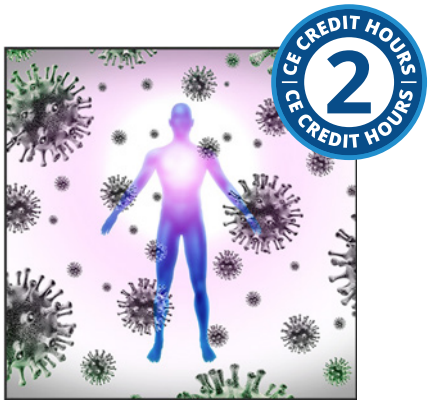
The Dental Professional's Role in the Prevention of Antibiotic Resistance and Adverse Antibiotic Reactions



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Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

Conflict of Interest Disclosure Statement

- The author reports no conflicts of interest associated with this course.

Overview – Antibiotic Resistance

This course will review the evidence regarding antibiotic usage in the dental setting, discuss the mechanisms of action of antibiotics commonly used in the dental setting, and establish the rationale for the ADA guidelines and best practices for their implementation in dental practices.

Course Contents

Introduction

Acute dental pain and swelling associated with pulpal and periapical disease is extremely common. In addition to patient visits in dental offices, there were 2.43 million dental-related visits to emergency departments (ED) in the United States (U.S.) in 2014. The most common oral-health related reasons for these visits were dental pain and intraoral swelling.[16,34] Dentists and physicians often prescribe antibiotics in response to these symptoms and dentists were the third highest prescribing group for antibiotics in the U.S.[2] It is estimated in reports from 2017 to 2019, between 30-85% of these prescriptions were suboptimal or not indicated.[3] Furthermore, patients' use of antibiotics is often not ideal. Both inappropriate prescribing patterns and failure to thoroughly advise patients on the importance of using antibiotics as directed have led to an increase in the number of multi-drug resistant bacteria. According to the U.S. Centers for Disease Control and Prevention (CDC), multi-drug resistant bacteria infect more than 2.8 million Americans each year and kill at least 35,000.[80,81] To address these concerns, the American Dental Association (ADA) recently published evidence-based clinical practice guidelines for antibiotic use in the urgent management of pulpal- and periapical-related dental pain and intraoral swelling.[8] This course will review the evidence regarding antibiotic usage in the dental setting, discuss the mechanisms of action of antibiotics commonly used in the dental setting, and establish the rationale for the ADA guidelines and best practices for their implementation in dental practices.

Penicillin, the first commercially available antibiotic, was discovered in 1928 by Alexander Fleming.[8] While the introduction of antibiotics revolutionized healthcare, their overuse has produced serious adverse health outcomes including adverse drug reactions, disruption of commensal flora resulting in opportunistic secondary infections and antibiotic resistance.[9-13] As the use of antibiotics increased, microorganisms developed the ability to evade the mechanisms of action of the antibiotics and/or antimicrobial agents used to combat them.[13] The prevalence of this antimicrobial resistance has increased with the increase in antibiotic use and the genetic material coding for such resistance has been transferred amongst bacteria in the environment. This allows those microorganisms to preferentially flourish despite antibiotic therapy. Infections caused by antibiotic-

resistant organisms often require use of costly and more toxic alternative therapies. In 2019 the Centers for Disease Control and Prevention (CDC) published an updated report categorizing the current antibiotic resistance threats (Figure1).[14]

Currently, the main causes of antibiotic resistance include inappropriate prescribing, inadequate compliance by patients who receive antibiotic prescriptions, overuse of antibiotics in livestock farming, and environmental antimicrobial use. The CDC recommends that healthcare providers follow published clinical guidelines regarding antibiotic prescription and stewardship, perform appropriate diagnostic tests to guide antibiotic therapy, utilize anti-infective protections, and inform patients of the importance of proper antibiotic use and disposal.[15] Given these concerns, it is critical that dental healthcare providers understand the risks of antibiotic resistance and the steps that can be applied to improve patient outcomes and decrease risks for the community as a whole.

Learning Objectives

Upon completion of this course, the dental professional should be able to:

- Understand the current evidence-based consensus recommendations about prescribing patterns for urgent pulpal and periapical-related dental pain and intraoral swelling.
- Assess the comparative effectiveness of different antibiotic drugs and prescribing directions in common clinical scenarios of acute dental pain and intraoral swelling.
- Review current dental and medical antibiotic prescribing patterns in the U.S. and worldwide.
- Assess emerging patterns of multi-drug resistance in bacteria and their effect on the healthcare system as a whole.
- Evaluate patients' risk factors and treatment needs based upon individualized patient needs and presentations.
- Enable dental professionals to best counsel their patients on appropriate antibiotic use and the rationale for their prescribing recommendations.

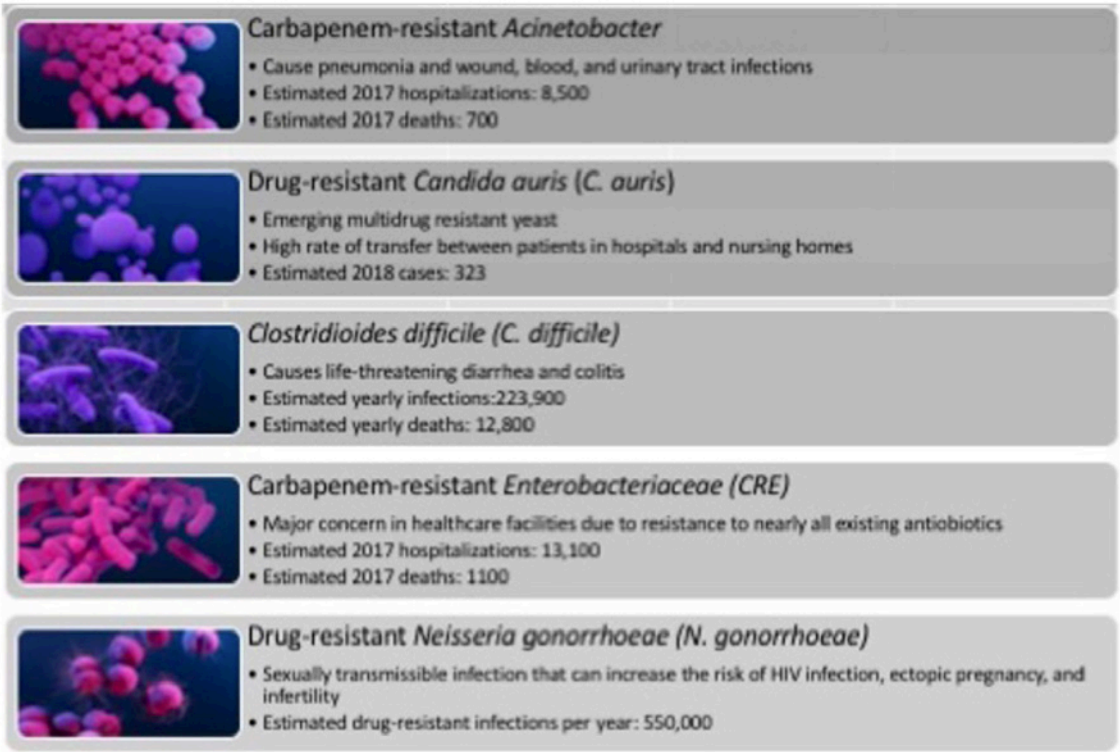

Figure 1. Bacteria and Fungi Listed in the 2019 AR Urgent Threats Report.[14]

- Participate actively in an interdisciplinary team of health care providers in educating patients and colleagues about changes to prescribing patterns that may decrease exposure and reduce societal risk for multi-drug resistant bacteria.

Inappropriate Antibiotic Prescribing Patterns in Dental and Emergency Settings: Individual and Overall Impact

Dentists encounter many intraoral conditions that may be caused by bacteria where antibiotic prescriptions may be warranted and beneficial. Bacteria associated with caries can cause acute inflammation of pulpal tissue including symptomatic irreversible pulpitis, which may progress to pulpal necrosis with or without symptomatic apical periodontitis.[16] Dentists may also perform procedures that can introduce oral bacteria into local or systemic spaces and/or foreign bodies/substances into the oral environment. The bacterial basis of a multitude of oral conditions result in dentists prescribing antibiotics either in response to acute dental pain and/or conditions or prophylactically to prevent infections after dental procedures. Dentists overall write the third highest number of antibiotic prescriptions in outpatient healthcare settings.[2] It is estimated, however, that between 30-85% of dental antibiotic prescriptions are "suboptimal or not indicated.[3-5]

Physician/Dentist Prescribing Patterns for Antibiotics

The United States (U.S.) CDC states that in 2019, healthcare providers prescribed 251.1 million antibiotic prescriptions—equivalent to 765 antibiotic prescriptions per 1000 persons.[17] It is estimated that at least 28% of all outpatient antibiotic use is unnecessary and up to 85% is inappropriate, including unnecessary prescriptions and inappropriate antibiotic course selection.[18-20] Dentists prescribe approximately 13% of all antibiotic prescriptions and represent the third largest group of prescribers behind family medicine and internal medicine physicians.[2] While the data are incomplete, a survey of dentists' prescribing patterns found that 70% of dentists reported patients' receiving inappropriate prescription of antibiotic prophylaxis prior to dental procedures and adherence to antibiotic prescribing guidelines by dental practitioners has been reported to be both variable and suboptimal.[22] Among dentists, the most common antibiotics prescribed were amoxicillin, clindamycin, penicillin, azithromycin, and cephalexin.[2] Overall, a high level of variability was reported in prescription rates between dental specialties, with Oral and Maxillofacial Pathology, Oral and Maxillofacial Surgery, and Oral and Maxillofacial Radiology prescribing on average over three times the number of antibiotic courses per practitioner compared to rates for dentists overall with Orthodontists having the lowest antibiotic prescription rates.[2] Additionally, it was found that most antibiotic prescription courses were prescribed for 7-10 days.[2]

Overall Rates of Multi-drug Resistance in the U.S. and Worldwide

The World Health Organization (WHO) monitors antibiotic resistance worldwide using the Global Antimicrobial Resistance Surveillance System (GlASS). The current WHO assessment is that antibiotic and antimicrobial resistance is present in every country worldwide with varying rates of prevalence that vary in different geographic locations.[23] However, with the globalization of trade and travel, antibiotic resistance can commonly cross borders. The WHO estimates that there were 480,000 new cases of multidrug-resistant tuberculosis in 2014, a form of tuberculosis that is resistant to the 2 most powerful anti-TB drugs.[23] Globally, only half of MDR-TB patients were successfully treated.[23] Additionally, it is estimated 7% and 20% of people starting antiretroviral therapy (ART) for HIV treatment have drug-resistant HIV in developing and developed countries, respectively.[23] The second and third-line medication regimens required in these cases are 3-18 times more costly, respectively, than first line drugs.[23]

Each year in the U.S. at least 2.8 million people are infected with antibiotic resistant bacteria and over 35,000 people die as a result.[24] Antibiotic resistance has been demonstrated shortly after antibiotic release in most cases. For example, after Penicillin's discovery in 1928, an isolate of E. coli was identified that demonstrated resistance to the antibiotic in

1940.[25] In response to this growing problem, a U.S. National Action Plan was published in 2015 and a 5-year plan was developed.[26] As a part of the National Action Plan, surveillance efforts to track the emergence of resistant bacteria and development of collaborations with academic and healthcare partners have been prioritized to alter prescribing practices and decrease rates of development of antibiotic resistance.[27]

Impact of Multi-drug Resistant Bacteria on Patients and Practitioners

The podcast "America Dissected," Dr. Abdul El-Sayed, former Executive Director of the Detroit Health Department and Assistant Professor of Epidemiology at Columbia University, discusses the personal impact of antibiotic resistance.[28] The episode, entitled, "Superbugging Out," interviews a patient, Addie Hoates from Tucson, Arizona, who was infected with methicillin-resistant Staphylococcus aureus (MRSA) and developed sepsis and disseminated intravascular coagulation (DIC). An avid softball player and a healthy 11-year-old, she developed symptoms that quickly progressed to a life-threatening illness and required her to be in the intensive care unit (ICU) for a prolonged period of time. During her time in the ICU she developed multiple subsequent nosocomial infections with antibiotic resistant bacteria, each of which required treatment with a series of increasingly-powerful second-, third-, and fourth-line antibiotics.[28] She stayed in the ICU for 5 months and ultimately required a lung transplant after pneumonia caused by Enterobacter aerogenes. Prior to the lung transplant, she required treatment with Polymyxin E (Colistin), a drug of last resort for multidrug-resistant Gram negative infections.[28] The side effects of this antibiotic therapy left Addie with severe immune deficiency and resulted in a stroke and vision loss, severe weight loss, permanent paresthesia, and motor damage.[28] While such outcomes may be uncommon, the economic, emotional, and quality of life toll that these infections took

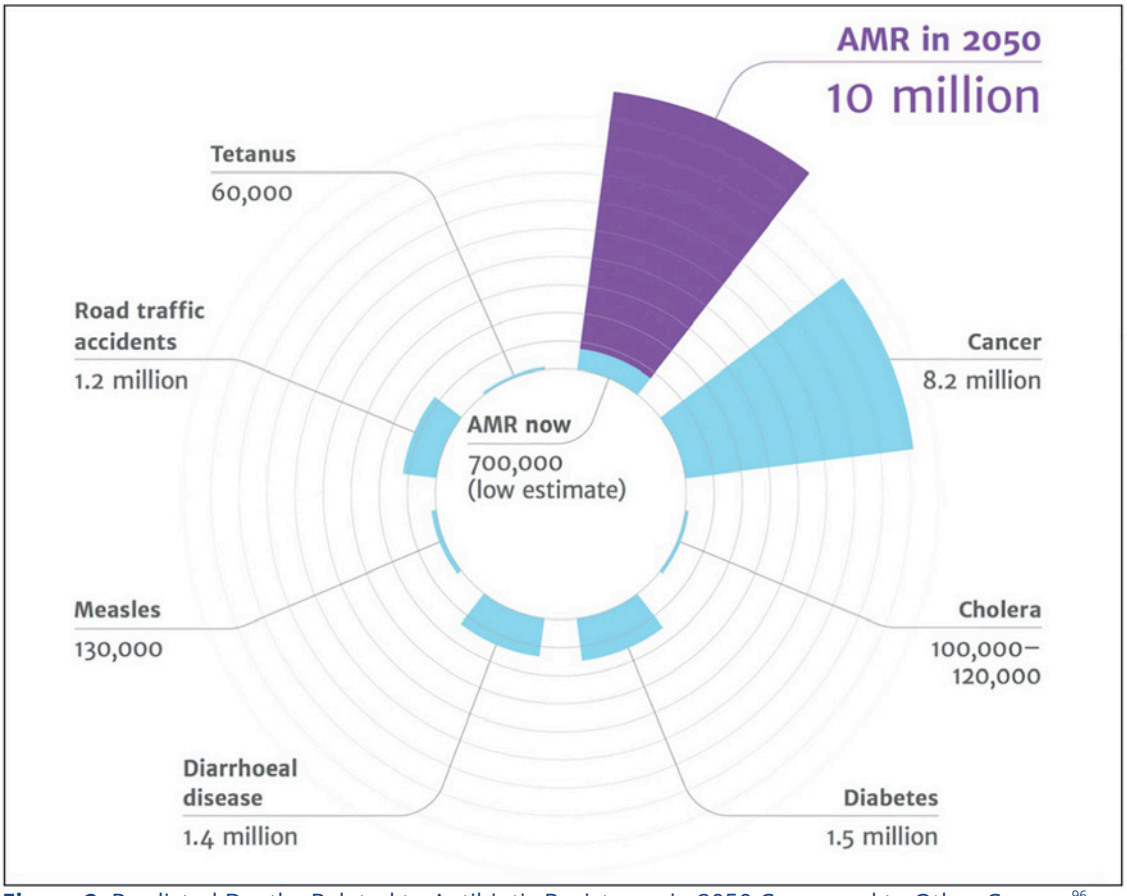

Figure 2. Predicted Deaths Related to Antibiotic Resistance in 2050 Compared to Other Causes.[96]

on Addie and her family is devastating and highlights the high stakes of emerging antibiotic resistance.

In a U.S. surveillance report of hospital-associated blood borne infections, the incidence of MRSA being present increased from 22-57% between 1995 and 2001.[29] In response to these statistics, physicians and hospitals instituted changes to infection control processes and prescribing practices. Between 2005 and 2017, the U.S. Department of Veteran's Affairs medical centers experienced a 43% decline in all S. aureus infections and a 55% decrease in MRSA infections.[30] This report is encouraging as it demonstrates that alterations in workplace infection control and prescribing patterns can positively impact infection rates. This is particularly important given recent data that suggest that the types of antibiotic resistant bacteria that were once significantly more common in hospital associated infections are increasing in proportion of community associated infections.[31,32]

Review of the 2019 ADA Clinical Practice Guidelines for Antibiotic Use

In response to the high rates of suboptimal prescribing patterns and inadequate patient adherence, an expert panel convened by the ADA Council on Scientific Affairs and the Center for Evidence-Based Dentistry conducted a systematic review and formulated clinical recommendations for the urgent management of symptomatic irreversible pulpitis (SIP) with or without symptomatic apical periodontitis (SAP), apical periodontitis, pulp necrosis and symptomatic apical periodontitis, (PN-SAP) or pulpal necrosis and localized acute apical abscess (PN-LAAA) using antibiotics, either alone or as adjuncts to definitive conservative dental treatment in immunocompetent adults.[7] Dental pain and intraoral swelling are commonly cited as reasons for seeking dental care with a dentist or in an emergency department (ED) with a physician.[1,33] These signs and symptoms are associated with pulpal and periapical conditions usually resulting from untreated dental caries. Patients often initially report sharp pain in response to tactile or temperature stimuli, which can progress to spontaneous and/or continuous pain. If this condition is left untreated, it can also progress to systemic infection.[16,34] Given the frequency of this presentation in dental and emergency clinics and the potential severity for undertreatment, as well as the global public health and fiscal impact of inappropriate treatment, development of evidence-based clinical practice guidelines for antibiotic use is timely for applications in dental practice.

Best Practices for Antibiotic Prescribing for the Acute Management of Pulpal and Periapical Related Dental Pain

As part of the development of the ADA's clinical practice guidelines, the expert panel reviewed four questions:[7]

Question 1: For immunocompetent adults with SIP with or without SAP, should we recommend the use of oral systemic antibiotics compared with the nonuse of oral systemic antibiotics to improve health outcomes?

Based upon current evidence, the expert panel recommends that dentists do not prescribe oral systemic antibiotics for immunocompetent adults with SIP with or without SAP. It is recommended that clinicians refer patients for definitive conservative dental treatment (DCDT) and provide interim monitoring. The ADA currently recommends that practitioners do not use antibiotics in immunocompetent adults with SIP with or without SAP. It found that the use of antibiotics may result in little to no difference in beneficial outcomes but were likely to result in a potentially large increase in harmful outcomes, which warrants a strong recommendation against their use.

Question 2: For immunocompetent adults with PN-SAP or PN-LAAA, should we recommend the use of oral systemic antibiotics compared with the nonuse of oral systemic antibiotics to improve health outcomes?

For patients with PN-SAP based upon current evidence, the expert panel recommends that dentists do not prescribe oral systemic antibiotics. It is recommended that clinicians refer patients for definitive conservative dental treatment (DCDT) and provide interim

monitoring. If DCDT is not feasible, it is recommended that a delayed prescription for oral amoxicillin (500 mg, three times daily for 3-7 days) or oral penicillin V potassium (500mg, four times daily for 3-7 days) be provided. In immunocompetent adults with PN-SAP or PN-LAAA, the ADA clinical guidelines suggest use of a delayed prescription if patients' symptoms worsen or DCDT has yet to be initiated after 24 to 48 hours. In addition, clinicians should provide urgent referral so that DCDT is not unduly delayed.

For patients with PN-LAAA based upon current evidence, the expert panel recommends that dentists prescribe oral systemic antibiotics if immediate DCDT is not available. While the beneficial effects of oral systemic antibiotics are low, the risks of progression to systemic involvement with PN-LAAA was deemed great enough to warrant prescriptions without immediate access to DCDT. The prescription regimen recommended by the expert panel stated that oral amoxicillin (500 mg, three times daily for 3-7 days) or oral penicillin V potassium (500mg, four times daily for 3-7 days) be provided.

Question 3: For immunocompetent adults with PN-SAP and PN-LAAA, should we recommend the use of oral systemic antibiotics compared with the nonuse of oral systemic antibiotics as adjuncts to DCDT to improve health outcomes?

The expert panel recommends that dentists do not prescribe systemic antibiotics for immunocompetent patients with PN-SAP or PN-LAAA as an adjunct to DCDT. Based upon findings that the use of antibiotics for immunocompetent adults with PN-SAP and PN-LAAA as adjunctive therapy in conjunction with DCDT may result in little to no difference in beneficial outcomes, but were likely to result in a potentially large increase in harmful outcomes, the ADA clinical guidelines issued a strong recommendation against antibiotic use.

Question 4: For immunocompetent adults with SIP with or without SAP, should we recommend the use of oral systemic antibiotics compared with the nonuse of oral systemic antibiotics as adjuncts to DCDT to improve health outcomes?

Based upon current evidence, the expert panel recommends that dentists do not prescribe oral systemic antibiotics for immunocompetent patients with SIP with or without SAP as an adjunct to DCDT. In patients with SIP with or without SAP, the use of adjunctive antibiotics with DCDT were found to generally result in little to no difference in beneficial outcomes, but were likely to result in a potentially large increase in harm outcomes. The results of this literature review suggested that a strong recommendation against their use is pertinent in these cases. Additionally, physiologically, patients with SIP with or without SAP the inflamed pulpal tissue is not associated with infection and/or necrosis, which is further biologic rationale to avoid using antibiotics for such patients.

Recommendations for Patients with Pulp Necrosis and Acute Apical Abscess (PN-AAA) with Systemic Involvement

Once systemic symptoms have developed, the clear advantage of the use of oral systemic antibiotics in the balance of benefits/harms is well-established. The expert panel suggests that dentists prescribe oral amoxicillin (500mg, three times daily for 3-7 days) or oral penicillin V potassium (500mg, four times daily for 3-7 days) for patients with PN-AAA. In addition, urgent referral for DCDT to avoid delay to definitive treatment. If conditions worsen or if the clinician is concerned about deeper space infection or an immediate threat to life, the patient should be referred for an urgent evaluation. Once DCDT is prescribed, adjunctive use of oral systemic antibiotics should also be used.

Summary of Rationale for the Type of Antibiotic and Regimen for Care

A review of the prescribing practices of dentists reveals considerable heterogeneity in prescribing practices, antibiotic regimen choices, and rationale for prescribing. Given the continued concerns with respect to antibiotic resistance, development of evidence-based clinical guidelines and adherence by dental practitioners to biologically indicated antibiotic regimens is critical to public health.[35] Studies have suggested that continuous professional development programs on time

management could address the overuse of antibiotics in dentistry by eliminating common barriers in oral health practices.[36] Specifically, participating general oral health care practitioners thought that the overuse of antibiotics was not related to dentists' level of knowledge or basic skills but, instead, was a consequence of barriers that arise in daily practice such as a lack of time, inability to inject local anesthetic because of infection, and difficulty accessing a tooth because of swelling, among others.[36] In accordance with antimicrobial stewardship initiatives in the U.S. and globally, oral health care professionals must work to educate themselves and the general public about the significance of antibiotic resistance and the importance of restricting the use of antibiotics in the oral health setting. Utilizing the ADA Clinical Practice Guidelines to limit antibiotic prescriptions in immunocompetent adults with pulpitis and pulpal necrosis should be evaluated carefully to determine ideal clinical scenarios.[7,35,37] In summary, the current recommendations suggest that shorter courses of antibiotics are equally as effective as longer courses and antibiotic courses longer than 5 days should be considered the exception rather than the rule to reduce antibiotic resistance.[7]

Evidence-based Comparisons of Antibiotics in Common Clinical Dilemmas While Treating Acute Dental Pain and/or Intraoral Swelling

Selection of a proper antibiotic for individual clinical situations is critical to ensure adequate treatment of existing infections. While approximately 10% of the population self-reports a penicillin allergy, it is estimated that less than 1% of the population demonstrates a true penicillin allergy.[39,40] However, in patients with a true penicillin allergy (e.g., history of anaphylaxis, angioedema, or hives), it is suggested that oral azithromycin be prescribed in cases where antibiotics are warranted and cephalosporin drugs should be avoided due to cross-reactivity.[7] Recent reports have removed oral clindamycin as a recommendation for penicillin-allergic patients due to the incidence of post-operative adverse reactions, including Clostridioides difficile infection (CDI).[41-43] It is also recommended that if initial therapy with first-line antibiotics is not effective, clinicians should consider adding complementary

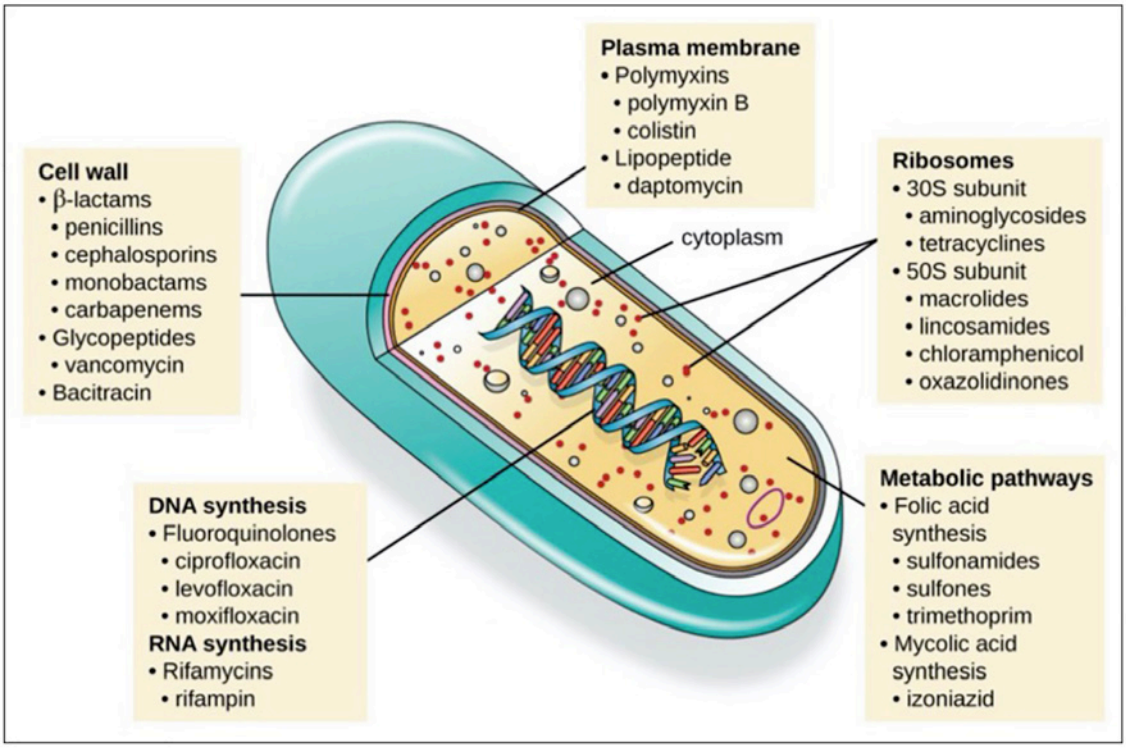

Figure 3. Common Antibiotic Agents and their Targets.[97]

treatment with metronidazole or discontinuing first-line antibiotic therapy and prescribing oral amoxicillin with clavulanate to enhance the efficacy against gram negative anaerobic bacteria.[7]

Duration of antibiotic course should also be carefully considered and personalized to patient symptoms and response. There is little to no evidence suggesting that in the case of symptomatic oral infections, a shortened course of antibiotics contributes to antimicrobial resistance.[42,43] As such, it is suggested that dental healthcare providers reevaluate patients who present with pulpal and periapical-related dental pain and/or intraoral swelling and who receive antibiotic therapy after three days to assess the current level of systemic signs and symptoms. If symptoms have begun to resolve, the ADA expert panel suggests that patients are instructed to discontinue antibiotics 24 hours after complete resolution of symptoms.[7]

Review of the Role of Adjunctive Antibiotics to Aid Dental Procedures

A recent publication has highlighted significant inconsistency in antibiotic prescribing patterns among the dental community.[44] These survey data demonstrated that adjunctive prescription of antibiotics was more common by American Academy of Periodontology (AAP) members than members of the American Dental Association.[44] Given the microbial etiology of periodontitis, it has been suggested that the adjunctive use of systemic antibiotics could be beneficial for clinical outcomes.[45-47] It should be noted that subsets of the population, such as those with immunocompromise or systemic illness, may demonstrate a larger clinical benefit and antibiotic prescription may be best served focused on such individuals.[48-50] Further research to identify patients who would best benefit from adjunctive antibiotic therapy with dental treatment could allow for a meaningful improvement in antibiotic stewardship.

Review of Current Guidelines for Prophylactic Antibiotic Prescriptions

Antibiotic prophylaxis prior to dental procedures is common and prescribing rates among dentists has remained steady, despite a decrease in overall antibiotic prescriptions nationally.[53] Guidelines regarding antibiotic prophylaxis for dental procedures in patients with certain medical conditions has evolved over time. Previous guidelines have recommended that patients with certain systemic conditions (i.e., recent prosthetic joint replacement, cardiac valvular incompetency) receive antibiotics prior to dental care. In these cases, these patients were considered at an increased risk for bacteremia during dental procedures leading to distant site infections (e.g., infective endocarditis and prosthetic joint infections). Updates to previous guidelines have significantly narrowed the scope of patients who are recommended to receive antibiotic prophylaxis for routine dental care.[4] These revisions were meant to reduce adverse events associated with antibiotic use, to reflect the low levels of evidence of the effectiveness of antibiotic prophylaxis to reduce distant infections, and a lack of demonstrable association between endocarditis, prosthetic joint infection and dental treatment.[54-57] Since patients demonstrate transient bacteremia after activities of daily living, including mastication and oral hygiene measures, that are in proportion to their levels of gingival inflammation and plaque deposits, dental treatment is unlikely to add significant additional risk for such patients.[58-60]

Furthermore, it has been common practice to utilize antibiotic prophylaxis prior to invasive surgical dental procedures, such as tooth extraction and endosseous dental implant placement.[t] The rationale for such treatment has been the reduction of post-operative infections and adverse healing events as well as a reduction in the contamination of dental implant surfaces during dental implant placement.[61-65] Recently, however, the appropriateness of this practice has been questioned as the overuse of antibiotics and the untoward adverse reactions and antibiotic resistance have become more of a public health concern.[66] It has also been noted that many surgical patients who may benefit from a single dose of antibiotic pre-procedurally, receive an additional post-procedural prescription that may be unnecessary.[4] The goal of dental practitioners should be to most appropriately dispense antibiotics so that they improve outcomes while also reducing the risk of harm to patients and communities.

Pre-treatment Antibiotic Prophylaxis for Dental Extractions

In healthy adults receiving extraction of non-periodontally involved teeth, the use of amoxicillin and moxifloxacin pre-operatively has been associated with decreased detection of post-extraction bacteremia, while preoperative clindamycin prophylaxis conferred no such benefit.[67] Similarly, post-operative infection rates were reduced in individuals receiving dental extraction therapy who receive antibiotic prophylaxis v. placebo. Infection rates were also associated with procedural length and complex bone removal procedures (alveolplasty, ostectomy, etc.).[68] Other investigations have not shown a benefit of prophylactic antibiotic use in a third molar extraction model.[69,70] Given the low level of conclusive evidence to suggest a benefit for the use of prophylactic antibiotic therapy prior to extractions not associated with infections in healthy patients, the routine use of antibiotics in these cases is not recommended.[64] Careful evaluation of the patient, any underlying clinical conditions, and surgical treatment rendered is necessary to optimize decision-making for antibiotic use and limit promiscuous prescribing practices.

Pre-treatment Antibiotic Prophylaxis for Dental Implant Placement

Systematic reviews and meta-analyses have suggested that a prophylactic loading dose of antibiotic can reduce implant failure rates in healthy adults.[64,65,71,72] It is estimated that for every 24-55 implant patients (mean 33 patients) undergoing dental implant placement who receive antibiotic prophylaxis prior to surgery, one implant failure is prevented.[64,71] Within reviews of antibiotic benefits, the overall benefit is often calculated for the population based upon number needed to treat (NNT). This figure describes the overall number of patients who when treated with antibiotic prophylaxis would experience one less implant failure. The NNT can then be compared to the overall prevalence of adverse events for individual antibiotics to determine the suitability and benefits of individual antibiotic type/dosage for use as pre-treatment antibiotic prophylaxis. Based upon these findings, some authorities have recommended that an antibiotic prophylaxis regimen of 2.0 gm amoxicillin administered 1-hour prior to implant surgery in a healthy, non-allergic patient would be beneficial to provide a clinically significant reduction in implant failure rates.[65,71] For individuals receiving adjunctive therapies with implant placement, including bone and/or soft tissue grafting, clinicians should adjust prescribing patterns to the individualized clinical scenario.

Antibiotic Prophylaxis in Immunocompromised Patients

Individuals with complex medical conditions and disability demonstrate poorer oral health and oral healthcare outcomes.[77-79] Therefore, they may be more likely to require invasive surgical dental procedures, such as tooth extractions and periodontal surgery. Recent investigations have demonstrated that in medically compromised patients in whom their systemic conditions are well controlled, routine dental extractions of non-infected teeth can be performed without antibiotics with low levels of post-operative infections and complications.[80,81] However, in other conditions where risk of infection cannot be mitigated or when the outcomes of infection may convey serious oral and/or systemic health risks to patients, the use of antibiotic prophylaxis prior to dental surgical procedures may be warranted.[82,83] Additionally, in cases where pre-existing infection at tooth sites is present, antibiotic prophylaxis may be advantageous to reduce post-operative complications.[84] Ultimately, the decision to prescribe antibiotic prophylaxis is, in most cases, empirical and it is imperative that dental healthcare providers thoroughly evaluate patient-, site-, and procedure-related risks to determine the overall risk-benefit of antibiotic prophylaxis for individual cases.

Dentist Education and Patient Counseling for Proper Use of Antibiotic Medications and Discussion of Rationale for Alterations in Prescribing Patterns

Both dentists and patients require education to ensure adherence to current guidelines and optimal principles for proper antibiotic stewardship. When dentists and physicians prescribe antibiotics when they are not

indicated, it often reflects personal unfamiliarity with current guidelines and acquiescence to pressure from patients who request antibiotic therapy.[85,86] Other factors that may influence inappropriate prescribing patterns include barriers in the health systems, aversion to the uncertainty of a watch-and-wait approach, diagnostic and prognostic uncertainties, and access-to-care issues.[85-89] Due to these factors influencing prescribing patterns, education of both dentists and patients is necessary. It has been demonstrated that a systematic education and monitoring program for antibiotic prescription stewardship can significantly reduce antibiotic prescription rates in a dental outpatient setting.[3] In one study, the implementation of 1-minute updates, once weekly for 12 weeks was undertaken to influence prescribing patterns for acute dentoalveolar conditions and, in the prescription rate decreased by 72.9% compared to pre-intervention levels.[3] Other programs including dental record audit with feedback, prescription writing guidance, and peer comparison have also been shown to be effective in better aligning prescribing habits with current guidance.[90-92] This evidence demonstrates that education of practitioners using standardized, evidence-based guidelines, such as the ADA's Clinical Practice Guidelines, should be instituted to reduce overprescribing and associated increase in antibacterial drug resistance.

In medical outpatient settings, patient education was also an important component of antibiotic stewardship and resulted in significant reductions in antibiotic prescription rates.[93] The combination of practitioner and patient education may be critical components to overall success in altering dentist prescribing patterns. Effective patient education measures included educational posters in patient waiting areas stating that "antibiotics are not always the answer" and provider-delivered patient counseling. These combined interventions demonstrated improved outcomes that resulted in decreased numbers of antibiotic prescriptions and decreased duration of antibiotic prescriptions, when they were prescribed.[93] Interestingly, certain practitioner characteristics were associated with improved adoption of updated clinical practice guidelines aimed at reducing antibiotic prescriptions. In these cases, practitioners who were specialty trained, female, and younger demonstrated better adherence to updated prescribing guidelines compared to their counterparts who altered prescribing patterns less.[94,95] Targeting these demographics and providing resources with which dental healthcare providers can educate patients may be critical to improving inappropriate antibiotic prescribing patterns throughout dentistry.

Summary

Many dental diseases are caused by bacteria and acute infections can arise from unrecognized dental disease and/or delayed care. Dentists currently rank #3 in U.S. antibiotic prescriptions, and it is estimated that between 30-85% of these prescriptions were suboptimal or not indicated.[3-5] Given the serious implications of antibiotic drug resistance on patients and communities, oral healthcare providers must be part of any solution for altering prescribing patterns in dental settings. It is critical, therefore, that dentists be fully aware of the risks and benefits associated with the prescription of antibacterial agents in the dental setting. The decision to prescribe an antibiotic agent to address pulpal- and periapical-related dental pain should be based on the recently released ADA evidenced-based guidelines and generally restricted to situations in which systemic involvement is present. Adoption of these guidelines in clinical practice should reduce the incidence of antibiotic resistance and other adverse reactions attributable to the dental profession.

Course Test Preview

To receive Continuing Education credit for this course, you must complete the online test. Please go to: *www.dentalcare.com/en-us/ce-courses/ce614/test*

1. Dentists are currently the _____ most frequent prescribers of antibiotics in the U.S.

A. first
B. second
C. third
D. fourth

2. It was estimated that between 2017-2019, up to _____ of antibacterial drug prescriptions were suboptimal or not indicated.

A. 50%
B. 65%
C. 75%
D. 85%

3. According to the U.S. Centers for Disease Control and Prevention, multi-drug resistant bacteria infect approximately _____ people each year.

A. 950,000
B. 1.4 million
C. 2.8 million
D. 5.3 million

4. It is estimated that the main causes of antibiotic resistance include all of the following EXCEPT:

A. inappropriate prescribing
B. inadequate compliance by patients who receive antibiotic prescriptions
C. use of antibiotics in livestock farming and environmentally
D. patient demand

5. All of the following are among the most common antibiotics prescribed by dentists, EXCEPT:

A. Ciprofloxacin
B. Amoxicillin
C. Clindamycin
D. Penicillin

6. There is a high level of variability between dental specialties with regard to prescription rates with _____ having the lowest antibiotic prescription rates.

A. Oral Pathologists
B. Orthodontists
C. Periodontists
D. Endodontists

7. The predicted death rates related to antibiotic resistance is estimated to rise to _____ by the year 2050.

A. 5 million
B. 10 million
C. 15 million
D. 20 million

8. **Workplace measures were effective in reducing *S. aureus* infections and MRSA infections in a VA hospital setting. These measures included strict adherence to infection control and prescribing best practices.**
   A. Both statements are true.
   B. The first statement is true, the second statement is false.
   C. The first statement is false, the second statement is true.
   D. Both statements are false.

9. **According to the 2019 ADA Clinical Practice Guidelines, what prescription (if any) is recommended for immunocompetent adults with symptomatic irreversible pulpitis (SIP) with or without symptomatic apical periodontitis (SAP)?**
   A. Amoxicillin 500mg, three times daily for 3-7 days
   B. Clindamycin 300mg, three times daily for 3-7 days
   C. Azithromycin 250mg, three times daily for 3-7 days
   D. No prescription is recommended.

10. **According to the 2019 ADA Clinical Practice Guidelines, what prescription (if any) is recommended for immunocompetent adults with pulp necrosis and symptomatic apical periodontitis, (PN-SAP)?**
   A. Amoxicillin 500mg, three times daily for 3-7 days
   B. Clindamycin 300mg, three times daily for 3-7 days
   C. Azithromycin 250mg, three times daily for 3-7 days
   D. No systemic antibiotic prescription is recommended.

11. **According to the 2019 ADA Clinical Practice Guidelines, what prescription (if any) is recommended for immunocompetent adults with pulp necrosis and acute apical abscess (PN-AAA) with systemic involvement?**
   A. Amoxicillin 500mg, three times daily for 3-7 days
   B. Clindamycin 300mg, three times daily for 3-7 days
   C. Azithromycin 250mg, three times daily for 3-7 days
   D. No prescription is recommended.

12. **In cases of pulpal and periapical-related dental pain and intraoral swelling where antibiotics are indicated for urgent management, what are the recommended next steps?**
   A. Addition of complementary treatment with metronidazole
   B. Discontinuing first-line antibiotic therapy and prescribing oral amoxicillin with clavulanate
   C. Discontinuing first-line antibiotic therapy and prescribing oral clindamycin
   D. A and B

13. **In cases of pulpal and periapical-related dental pain and intraoral swelling where antibiotics are indicated for urgent management, what are the recommended next steps?**
   A. Re-evaluate after 3 days to assess the current level of systemic signs and symptoms.
   B. Instruct patient to discontinue antibiotics 24 hours after complete resolution of symptoms.
   C. Instruct patient to finish entire course of antibiotics even 24 hours after complete resolution of symptoms.
   D. A and B

14. Patients demonstrate bacteremia after activities of daily living, including mastication and oral hygiene measures, that are in proportion to their levels of gingival inflammation and plaque deposits. In immunocompetent adults without other predisposing conditions, dental treatment may add significant additional risk for such patients.

A. Both statements are true.
B. The first statement is true, the second statement is false.
C. The first statement is false, the second statement is true.
D. Both statements are false.

15. In a third molar extraction model, prophylactic antibiotic therapy prior to extractions not associated with infections in healthy patients, the routine use of antibiotics in these cases _____.

A. is recommended
B. is not recommended
C. is recommended in older patients
D. is recommended in full bony impactions

16. It is estimated that, on average, for every _____ implant patients undergoing dental implant placement who receive antibiotic prophylaxis prior to surgery, one implant failure is prevented.

A. 15
B. 24
C. 33
D. 32

17. What is the current evidence-based recommended antibacterial prophylaxis prior to dental implant therapy to provide a clinically significant reduction in implant failure rates in a healthy, non-antibiotic allergic adult?

A. 1.0g Amoxicillin, 1 hour prior to dental implant procedure
B. 2.0 g of Amoxicillin, 1 hour prior to dental implant procedure
C. 500mg of Azithromycin, 1 hour prior to dental implant procedure
D. No antibiotic prophylaxis is recommended.

18. Practitioner education, including 1-minute updates, once weekly for 12 weeks, have been shown to influence prescribing patterns for acute dentoalveolar conditions and decrease prescription rate decreased by _____ compared to pre-intervention levels.

A. 54%
B. 65%
C. 73%
D. 87%

19. Providing patients information about the risks of antibiotic over-prescription, including educational posters in patient waiting areas stating that "antibiotics are not always the answer" and provider-delivered patient counseling are effective in reducing patient requests for antibiotic prescriptions.

A. True
B. False

20. Medical practitioners who adopted antibiotic stewardship interventions are more likely to be all of the following characteristics EXCEPT:

A. female
B. younger
C. more likely to practice in hospital settings
D. specialty trained

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Additional Resources

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