribing for persons aged  $\leq 14$  years --- United States, 1993—1994 to 2007—2008. *MMWR Morb Mortal Wkly Rep*. 2011; 60 (34): 1153-6.
4. Department of Health. Annual Report of the Chief Medical Officer, Volume Two, 2011. Infections and the rise of antimicrobial resistance. London: DH; 2013.
5. World Health Organization (WHO). Antimicrobial resistance fact sheet. Updated September 2016. Available via the internet: <http://www.who.int/mediacentre/factsheets/fs194/en>
6. Haas D.A., Epstein J.B., Eggert F.M. Antimicrobial resistance: dentistry's role. *J Can Dent Assoc*. 1998; 64 (7): 496-502.
7. Oberoi S.S., Dhingra C., Sharma G., Sardana D. Antibiotics in dental practice: how justified are we. *Internat. Dental J*. 2015; 65: 4-10.
8. Farbod F., Kanaan H., Farbod J. Infective endocarditis and antibiotic prophylaxis prior to dental/oral procedures: latest revision to the guidelines by the American Heart Association published April 2007. *Int J Oral Maxillofac Surg*. 2009;38: 626 – 631.
9. Palmer N.O., Martin M.V., Peeling R. and Ireland R.S. An analysis of antibiotic prescriptions from general dental practitioners in England. *J Antimicrob Chemother*. 2000; 46: 1033-5.
10. Aminoshariae A., Kulid J.C. Evidence-based recommendations for antibiotic usage to treat

endodontic infections and pain. JADA. 2016; 147 (3):186-191.

11. Bayramov D.F., Neff J.A. Beyond conventional antibiotics – New directions for combination products to combat biofilm. Adv. Drug Deliv. Rev. 2016; <http://dx.doi.org/10.1016/j.addr.2016.07.010>
12. Kostyanev T., Bonten M.J.M., O'Brien O., Steel H. et al. The innovative medicines initiative's new drugs for bad bugs programme: European public – private partnerships for the development of new strategies to tackle antibiotic resistance. J Antimicrob Chemother. 2016; 71:290-295.
13. Özgenç O. Methodology in improving antibiotic implementation policies. World J. Methodol. 2016; 6(2):143-153.
14. Lim C.J., Kong D.C.M., Stuart R.L. Reducing inappropriate antibiotic prescribing in the residential care setting: current perspectives. Clin Interv Aging. 2014; 9: 165-177.

### **Mauricio Montero-Aguilar DDS, MSc<sup>1</sup>**

1. Profesor-Investigador, Facultad de Odontología, Universidad de Costa Rica, Costa Rica.

Correo electrónico: [mauricio.monteroaguilar@ucr.ac.cr](mailto:mauricio.monteroaguilar@ucr.ac.cr)  
Teléfono: (506) 2511-8054



Attribution (BY-NC) - (BY) You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggest the licensor endorses you or your use. (NC) You may not use the material for commercial purposes.