

Proper Prescribing Principles for Antibiotics in Dentistry

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Learning Objectives

- ▶ Learning Objective 1: Identify the clinical terminology for pulpal and periapical diagnoses
- ▶ Learning Objective 2: Explain the use of clinical and radiographic evidence in diagnosing tooth pain/swelling
- ▶ Learning Objective 3: Define when antibiotic therapy is indicated using the ADA guidelines and a patient's health status

Antibiotic Stewardship

What is it?

Reviewing 2 Main Components

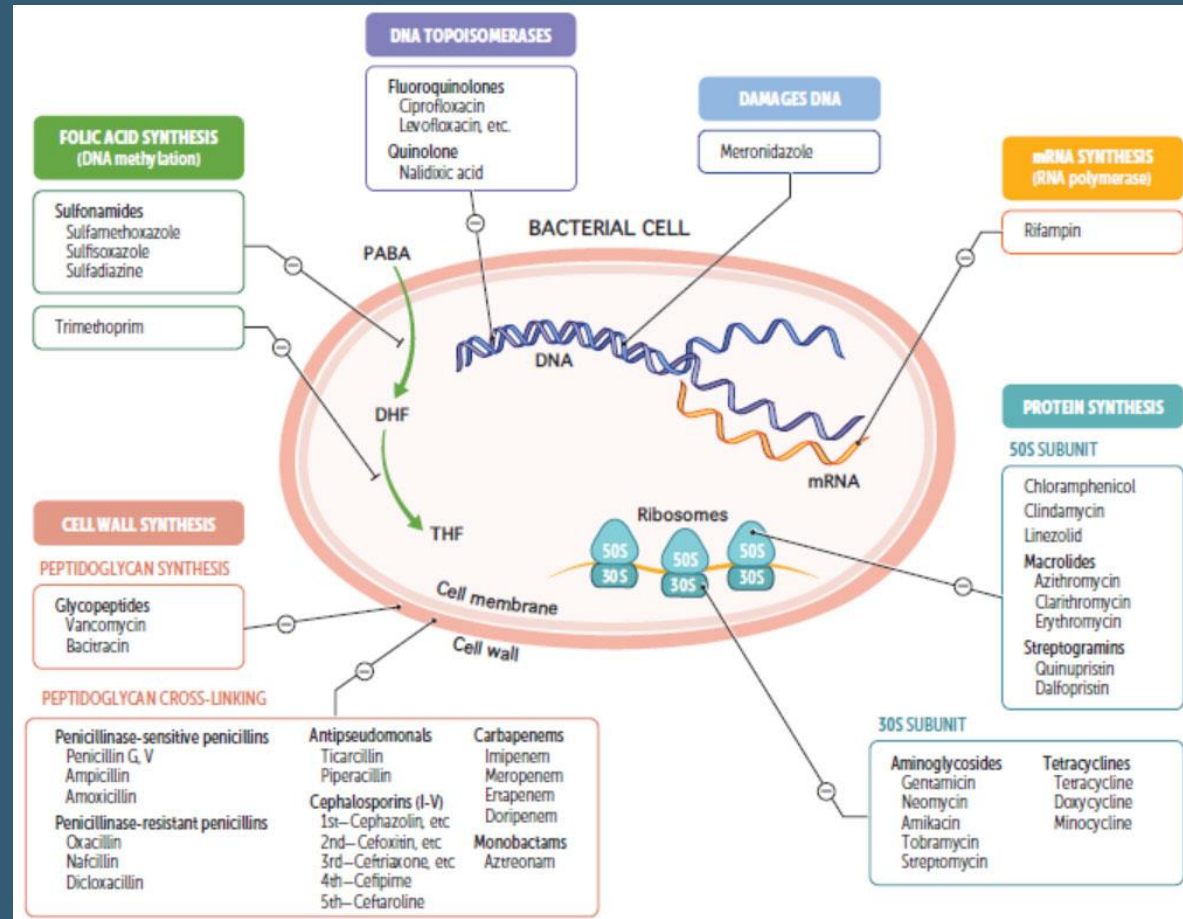
- ▶ Was an antibiotic appropriate to prescribe per the diagnosis?
- ▶ Was the appropriate antibiotic prescribed for the appropriate length and duration based on the diagnosis?



Why?

- ▶ Reduce antibiotic resistance
- ▶ Lower cost
- ▶ Improve patient outcomes
- ▶ Decrease the spread of infections by multidrug resistant organisms

Antibiotics-Mechanism of Action



HOW ANTIBIOTIC RESISTANCE HAPPENS



**BE
ANTIBIOTICS
AWARE**
SMART USE, BEST CARE

1

There are lots of germs and a few are resistant to **antibiotics**.



2

When **antibiotics** kill bacteria causing illness, they also kill good bacteria protecting the body from infection.



3

The **antibiotic-resistant** bacteria grow and take over.



4

Some bacteria give their **antibiotic resistance** to other bacteria, causing more problems.

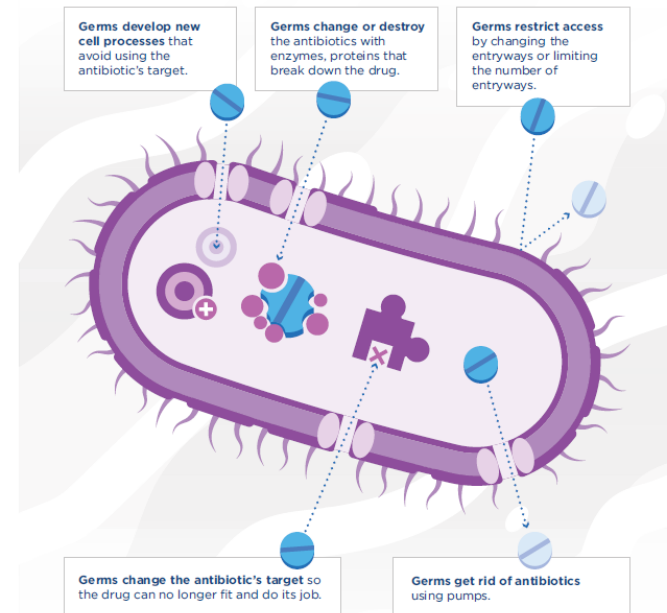


www.cdc.gov/antibiotic-use

Antibiotic Resistance

How Bacteria and Fungi Fight Back Against Antibiotics

Antibiotics fight germs (bacteria and fungi). But germs fight back and find new ways to survive. Their defense strategies are called **resistance mechanisms**. Only germs, not people, become resistant to antibiotics.





How Antibiotic Resistance Moves Directly Germ to Germ

Any antibiotic use can lead to antibiotic resistance. Antibiotics kill germs like bacteria and fungi, but the resistant survivors remain.

Resistance traits can be inherited generation to generation. They can also pass directly from germ to germ by way of **mobile genetic elements**.

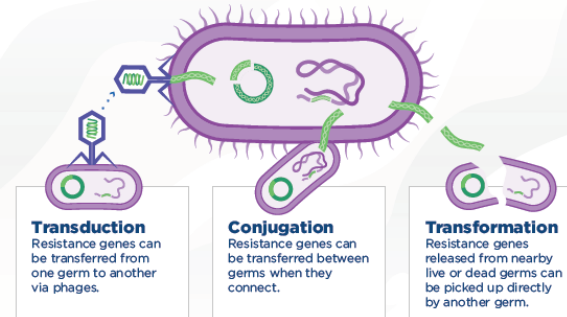
Mobile Genetic Elements


Plasmids
Circles of DNA that can move between cells.


Transposons
Small pieces of DNA that can go into and change the overall DNA of a cell. These can move from chromosomes (which carry all the genes essential for germ survival) to plasmids and back.


Phages
Viruses that attack germs and can carry DNA from germ to germ.

How Mobile Genetic Elements Work



Antibiotic Resistance

- ▶ Develop resistance at a very high rate
- ▶ Bacteria resistant to new drugs are found soon after the drug is released

What is Causing Antibiotic Resistance?

- ▶ Widespread use and misuse of antibacterial drugs
 - ▶ 30% - 50% of prescribed antibiotics are either not necessary or not prescribed appropriately
 - ▶ Patient expectations
 - ▶ Fear of litigation
 - ▶ Diagnostic uncertainty
 - ▶ Lack of knowledge of antibiotic risks
 - ▶ Excessive use of antibiotics in animals

Consequences

- ▶ Serious global health threat
- ▶ Certain infectious diseases are no longer treatable
- ▶ Every year in U.S. at least 2 million people become infected with antibiotic resistant bacteria
- ▶ 23,000 of those infected die
- ▶ Increased cost due to hospitalizations

Worst Case Scenario

- ▶ World left without an antibiotics to treat bacterial infections



Dentists

- ▶ Prescribe about 10% of all prescriptions (25.6 million/year)
- ▶ Prescribe the most Clindamycin in the US



Problems in Antibiotic Stewardship Review

- ▶ No diagnosis evident
- ▶ Length and duration of antibiotic
- ▶ Antibiotic choice

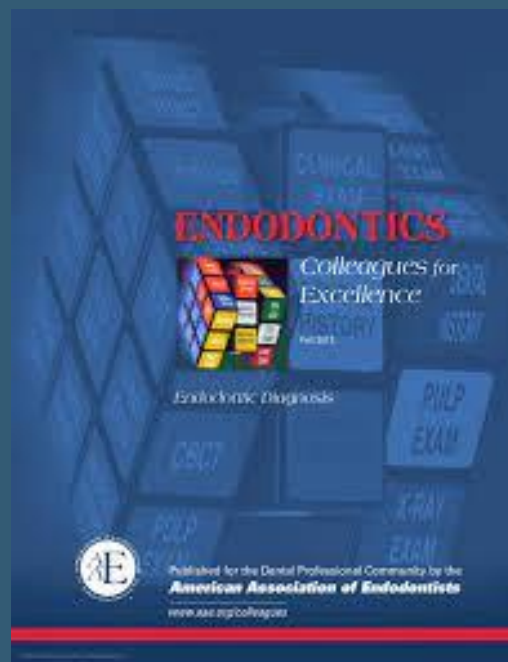
Diagnosis

▶ Why do we need a diagnosis?

- ▶ To determine the appropriate clinical treatment

Diagnostic Terminology

- ▶ 2008 American Association of Endodontists standardized diagnostic terms used in endodontics
- ▶ Their use is recommended the AAE and American Board of Endodontics across all disciplines and health professions



Clinical Exam

TABLE 1: Examination Procedures Required to Make an Endodontic Diagnosis¹⁵

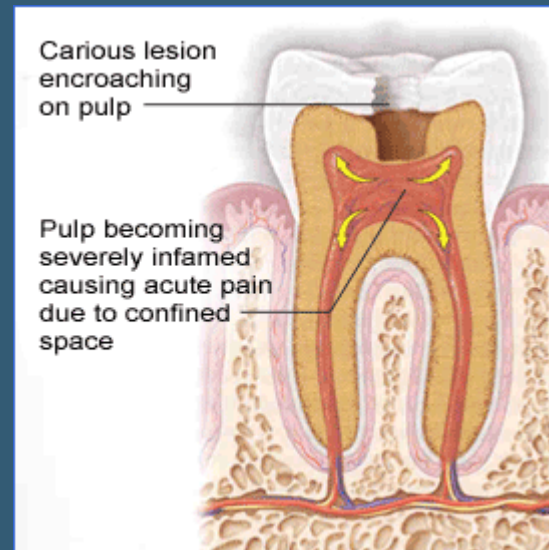
Medical/Dental History	Past/Recent Treatment and/or Drugs
Chief complaint (if any)	How long: symptoms, duration of pain, location, onset, stimuli, relief, referred, medications
Clinical exam	Facial symmetry, sinus tract, soft tissue, periodontal status (probing, mobility), caries, restorations (defective, newly placed?)
Clinical testing: Pulp tests Periapical tests	Cold, electric pulp test, heat Percussion, palpation, fracture-detecting device (biting)
Radiographic analysis	New periapicals (at least two), bitewing, cone beam computed tomography
Additional tests	Transillumination, selective anesthesia, test cavity

TABLE 1. American Association of Endodontists Consensus Conference Recommended Diagnostic Terminology

Pulpal	
Normal pulp	A clinical diagnostic category in which the pulp is symptom-free and normally responsive to pulp testing.
Reversible pulpitis	A clinical diagnosis based on subjective and objective findings indicating that the inflammation should resolve and the pulp return to normal.
Symptomatic irreversible pulpitis	A clinical diagnosis based on subjective and objective findings indicating that the vital-inflamed pulp is incapable of healing. Additional descriptors: lingering thermal pain, spontaneous pain, referred pain.
Asymptomatic irreversible pulpitis	A clinical diagnosis based on subjective and objective findings indicating that the vital inflamed pulp is incapable of healing. Additional descriptors: no clinical symptoms but inflammation produced by caries, caries excavation, trauma.
Pulp necrosis	A clinical diagnostic category indicating death of the dental pulp. The pulp is usually nonresponsive to pulp testing.
Previously treated	A clinical diagnostic category indicating that the tooth has been endodontically treated and the canals are obturated with various filling materials other than intracanal medicaments.
Previously initiated therapy	A clinical diagnostic category indicating that the tooth has been previously treated by partial endodontic therapy (eg, pulpotomy, pulpectomy).
Apical	
Normal apical tissues	Teeth with normal periradicular tissues that are not sensitive to percussion or palpation testing. The lamina dura surrounding the root is intact, and the periodontal ligament space is uniform.
Symptomatic apical periodontitis	Inflammation, usually of the apical periodontium, producing clinical symptoms including a painful response to biting and/or percussion or palpation. It might or might not be associated with an apical radiolucent area.
Asymptomatic apical periodontitis	Inflammation and destruction of apical periodontium that is of pulpal origin, appears as an apical radiolucent area, and does not produce clinical symptoms.
Acute apical abscess	An inflammatory reaction to pulpal infection and necrosis characterized by rapid onset, spontaneous pain, tenderness of the tooth to pressure, pus formation, and swelling of associated tissues.
Chronic apical abscess	An inflammatory reaction to pulpal infection and necrosis characterized by gradual onset, little or no discomfort, and the intermittent discharge of pus through an associated sinus tract.
Condensing osteitis	Diffuse radiopaque lesion representing a localized bony reaction to a low-grade inflammatory stimulus, usually seen at apex of tooth.

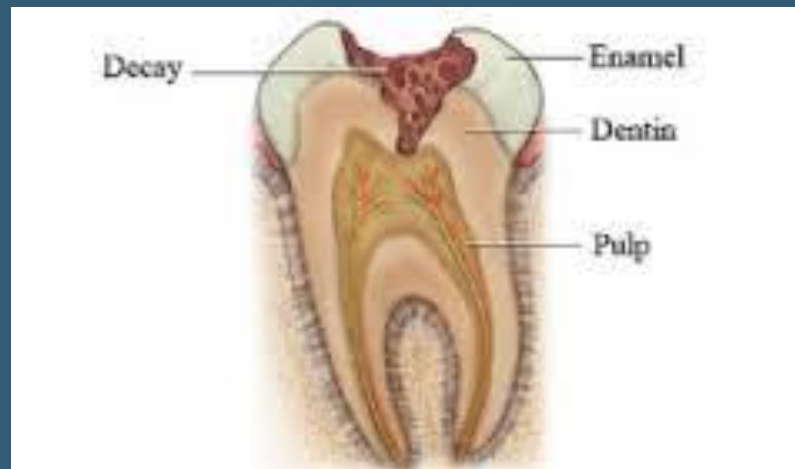
Reversible Pulpitis

- ▶ Pulpal inflammation that still can be reversed.
- ▶ Bacteria is close to but has not reached the pulp.
- ▶ Symptoms:
 - ▶ Sensitivity or pain to cold, hot, sweets and mechanical stimuli



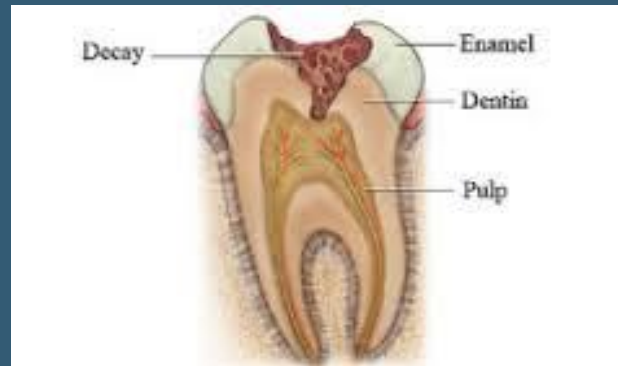
Symptomatic Irreversible Pulpitis

- ▶ Bacteria has made its way to the pulpal system causing inflammation
- ▶ Symptoms:
 - ▶ May have spontaneous pain
 - ▶ Prolonged response to hot and cold



Asymptomatic Irreversible Pulpitis

- ▶ Bacteria has made it's way to the pulpal system and will eventually cause pulpal necrosis
 - ▶ No Clinical symptoms
 - ▶ Tests normal to cold testing
 - ▶ Usually occurs during caries excavation or trauma



Necrotic

- ▶ Bacteria has caused inflammation leading to pulpal death
 - ▶ Tooth has no response to temperature stimuli or pulp testing



Previously Initiated

- ▶ Root canal was starting but never finished
 - ▶ Patient referred from GP to endo
 - ▶ Patient never returned to finish treatment



Previously Treated

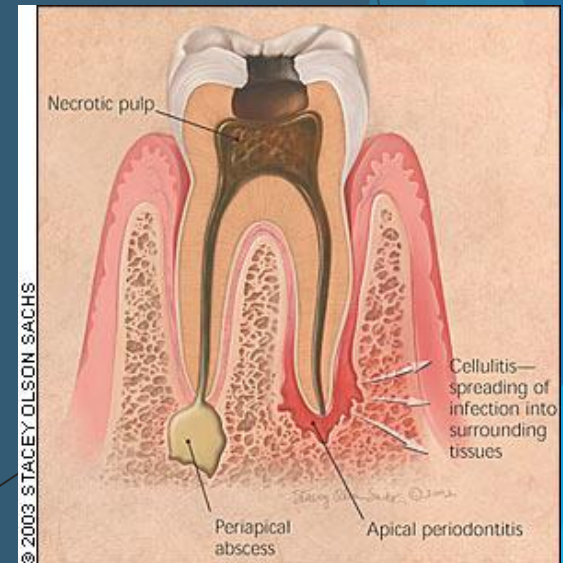
- ▶ Tooth has a completed root canal



Periapical Diagnosis

Symptomatic Apical Periodontitis

- ▶ Irritants and bacteria spread into periradicular tissues of the tooth causing inflammation
- ▶ Symptoms:
 - ▶ Pain to percussion
 - ▶ Pain to chewing
 - ▶ Pain associated with apical end of the tooth - tender to palpation
 - ▶ May or may not have an apical radiolucency



Asymptomatic Apical Periodontitis

- ▶ Irritants and bacteria spread into periradicular tissues of the tooth causing inflammation and destruction
 - ▶ Periapical radiolucency but tooth is not sensitive to percussion



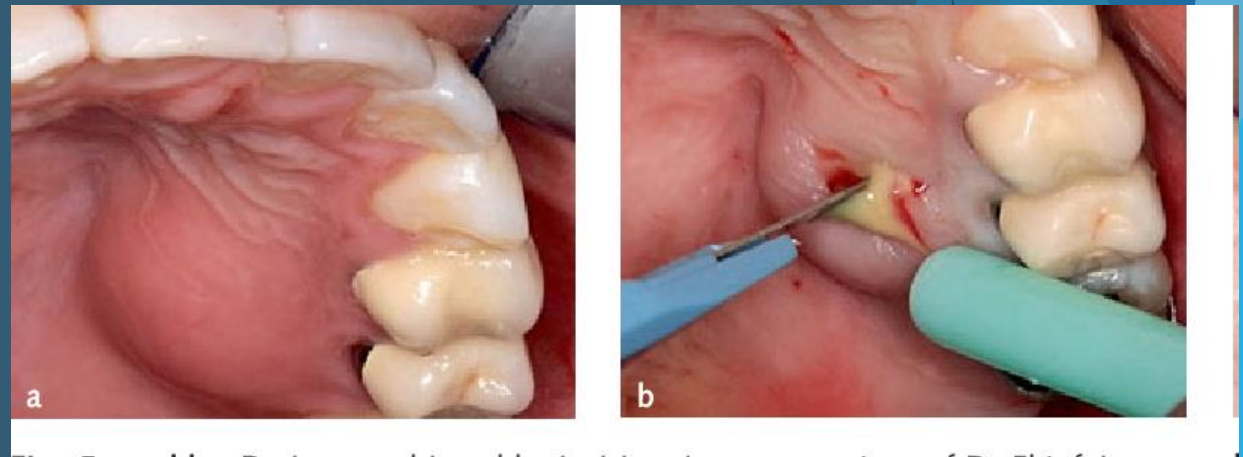
Chronic Apical Abscess

- ▶ Infection progresses through cancellous bone along the path of least resistance
- ▶ Symptoms:
 - ▶ No pain or swelling
 - ▶ Purulence through sinus tract



Acute Apical Abscess

- ▶ Bacteria/infections extends into the alveolar bone and soft tissue.
- ▶ Symptoms:
 - ▶ Intraoral and/or extraoral swelling
 - ▶ Usually severe and constant pain
 - ▶ Unable to chew
 - ▶ Tooth may be mobile
 - ▶ Purulence
 - ▶ Malaise or fever may be present



Cellulitis

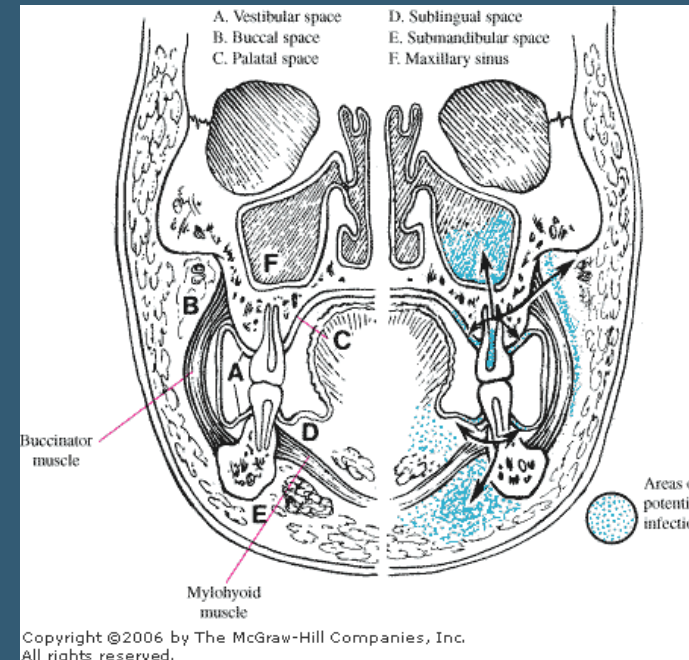
- ▶ Bacteria extends into the surrounding tissues
- ▶ Symptoms:
 - ▶ Area is edematous and indurated with diffuse inflammation
 - ▶ Usually restricted to the jaws
 - ▶ Pain
 - ▶ Malaise
 - ▶ Trismus
 - ▶ Regional lymphadenopathy
 - ▶ Fever
- ▶ Treatment:
 - ▶ Oral/IV antibiotics
 - ▶ Incision and drainage
 - ▶ Dental treatment - extraction



Fascial Space Infections

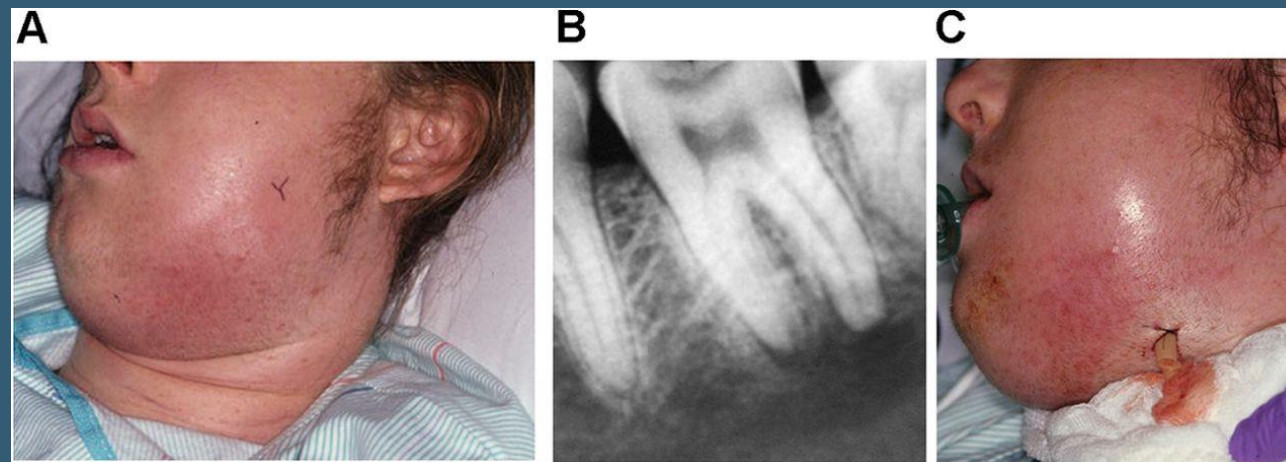
- ▶ Infections spreads through the fascial spaces of the head and neck and into the:

- ▶ Canine
- ▶ Buccal
- ▶ Masticatory space
- ▶ Submental
- ▶ Sublingual
- ▶ Submandibular
- ▶ Vestibular
- ▶ Parotid
- ▶ Parapharyngeal
- ▶ Retropharyngeal
- ▶ Deep spaces of head and neck and mediastinum



Space Infections

- ▶ Treatment:
 - ▶ IV antibiotics
 - ▶ Incision and drainage
 - ▶ Protection of the airway
 - ▶ Dental treatment - extraction



Condensing Osteitis

- ▶ Diffused radiopaque lesion
 - ▶ Bony reaction to a low-grade inflammatory stimuli
 - ▶ See at the apex
 - ▶ Tooth is usually necrotic



Antibiotic Therapy in Dentistry

- ▶ 1. Based on diagnosis, should antibiotics be prescribed?
- ▶ 2. If antibiotics prescribed
 - ▶ Which antibiotic?
 - ▶ How many times a day and for how long?



Antibiotic Therapy in Dentistry

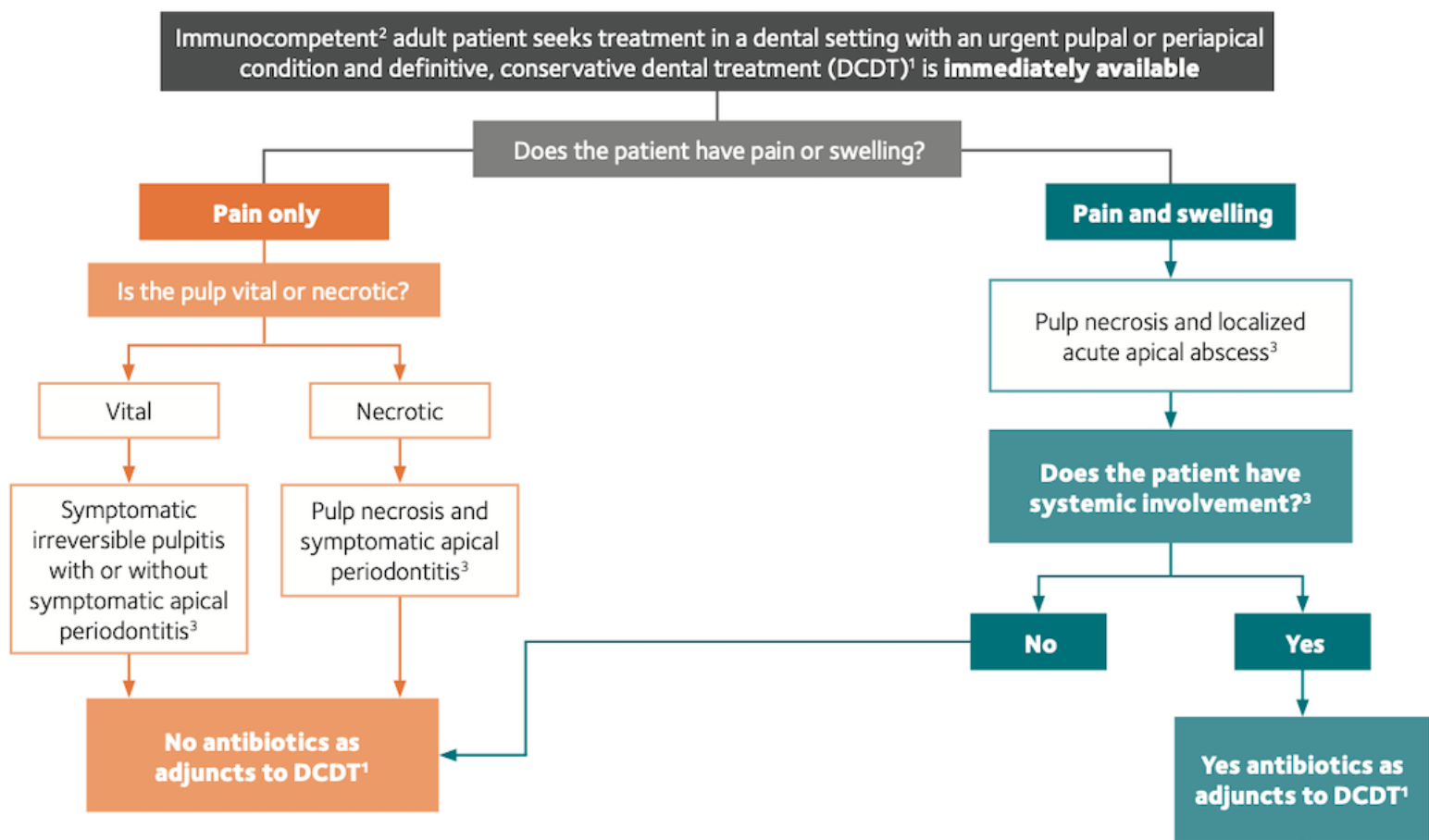
- ▶ November 2019 - Article published in JADA “Evidence-based clinical practice guideline on antibiotic use for the urgent management of pulpal- and periapical-related dental pain and intraoral swelling”
 - ▶ Expert panel convened by the ADA Council on Scientific Affairs and Center for Evidence Based Dentistry conducted a systematic review of literature to gather evidence on the benefits and harms of antibiotic use.
 - ▶ This article is the first guideline on antibiotic use from the ADA
 - ▶ It is the first developed by a multidisciplinary panel
 - ▶ It is the first intended primarily for general dentists



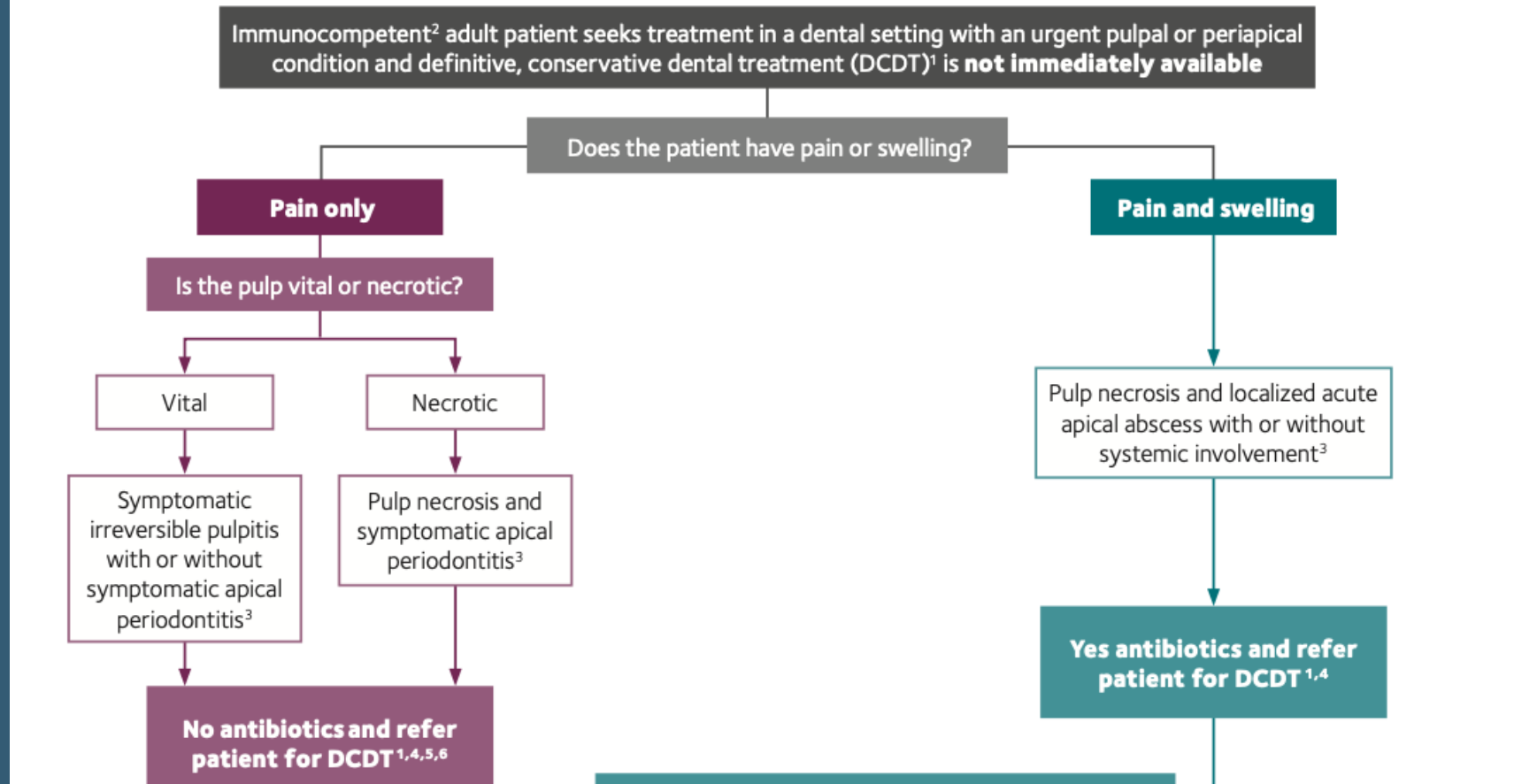
Antibiotic Therapy in Dentistry

- ▶ Purpose - To help clinicians to determine the appropriate use of systemic antibiotics for management of the following conditions:
 - ▶ Symptomatic Irreversible Pulpitis with or without Symptomatic Apical Periodontitis
 - ▶ Pulp Necrosis and Symptomatic Apical Periodontitis
 - ▶ Pulp Necrosis and Localized Acute Apical Abscess

Evidence-Based Clinical Practice Guideline on Antibiotic Use for the Urgent Management of Pulpal- and Periapical-Related Dental Pain and Intraoral Swelling: A Report from the American Dental Association



Evidence-Based Clinical Practice Guideline on Antibiotic Use for the Urgent Management of Pulpal- and Periapical-Related Dental Pain and Intraoral Swelling: A Report from the American Dental Association



Case Example #1



56 year old healthy male presented following the placement of a full gold crown on the maxillary right second molar, the patient complained of sensitivity to both hot and cold liquids; now the discomfort is spontaneous. Upon application of a pulp vitality refrigerant spray on this tooth (i.e., thermal testing), the patient experienced pain, and, upon removal of the stimulus, the discomfort lingered for 12 seconds. Responses to both percussion and palpation were normal; radiographically, there was no evidence of osseous changes.

- ▶ *Diagnosis: Symptomatic irreversible pulpitis; normal apical tissues.*
- ▶ *Treatment: no antibiotics indicated; analgesics for pain management; schedule for treatment ASAP*

Diagnostic Case Example #2



42 year old healthy female presented with a relatively large apical radiolucency encompassing both the mesial and distal roots, along with furcation involvement on her mandibular left first molar demonstrates Periodontal probing depths were all within normal limits. The tooth did not respond to thermal (cold) testing, and both percussion and palpation elicited normal responses. There was a draining sinus tract on the midfacial of the attached gingiva, which was traced with a gutta-percha cone. There was recurrent caries around the distal margin of the crown.

- ▶ *Diagnosis: pulp necrosis; chronic apical abscess.*
- ▶ *Treatment: no antibiotics indicated; analgesics for pain management; schedule for treatment ASAP*

Diagnostic Case Example #3



36 year old healthy female presented with her maxillary left first molar being endodontically treated more than 10 years ago. The patient is complaining of pain to biting over the past three months. There appear to be apical radiolucencies around all three roots. The tooth was tender to both percussion and use of a fracture-detecting device.

- ▶ *Diagnosis: previously treated; symptomatic apical periodontitis.*
- ▶ *Treatment: no antibiotics indicated; analgesics for pain management; schedule for treatment ASAP*

Antibiotic Therapy in Dentistry

- ▶ 1. Based on diagnosis, should antibiotics be prescribed?
- ▶ 2. If antibiotics prescribed
 - ▶ Which antibiotic?
 - ▶ How many times a day and for how long?



Which Antibiotic?

- ▶ Choice based on the most effective against common microorganisms in dental infections of pulpal origin
- ▶ Most Odontogenic Infections (70%)
 - ▶ **Polymicrobial** - Mixed aerobic and anaerobic bacteria
- ▶ Early infection - aerobic with gram-positive, alpha-hemolytic streptococci predominating.
- ▶ Progression and pulpal death
 - more anaerobic gram-positive cocci and gram-negative rods

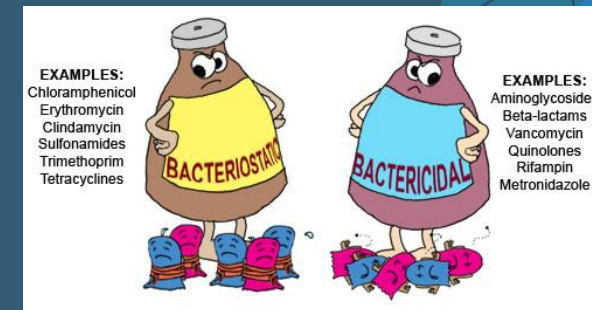


Table 1. Type of odontogenic infections and organisms responsible.

Infectious process	Predominant odontopathogens
Periodontitis	<i>Porphyromonas gingivalis</i> . <i>Tannerella forsythensis</i> <i>Actinomyces actinomycetemcomitans</i> <i>Prevotella intermedia</i> <i>Fusobacterium nucleatum</i> <i>Veillonella parvula</i> <i>Treponema denticola</i> <i>Streptococcus spp.</i>
Pulpitis with periapical abscess	<i>Fusobacterium nucleatum</i> <i>Prevotella intermedia</i> <i>Peptostreptococcus micros</i> <i>Capnocytophaga ochracea</i> <i>Selenomonas sputigena</i> <i>Porphyromonas endodontalis</i> <i>Streptococcus spp.</i>
Pericoronitis	<i>Prevotella intermedia</i> <i>Veillonella parvula</i> <i>Prevotella melaninogenica</i> <i>Fusobacterium nucleatum</i> <i>Actinomyces israelii/odontolyticus</i> <i>Streptococcus spp.</i>
Periimplantitis	<i>Fusobacterium nucleatum</i> <i>Prevotella intermedia</i> <i>Pseudomonas aeruginosa</i> <i>Staphylococcus spp</i> <i>Actinomyces actinomycetemcomitans</i>

Dosage, Dosing Intervals, and Duration of Therapy

- ▶ The dosage and dosing intervals for antibiotics - Based pharmacological studies and principles
 - ▶ use half-life to establish maximum effective dose in the plasma
 - ▶ antibiotics mechanism of action
- ▶ Duration of treatment
 - ▶ Much less evidence to establish definitive time periods
 - ▶ Most recommendations vary from 3-7 days
 - ▶ ADA recommends having the patient stop antibiotic after symptom free for 24 hours



Penicillin/Amoxicillin

- ▶ Drugs of choice for Odontogenic infections
- ▶ Bactericidal- inhibiting cross-linking in the bacterial cell wall
- ▶ Pen VK -fairly narrow antimicrobial spectrum, but cover most bacteria associated with odontogenic infections
- ▶ Amoxicillin -Broader Spectrum but little less effective against aerobic gram positive cocci but more convenient dosage regimen



If no response in 48-72 hours

- ▶ Most likely a bacterial resistance to Penicillin due to Beta-lactamase producing bacteria
- ▶ Need to choose an antibiotic effective against beta-lactamase
 - ▶ Augmentin (Amoxicillin/Clavulanic acid)
 - ▶ Add Metronidazole to Amoxicillin
 - ▶ Cephalexin

If Allergic to Penicillin

- ▶ Azithromycin(Z-Pak)
- ▶ Clindamycin



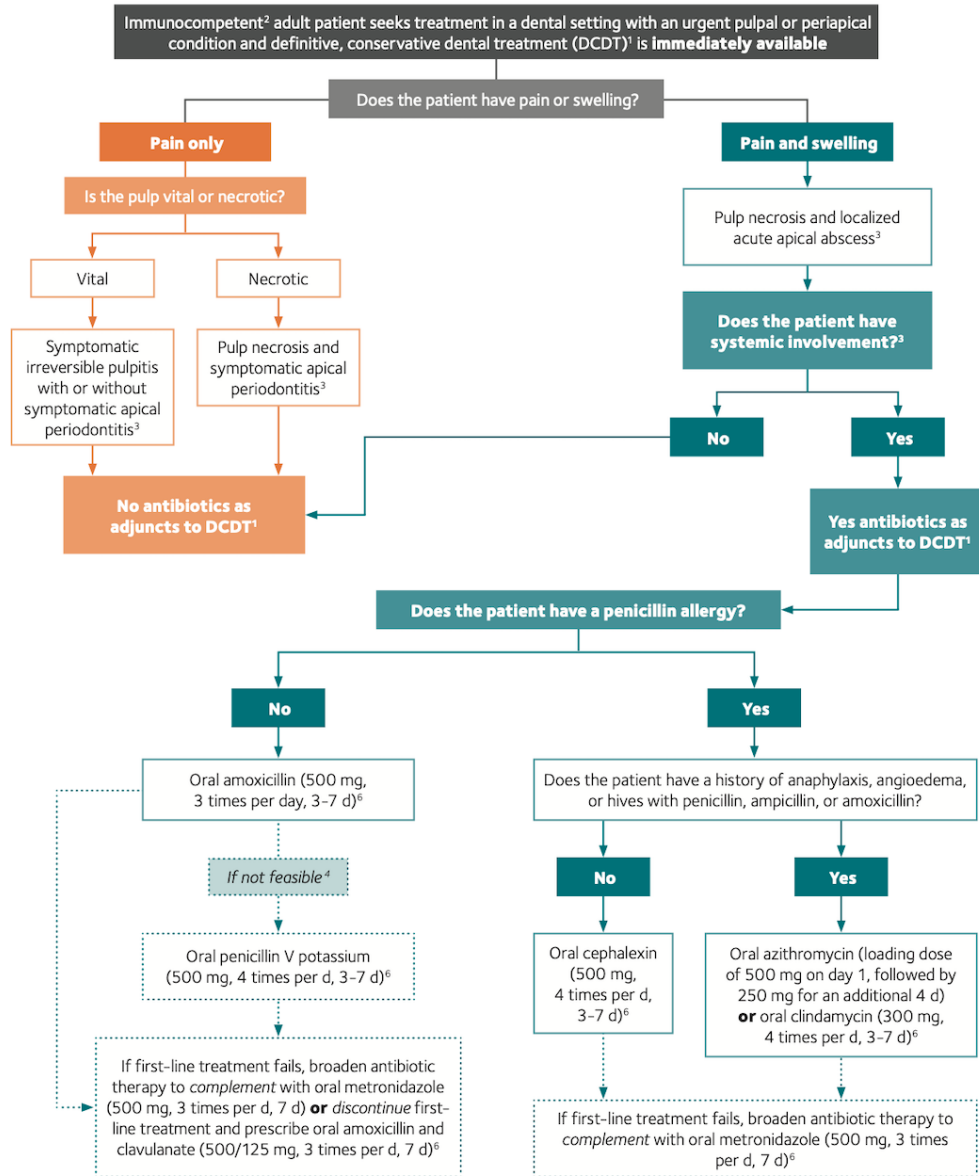
Clindamycin



- ▶ Narrow Spectrum
- ▶ Inhibits bacterial protein synthesis
- ▶ Bacteriostatic but bactericidal at high doses against gram-positive organisms, including anaerobes and B-lactamase producing strains.
- ▶ Great oral absorption
- ▶ Adverse gastrointestinal side effects
 - ▶ C.Diff

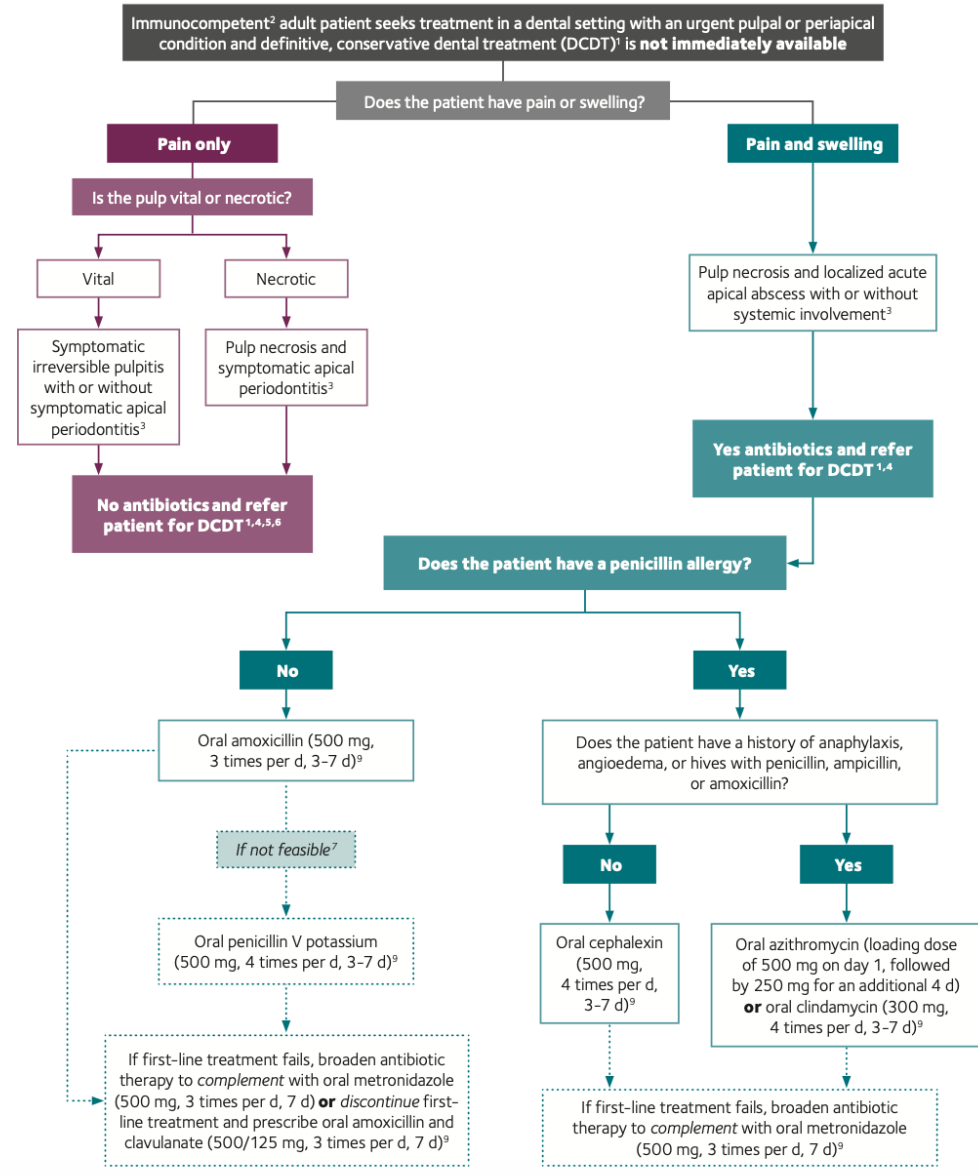


Evidence-Based Clinical Practice Guideline on Antibiotic Use for the Urgent Management of Pulpal- and Periapical-Related Dental Pain and Intraoral Swelling: A Report from the American Dental Association



See footnotes on opposite side.

Evidence-Based Clinical Practice Guideline on Antibiotic Use for the Urgent Management of Pulpal- and Periapical-Related Dental Pain and Intraoral Swelling: A Report from the American Dental Association



See footnotes on opposite side.

Antibiotics of Choice for Odontogenic Infections

Type of Infection	Antibiotic	Dosage
Early (first 3 days of infection)	Amoxicillin	500mg tid for 7 days
	Penicillin VK	500mg qid for 7 days
No response in 24-48 hours	Clindamycin	300mg tid or qid for 7 days
	Augmentin	500mg tid for 7 days
	Add Metronidazole to Amoxicillin	500mg qid for 7 days
	Cephalexin	500mg qid for 7 days
If allergic to Penicillin	Azithromycin (Z-Pak)	1 pack (6 x 250mg tablets) Take 2 tablets on day 1 and 1 tablet on days 2-5
	Clindamycin	300mg tid or qid for 7 days
IV Antibiotics	Unasyn	3g q 6 hours
	Cleocin	300 mg or 900 mg q 8 h

Special Considerations

Immunocompromised

- ▶ Cancer undergoing immunosuppressive chemotherapy
 - ▶ with febrile (39° C) neutropenia (absolute neutrophil count $< 2,000$)
 - ▶ severe neutropenia irrespective of fever (absolute neutrophil count < 500);
- ▶ Use of potent immunosuppressive drugs
 - ▶ Tumor necrosis factor alpha inhibitors
 - ▶ steroids (for example, prednisone > 10 milligrams per day). Organ transplant on immunosuppressants;
- ▶ Inherited diseases of immunodeficiency
 - ▶ congenital agammaglobulinemia
 - ▶ congenital immunoglobulin A deficiency
- ▶ Bone marrow transplant
- ▶ Organ Transplant
- ▶ Uncontrolled diabetes
- ▶ HIV
- ▶ Alcoholism
- ▶ Liver Disease

- ▶ “for patients with access to care issues, this guideline’s recommendations may be difficult to implement”

Implications For DOC

- ▶ Long lists for extractions, especially oral surgeon
- ▶ Medication administration times (BID, TID)
- ▶ Immunocompromised patients

Antibiotic Prophylaxis

AHA Recommendations

TABLE 1. Indications for Antimicrobial Prophylaxis¹

Prosthetic cardiac valves/material	<ul style="list-style-type: none">• Transcatheter implanted prosthetic valves• Annuloplasty, rings, or clips• Left ventricular assist devices or implantable heart
Congenital heart disease (CHD)	<ul style="list-style-type: none">• Unrepaired cyanotic congenital, including palliative shunts and conduits• Completely repaired defect with prosthetic material or device within 6 months after the procedure• Repaired CHD with residual defects at or adjacent to the site of prosthetic material• Surgical or transcatheter pulmonary artery valve or conduit placement
Previous, relapse, or recurrent infective endocarditis	
Cardiac transplant recipients who develop cardiac valvulopathy	

Management of patients with prosthetic joints undergoing dental procedures

Clinical Recommendation:

In general, for patients with prosthetic joint implants, prophylactic antibiotics are *not* recommended prior to dental procedures to prevent prosthetic joint infection.

For patients with a history of complications associated with their joint replacement surgery who are undergoing dental procedures that include gingival manipulation or mucosal incision, prophylactic antibiotics should only be considered after consultation with the patient and orthopedic surgeon.* To assess a patient's medical status, a complete health history is always recommended when making final decisions regarding the need for antibiotic prophylaxis.

Clinical Reasoning for the Recommendation:

- There is evidence that dental procedures are not associated with prosthetic joint implant infections.
- There is evidence that antibiotics provided before oral care do not prevent prosthetic joint implant infections.
- There are potential harms of antibiotics including risk for anaphylaxis, antibiotic resistance, and opportunistic infections like *Clostridium difficile*.
- The benefits of antibiotic prophylaxis may not exceed the harms for most patients.
- The individual patient's circumstances and preferences should be considered when deciding whether to prescribe prophylactic antibiotics prior to dental procedures.

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ADA. Center for Evidence-Based Dentistry™

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

Clindamycin no longer recommended for Premedication

- ▶ Clindamycin for dental prophylaxis was removed from the 2016 American Academy of orthopaedic Surgeons (AAOS)
- ▶ The 2021 AHA scientific statement no longer recommends the use of clindamycin for patients who are allergic to penicillin or ampicillin
- ▶ Severe adverse reactions such as *C. diff*
- ▶ One dose of clindamycin has an equivalent risk of *C. diff* compared with a prolonged course.
 - ▶ A Minnesota Department of Health found that 8% of community acquired *C. Diff* infections were related to prophylaxis for dental treatment.

Prophylaxis Prior to Dental Treatment

TABLE 1: Current antibiotic regimens prior to a dental procedure*

Patient status	Medication	Adults	Children
Can take oral medication	amoxicillin	2 g	50 mg/kg
Unable to take oral medication	ampicillin or cefazolin or ceftriaxone	2 g IM or IV	50 mg/kg IM or IV
		1 g IM or IV	50 mg/kg IM or IV
Can take oral medication and allergic to penicillin or ampicillin	cephalexin or azithromycin or clarithromycin or doxycycline	2 g	50 mg/kg IM or IV
		500 mg 100 mg	15 mg/kg <45 kg, 4.4 mg/kg >45 kg, 100 mg
Cannot take oral medication and allergic to penicillin or ampicillin	cefazolin or ceftriaxone	1 g IM or IV	50 mg/kg IM or IV

* Single dose should be taken or administered 30–60 minutes before a dental procedure.

Conclusion

- ▶ Use clinical and radiographic evidence to establish a diagnosis.
- ▶ Determine whether or not an antibiotic is necessary based on the diagnosis.
- ▶ Determine the appropriate antibiotic with the proper dosing intervals and duration to provide adequate treatment.

You are the Provider!

- ▶ These are all recommendations and guidelines
- ▶ Use best clinical judgement and take in the needs of each individual patient



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