

Antibiotic stewardship in dentistry – review of evidence-based clinical recommendations on appropriate antibiotic prescribing in dental practice

Part 2: Clinical guidelines and recommendations for antibiotic prescribing in dental practice

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Executive summary

Rational

- Antibiotic stewardship efforts in dental practice are an opportunity to improve antibiotic prescribing practices and to curb antibiotic resistance.

Key Points

- Antibiotic prophylaxis is used routinely in high-risk groups of patients to reduce bacteraemia and the risk of developing infective endocarditis.
- Endocarditis prophylaxis is required in all dental procedures that involve manipulation of gingival tissue, the periapical region of teeth, or perforation of the oral mucosa
- In general, for patients with prosthetic joint implants, prophylactic antibiotics are NOT recommended prior to dental procedures to prevent prosthetic joint infection. In cases where antibiotics are deemed necessary, it is appropriate that the orthopaedic surgeon recommend the antibiotic regimen and when reasonable write the prescription.
- A single dose 2gm of amoxicillin given orally 1 hour preoperatively is effective and efficacious and significantly reduce failures of dental implants placed in ordinary conditions.
- There is no conclusive evidence to suggest the routine use of antibiotic as prophylaxis for third molar extraction surgery in healthy young adults.
- The primary care for odontogenic infections is by local intervention through drainage and or removal of the cause of infection by means of endodontic or surgical therapy.
- In patients with clearly established oral and dental infections, antibiotic therapy should be reserved for those patients who have regional or systemic body manifestations.
- Patients with infection spreading to the eye (orbital cellulitis) or throat (Ludwig's angina) or presenting with life threatening symptoms should be referred to an Oral Maxillo-

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Facial Surgeon for immediate intravenous antibiotics and appropriate surgical intervention.

- Prescribe narrow-spectrum antibiotics for the shortest duration possible until the clinical cure of the patient is obtained. This will also minimize disturbance of the normal gut flora.
- Amoxicillin is the preferred first line antibiotic because it is more effective against various Gram-negative anaerobes and has a lower incidence of gastro-intestinal adverse effects.
- A review point two to three days after drainage of an acute dental infection is a key element of the guidance. Those patients whose infections have resolved, and body temperature returned to normal, should be instructed to stop taking the antibiotics.
- Antibiotics may be used in conjunction with, but not as an alternative to other appropriate interventions, such as endodontic therapy, periodontal debridement, or surgical extraction of a tooth.
- Dentists should curb the use of Clindamycin due to high frequency of side effects, and specifically because it increases the risk of *Clostridiosis* (formerly *Clostridium difficile* pseudomembranous colitis 4 x
- Any antibiotic prescribing recommendations should be integrated with the practitioner's professional judgement in consultation with the patients' physician, and the patient's needs and preferences.
- The benefits of giving an antibiotic should always outweigh the risks of antibiotic-related allergy, toxicity, super infection and the development of drug-resistant strains.

Practical implications

- Local intervention (endodontic therapy, periodontal debridement, extraction and surgical drainage) are always first line primary care, with antibiotics serving as adjunctive therapy in indicated cases.
- First line antibiotics used in dentistry are penicillin's, amoxicillin, clindamycin and azithromycin. The use of Clindamycin should be reviewed and used with caution.
- Topical or local administration of 10% Doxycycline as an adjunctive to deep scaling and root planning (SRP) for treatment of periodontitis, can reduce or avoid the need for systemic therapy and subsequent gut microbiome exposure.
- Amoxicillin is the most commonly recommended antibiotic for children, with metronidazole or azithromycin being the alternative antibiotic in penicillin-sensitive patients.
- Safety and product cost should always be taken in consideration when selecting an appropriate antibiotic.

Introduction

Avoiding unnecessarily and inappropriate prescribing of antibiotics is the key to reducing the number of adverse drug reactions and curbing antibiotic resistance.

Various international (World Health Organization), Governmental Organizations (Centers for Disease Control and Health Prevention, USA, Department of Health and Human Services, USA, National Health Service, UK, British National Formulary, UK), Health Related Associations (American Heart Association, American Dental Association, Faculty of General Dental Practitioners, UK), Research Organizations (Cochrane Database) and Independent research collaborative efforts, publish and regularly update evidence-based clinical guidelines, recommendations and systematic reviews and meta-analysis for prescribing antibiotics. These clinical recommendations and guidelines are a key element of antibiotic stewardship and therefore fundamental for appropriate antibiotics prescribing in the dental setting.

- **Infective endocarditis prophylaxis recommendations¹**
- **Indications**

Antibiotic prophylaxis is used routinely in high-risk groups of patients to reduce bacteraemia, and the risk of developing infective endocarditis.² Patients at increased risk of developing infective carditis (IE) are:

- Prosthetic cardiac valves, including trans catheter-implanted prostheses and homografts
- Prosthetic material used for cardiac valve repair, such as annuloplasty rings and cords
- Previous IE
- Unrepaired cyanotic congenital heart disease or repaired congenital heart disease, with residual shunts or valvular regurgitation at the site of or adjacent to the site of a prosthetic patch or prosthetic device.
- Cardiac transplant with valve regurgitation due to structurally abnormal valve.

Endocarditis prophylaxis is required in all dental procedures that involve manipulation of gingival tissue, the periapical region of teeth, or perforation of the oral mucosa, including prophylactic cleaning, dental extractions, periodontal procedures, endodontic instrumentation, placement of orthodontic bands, placement of implants or any oral surgical procedure.

- **Antibiotic regimen**

The AHA guidelines state that an antibiotic for prophylaxis should be administered in a single dose 1 hour before the procedure^{3,4} (Table 3)

Table 3: Prophylactic regimen to prevent infective endocarditis ¹

Situation	Regimen: Single dose 30-60 minutes before procedure		
	Antibiotic	Adults	Children
Oral	Amoxicillin	2g	50mg/kg
Unable to take oral medication	Ampicillin OR	2g IM or IV	50mg/kg IM or IV
	Cefazolin or Ceftriaxone	1g IM or IV	50mg IM or IV
Allergic to penicillin or ampicillin – oral	Cephalexin	2g	50mg/kg
	OR Clindamycin	600mg	20mg/kg
	OR Azithromycin or clarithromycin	500mg	15mg/kg
Allergic to penicillin or ampicillin and unable to take oral medication	Cefazolin or Ceftriaxone	1g IM or IV	50mg/kg IM or IV
	OR Clindamycin	600mg IM or IV	20mg/kg IM or IV

However, in the event that the dosage of antibiotic is inadvertently not administered before the procedure, it may be administered up to two hours after the procedure.

For patients already receiving an antibiotic that is also recommended for IE prophylaxis, then a drug should be selected from a different class; for example, a patient already taking oral penicillin for other purposes may likely have in their oral cavity *Streptococcus viridans* that are relatively resistant to beta-lactams. In these situations, clindamycin, azithromycin or clarithromycin would be recommended for antibiotic prophylaxis.^{3,4} Alternatively if possible, treatment should be delayed until at least 10 days after completion of the antibiotic to allow reestablishment of usual oral flora.

A recent systematic review ² made the following recommendations based of the available evidence-based literature:

Antibiotic prophylaxis should be limited to patients at high risk of developing infective endocarditis, according to the recommendations and protocol of the American Heart Association as summarized above.

- Oral amoxicillin is still the antibiotic of choice to reduce bacteraemia.
- IV amoxicillin-clavulanic acid could be used for patients at high risk of developing IE who require invasive dental procedures and are treated under general anaesthesia.
- In patients with penicillin allergies, oral azithromycin showed higher efficacy for the reduction of bacteraemia.
- The use of clindamycin should be reviewed.

• *Prophylactic antibiotics prior to dental procedures in patients with prosthetic joints*

Based on the updated systematic review and the 2015 ADA clinical practice guidelines state: "In general for patients with prosthetic joint implants, prophylactic antibiotics are NOT recommended prior to dental procedures to prevent prosthetic joint infection"⁵

However, a commentary published in February 2017 issue of JADA written by American Dental Association appointed experts, calls for appropriate decision-making criteria and to encourage dentists to continue using the 2015 guidelines.⁶ It is recommended that dentists, patients and orthopedic surgeons should discuss and weigh the potential risks and benefits before making a decision. It is also recommended that the dentists consult the appropriate use criteria as needed and respect the patients' specific needs and preferences when considering antibiotic prophylaxis before dental treatment.⁵

In cases where antibiotics are deemed necessary, it is most appropriate that the orthopaedic surgeon recommend the appropriate antibiotic regimen and when reasonable write the prescription.⁷

• *Prophylaxis for preventing implant failures*

The use of antibiotics in implant dentistry is controversial. The evidence-based data suggests that a single dose 2gm of amoxicillin given orally 1 hour preoperatively is effective and efficacious and significantly reduce failures of dental

implants placed in ordinary conditions.^{8,9,10} It is still unknown whether postoperative antibiotics are beneficial, and which is the most effective antibiotic.

- **Prophylaxis for preventing infection in third molar extractions**

There is evidence that prophylactic antibiotics reduce the risk of infection, dry socket and pain following third molar extractions and result in mild and transient adverse effects. It is unclear whether the evidence is generalizable to individuals with concomitant illnesses or immune-deficiencies, or those undergoing the extraction of teeth due to severe caries or periodontitis.¹¹ In a recent systematic review and meta-analysis it was concluded that there is little conclusive evidence to suggest the routine use of antibiotic as prophylaxis for third molar extraction surgery in healthy young adults.¹²

- **Oral and Dento-Facial infections**

As a general guideline antibiotic therapy should be reserved for those patients with clearly established infections who have regional or systemic body manifestations e.g., presence of pronounced oedema (cellulitis), limited mouth opening (trismus), increased heart rate (tachycardia), difficulty swallowing (dysphagia), general malaise, fever and should be used as an aid to fight infection.¹³ Such patients should be treated surgically as early as possible. Adjunctive treatment should include endodontic therapy, or extraction of the causative tooth and surgical drainage of any areas of pus accumulation.

- **Life threatening sepsis:**

Patients with infection spreading to the eye (orbital cellulitis), or throat (Ludwig's angina), or presenting with symptoms indicating a life threatening sepsis such as an altered mental state, decreasing respiration rate, oxygen saturation below 92%, and increased heart rate >130bpm, systolic BP <90mmHg, should be referred to an Oral Maxillo-Facial Surgeon for immediate treatment with intravenous antibiotics and appropriate surgical intervention.¹⁴

- **Abscess:** acute dentoalveolar cellulitis and abscess usually require antibiotic therapy. Chronic dental abscesses need no antibiotic therapy.

- **Pericoronitis:**

The bacteria responsible for pericoronitis are all Gram-negative anaerobic bacteria. Debridement by irrigation

and possible extraction of the offending tooth usually are sufficient without requirement for antibiotic therapy.¹⁵ However if the patient presents with temperature elevation and trismus preventing adequate surgical therapy, then the use of antibiotics may be necessary for several days before surgery can be performed. Penicillin is the drug of choice.¹⁵

- **Osteomyelitis:**

Osteomyelitis usually requires surgical and antibiotic therapy for successful treatment. Special care must be taken to identify the causative organisms using anaerobic and aerobic culture of tissue removed at surgery for appropriate antibiotic therapy. Osteomyelitis must be treated with antibiotics for much longer period than soft tissue infections.¹⁵

- **Management of maxillo-facial fractures:**

Administration of antibiotics should begin as early as possible after diagnosis to diminish the chance of clinical infection.

Dento-facial infections can be treated with less extensive and aggressive surgical and antibiotic therapy, reduced hospitalization costs and fewer complications if approached earlier when diagnosed during premature clinical manifestations.¹⁶

- **Odontogenic infections**

Current clinical guidelines for the rational use of antibiotics in the United Kingdom on treating acute dental infections is provided by the Faculty of General Dental Practice (FGDP)¹⁷, British National Formulary¹⁸, and Scottish Dental Clinical Effectiveness Programme.¹⁹

The primary care for odontogenic infections is by local intervention through drainage and or removal of the cause of infection by means of endodontic or surgical therapy. It is suggested that the correct diagnosis and local intervention should be given the greatest attention by the dentist, whilst the choice of antibiotic playing a secondary role, provided that the antibiotic used fits in with the spectrum that has been proved effective in the treatment of odontogenic infections.¹³ The safety and cost of antibiotic should be taken into account.

Management of odontogenic infections includes diagnosis of causative organisms, clinical management including appropriate antibiotic selection, and referral to a specialist where indicated.^{20,21,22}

- **Endodontic (pulpal-and periapical-related) infections**

Studies have shown that adjunctive antibiotics are not

effective in preventing or ameliorating signs and symptoms in cases of irreversible pulpitis, symptomatic apical periodontitis, or localized acute apical abscess, when adequate local debridement, medication and incision for drainage, if indicated, have been achieved.²³⁻²⁸

A clinical practice guideline just released by an expert panel of the American Dental Association made the following recommendations on antibiotic use for the urgent management of pulpal- and periapical-related conditions in immunocompetent adult patients.²⁹

- Antibiotics should not be prescribed for immunocompetent adult patients with pulpal or periapical-related conditions where definitive conservative dental treatment is available, including pulpotomy, pulpectomy, or incision drainage of an abscess.
- Prescribing antibiotics in immunocompetent adults are not recommended owing to potentially negligible benefits and likely large harms associated with their use.
- Antibiotics should be prescribed for immunocompetent adult patients with pulp necrosis and localized acute apical abscess, in settings where no definitive conservative dental treatment is available.
- It is suggested good practice to prescribe oral amoxicillin (500mg, 3 times per d, 3-7d) or oral penicillin V potassium (500mg, 4 times per d, 3-7d) for immunocompetent adults with pulp necrosis and acute apical abscess with systemic

involvement.

Antibiotics should only be used as adjuvant therapies in cases with evidence of systemic involvement.²⁹ In addition patients who are immune-compromised or having predisposing conditions such as previous endocarditis should receive prophylactic antibiotics. When using adjunctive antibiotics in addition to adequate debridement and surgical drainage, such as in cases with spreading infections, the practitioner should use the shortest effective course of antibiotics, minimize the use of broad spectrum antibiotics and monitor the patient closely.³⁰ Penicillin VK and amoxicillin are the first line of antibiotics used for urgent management of pulpal- and periapical- related pain and intra-oral swelling.³⁰ However, amoxicillin is the preferred antibiotic because it is more effective against various Gram-negative anaerobes and has a lower incidence of gastrointestinal adverse effects.²⁹

As an alternative for patients with a history of penicillin allergy, but without a history of anaphylaxis, angioedema, or hives with penicillin, ampicillin or amoxicillin, oral cephalexin (500mg, 4 times per d, 3-7 d) is recommended.

As an alternative for patients with a history of penicillin allergy, and a history of anaphylaxis, angioedema, or hives with penicillin, ampicillin or amoxicillin, oral azithromycin (loading dose of 500mg on day 1, followed by 250mg for

Table 4: Recommended antibiotic regimens for orofacial infections in children^{34,35}

Infection	Recommended antibiotic regimen	Infection	Recommended antibiotic regimen for penicillin-allergic patient
Cellulitis, Necrotizing ulcerative gingivitis or pericoronitis	Amoxicillin (2-3 days, max 5 days) Children >3 mths and <40kg: 20-40mgs/kg/day in divided doses 8 hourly Children >40 kg 250-500mg 8 hourly Or 500-875mg 12 hourly	Cellulitis Necrotizing ulcerative gingivitis pericoronitis	Metronidazole (3 days): Children: 30mg/kg/day in divided doses 6 hourly (max 4gm/24 hr) Adolescents: 7.5mg/kg/ 6 hourly (max 4g/24hrs) OR Azithromycin (3 days): Children < 6mths – 16 yrs: 5-12mg/kg/daily for 3 days (max 500mg/day) OR Clarithromycin (7 days) 7.5mg/kg 12 hourly 13-18yrs: 250mg 12 hourly
Aggressive periodontitis	Amoxicillin 50mg/kg/day AND Metronidazole 30mg/kg/day 8 hourly for 7 days	Aggressive periodontitis	Azithromycin (3 days) 10mg/kg daily OR Metronidazole 30mg/kg/day 8 hourly for 7 days

(Adapted from: Geller, Lovegrove, Shehab et al, 2018)⁴⁹

an additional 4 days, or oral clindamycin (300mg 4 times per d , 3-7 d). Bacterial resistance rates for azithromycin are higher than for other antibiotics and clindamycin substantially increases the risk of developing Clostridiosis difficile infection after a single dose.^{29, 30}

The recommended dose regimen for amoxicillin is 500mg tds, with or without a loading dose of 1000mg.

• **Periodontal infections**

Antibiotics are not needed for most cases of periodontal infections. Non-surgical mechanical debridement by deep scaling and root planning (SRP) resolves a considerable amount of infection on its own. Antibiotics adjunctive to SRP should be assessed on an individual risk basis against the necessity for further therapy.³² Specific indications for prescribing antibiotics as an adjunct to mechanical debridement are multiple deep pockets, especially in the molar area, severe periodontitis with a rapid rate of progression and ANUG.³² So far, no antibiotic or combination of antibiotics, has shown clinical or microbiological superiority to amoxicillin 500mg tds and metronidazole 400mg tds in any appropriately conducted randomized clinical trial.³² Poor quality mechanical

debridement and poor oral hygiene is a contraindication for prescribing antibiotics.³² Administration of antibiotics has been identified as a risk for the development of periodontal abscesses if subgingival debridement in the apical portion of a lesion is incomplete.³³ It is also suggested that the use of topical or local administration of antibiotics (e.g., 10% Doxycycline) can reduce or avoid the need for systemic therapy and subsequent gut microbiome exposure.³⁴

• **Pediatrics – Treatment of acute dental infections**

A systematic review of the literature revealed that the main indication for use of antibiotics in children were for cellulitis, aggressive periodontitis, ulcerative gingivitis and pericoronitis. Amoxicillin was found to be the most commonly recommended antibiotic for short durations of 3-5 days, with metronidazole or azithromycin being the alternative antibiotic in penicillin-sensitive patients.³⁵

Children should be followed up for a few days to evaluate response to treatment, and the development of unwanted side effects.³⁵

The recommended antibiotic prescribing clinical guidelines by the Faculty of General Dental Practitioners (UK)¹⁷ for acute dental infections in children are as follows:

Table 5: Alternative recommended antibiotic prescribing clinical guidelines for children¹⁷

Amoxicillin dosing	
1mth- 1 yr	125mg every 8 hrs, increased if necessary up to 30mg/kg every 8 hrs
1-5 yrs	250 mg every 8 hrs, increased if necessary up to 30mg/kg every 8 hrs
5-12 yrs	500 mg every 8 hrs (max 1gm every 8 hrs)
12-18 yrs	500 mg every 8 hrs, in sever infections 1 gm every 8 hrs
Metronidazole dosing	
1 - 3 yrs	100mg tds for up to 5 days- review after 2-3 days and discontinue if resolved
3-7 yrs	200mg bd for up to 5 days- review after 2-3 days and discontinue if resolved
7-10 yrs	200mg tds for up to 5 days - review after 2-3 days and discontinue if resolved

A review point two to three days after drainage of an acute dental infection is a key element of the guidance. Those patients whose infections have resolved, and body temperature returned to normal, should be instructed to stop taking the antibiotics.³⁷

Fundamental clinical guidelines for pediatric antibiotic

stewardship, embrace the following principles^{17,38}:

- Avoid prescribing antibiotics for conditions where antibiotics are not indicated.
- Reduce macrolides.
- Increase first-line guideline concordant.
- Review after 2-3 days and discontinue if infection has resolved.

Ethical considerations and medical risk

Patients have the right to expect that clinicians will examine them thoroughly, diagnose their needs correctly, provide a clear treatment plan and treat them accordingly. Dentists must be prepared to decline requests for a particular treatment if they judge it would not benefit the patient's health, such as when a patient requests antibiotics without any real indication for a prescription.³⁹ The dentist has an obligation to explain the consequences and/or risks of not continuing the treatment and ensure the patient knows that they are responsible for any future problems which arise as a result of not following or completing the treatment.

The practitioner should in consultation with the patient consider if there are possible clinical circumstances that may suggest the presence of a significant medical risk in providing dental care without antibiotic prescribing. Any antibiotic prescribing recommendations should be integrated with the practitioner's professional judgement in consultation with the patients' physician, and the patient's needs and preferences. All communications between the dentist and the patient in this regard must be recorded in the patients' notes.

Due to the increasing prevalence of bacteria, which are resistant to treatment by currently available antibiotics, clinicians should consider carefully treating all patients' with antibiotics. This is likely to do more harm than good.¹¹ Ultimately dentists must weigh the benefits and risks of antibiotics and make an informed decision with their patients on the appropriateness of using antibiotics. The benefits of giving antibiotics should always outweigh the risks of antibiotic-related allergy, toxicity, super infection and the development of drug-resistant strains.¹⁵

It is the duty of every dentist to arrive at a correct diagnosis in order to avoid inappropriate use of antibiotics. When selecting an antibiotic that fits in with the action spectrum that has been proved effective for treatment, safety of antibiotic use and product cost should always be taken in consideration.¹³

Conclusion

Primary indications for using antibiotics to prevent and fight bacterial infections in the dental setting are: prophylaxis to prevent infective endocarditis, when there is systemic body response to infection, and in patients that are immune-suppressed or immune-compromised. Antibiotic prescribing in the dental setting should always be based on the narrowest spectrum antibiotic for the shortest duration possible. In addition, effective plaque control must also be prioritised.

As a society we need to recognize that antibiotics are fundamental to how we practice modern dentistry, and therefore use and value antibiotics prudently and cautiously. It is essential to understand that antibiotic therapy will fail if the source of infection is not removed. Primary dental care, including periodontal debridement, endodontic therapy, extractions, drainage and/or surgical intervention should always be the first line of care, with antibiotics serving as adjunctive therapy in indicated cases. Antibiotics are not a replacement for surgical drainage or debridement.

Any antibiotic prescribing should be based on the practitioner's professional judgement, in consultation with the patients' physician, and the patient's needs and preferences. The benefits of giving antibiotics should always outweigh the risks of antibiotic-related allergy, toxicity, super infection and the development of drug-resistant strains.

References

1. Nishimura RA, Otto CM, Bonow CO, et al. American Heart Association and The American College of Cardiology Focused Update of the 2014 AHA/ACC Guideline for the management of patients with valvular heart disease: A Report of the American College of Cardiology / American Heart Association Task Force on Clinical Practice Guidelines. *Circulation* 2017; 135: e1159-e1195.
2. Lafaurie GI, Noriega L, Torres CC, et al. Systematic Review: Impact of antibiotic prophylaxis on the incidence, nature, magnitude, and duration of bacteremia associated with dental procedures. *JADA*. 10 September 2019. Article in Press.
3. Wilson W, Taubert KA, Gewitz M. Prevention of infective endocarditis: Guidelines from the American Heart Association – A guideline from the American Heart Association Rheumatic Fever, Endocarditis and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and anaesthesia. *Circulation* 2007; 116(15): 1736-1754.
4. Wilson W, Taubert KA, Gewitz M et al. Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anaesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. *J Amer Dent Assoc* 2008; 133 Suppl: 3S-24S.
5. Sollecito TB, Abt E, Lockhart PB, et al. The use of prophylactic antibiotics prior to dental procedures in patients with prosthetic joints: Evidence-based clinical guidelines for dental practitioners – A report of the American Dental Association Council on Scientific Affairs. *J Amer Dent Assoc* 2015; 146(1): 11-16.
6. American Dental Association. ADA appointed members of the Expert Writing and Voting Panels contributing to the development of the American Academy of Orthopaedic Surgeon appropriate to use criteria. American Dental Association guidance for utilizing appropriate use criteria in the management and care of patients with orthopaedic implants undergoing dental procedures. *J Amer Dent Assoc* 2017;

148(20): 57-59.

7. Quinn RH, Murray JN, Pezold R, Sevarino KS. The American Academy of Orthopaedic Surgeons appropriate use criteria for the management of patients with orthopaedic implants undergoing dental procedures. *J Bone Joint Surg* 2017; 99(2): 161-163.

8. Esposito M, Worthington HV, Loli V et al. Interventions for replacing missing teeth: antibiotics at dental implant placement to prevent complications. *Cochrane Database Syst Rev* 2010; 7: CD004152. <https://doi:10.1002/14651858.CD004152.pub3>

9. Esposito M, Grusovin MG, Worthington HV. Interventions for replacing missing teeth: antibiotics at dental implant placement to prevent complications. *Cochrane Database Syst Rev* 2013; 7: CD004152. <https://doi:10.1002/14651858.CD004152.pub34>

10. Sánchez FR, Andrés CR, Arteagoita I. Which antibiotic regimen prevents implant failures or infection after dental implant surgery: A systematic review and meta-analysis. *J Cranio Maxillofac Surg* 2018; 46(4): 722-738.

11. Lodi G, Figini L, Sardella, et al. Antibiotics to prevent complications following tooth extractions. *Cochrane database Syst Rev* 2012; 11: CD003811. <https://doi:10.1002/14651858.CD003811.pub2>

12. Gill AM, Morrissey H, Rahman A. A systematic review and meta-analysis evaluating antibiotic prophylaxis in dental implants and extraction procedures. *Medicina* 2018; 54(6): pii:E95. <https://doi:10.3390/medicina54060095>

13. Martins JR, Chogas OL, Velasques BD, et al. The use of antibiotics in odontogenic infections: What is the best choice? A systematic review. *J Oral Maxillofac Surg* 2017; 72(12): 2606e1-2608e11.

14. Bowe CM, O'Neill MA, O'Connell JE, Kearns GJ. The surgical management of severe dentofacial infections (DFI_ A prospective study. *Irish J Med Sci* 2019; 188(1): 327-331.

15. Shivanand S, Doddawad VG, Vidya CS, et al. The current concepts in the use of antibiotics in dental Practice. *Int J App Eng Res* 2018; 13(5): 2959-2964.

16. Tormes AKK, De Bortoli MM, Júnior RM, Andrades ESS. Management of a severe cervicofacial odontogenic infection. *J Contemp Dent Practice* 2018; 19(3): 352-355.

17. Faculty of General Dental Practitioners (UK). Antimicrobial prescribing for general dental practitioners, 2nd ed. June 2016. Faculty of General Dental Practice, London. Available at: www.fgdp.org.uk/osi/open-standards-initiative.ashx

18. Joint Formulary Committee, British National Formulary. *BMJ Group and Pharmaceutical Press, London* 2015. Available at: www.medicinescomplete.com

19. Scottish Dental Clinical Effectiveness programme. Management of acute dental problems – Guidance for Healthcare professionals. 2013. Available at:

www.sdcep.org.uk/published-guidance/management-of-acute-dental-problems-madp

20. Gregoire C. How are odontogenic infections best managed? *J Can Dent Assoc* 2010; 76(2): 114- 117.

21. Flynn TR, Halpern LR. Antibiotic selection in head and neck infection. *Oral Maxillofac Surg Clin North Am* 2003; 15(1): 21.

22. Flynn TR. What are the antibiotics of choice for odontogenic

infections, and how long should the treatment course last? *Oral Maxillofac Surg Clin North Am* 2011; 23(4): 519-536.

23. Cope A, Francis N, Wood F et al. Systemic antibiotics for symptomatic apical periodontitis and acute apical abscess in adults. *Cochrane Database Syst Rev* 2014; 6: CD010136.

24. Fouad AF, Rivera EM, Walton RE. penicillin as a supplement in resolving the localized acute apical abscess. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1996; 81: 590-595.

25. Henry M, Reader A, Beck M. Effect of penicillin on postoperative endodontic pain and swelling in symptomatic teeth. *J Endod* 2001; 27: 117-123.

26. Matthews DC, Sutherland S, Basrani B. Emergency management of acute apical abscess in the permanent dentition: a systematic review of the literature. *J Can Dent Assoc* 2003; 69: 660.

27. Nagel D, Reader A, Beck M, Weaver J. Effect of systemic penicillin on pain in untreated irreversible pulpitis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000; 90: 636-640.

28. Pickenpaugh L, Reader A, Beck M et al. Effect of prophylactic amoxicillin on endodontic flare-up in asymptomatic, necrotic teeth *J Endod* 2001; 27: 53-56.

29. Lockhart PB, Tampi MP, Abt E, et al. Evidence-based clinical guideline on antibiotic use for the urgent management of pulpal-and periapical-related dental pain and intra-oral swelling. A report from the American Dental Association. *JADA* 2019; 150(11): 906-921.e12

30. American Association of Endodontists. AEE guidance on the use of systemic antibiotics in endodontics. AAE Position Statement. 2017

31. Leffler DA, Lamont JT. Clostridium difficile infection. *N Eng J Med* 2015; 372: 1539-1548.

32. Mombelli A. Should antibiotics be rationed in periodontics – if Yes, how?

Curr Oral Health Rep 2019. <https://doi:10.1007/s40496-019-00225-6>

33. Topoll HH, Lange DE, Müller RF. Multiple periodontal abscesses after systemic antibiotic therapy. *J Clin Periodontol* 1990; 17: 268-272.

34. Shahi F, Redeker K, Chong J. Rethinking antimicrobial stewardship paradigms in the context of the gut microbiome. *JAC Antimicrob Resist* 2019; <https://doi:10.1093/jacamt/dlz015>

35. Dar-Odeh N, Fadel HT, Abu-Hammad S, et al. Antibiotic prescribing for orofacial infections in the paediatric outpatient: A Review. *Antibiotics* 2018; 7: 38. <https://doi:10.3390/antibiotics7020038>

36. Peedikayil FC. Antibiotics in odontogenic infections – An update. *J Antimicrobial Agents* 2016; 2(2): 117. <https://doi:10.4172/2472-1212.1000117>

37. Thompson W, Rios LE, Fedorowicz Z, et al. I've got toothache, I need antibiotics: A UK perspective on rational antibiotic prescribing by dentists. *Braz Dent J* 2018; 29(4): 395-399.

38. Poole NM, Shapiro DJ, Fleming-Dutra KE, et al. Antibiotic prescribing for children in United states Emergency Departments: 2009-2014. *Pediatrics* 2019; 143(2): <https://doi:10.1542/peds.2018-1056>.

39. General Medical Council. Consent: patients and doctors making decisions together. 2008. General Medical Council. Available at: https://www.gmc-uk.org/guidance/ethical_guidance/consent_guidance_index.asp.