Medications Ued In Dentistry

Continuing Education for Dentists, Registered Dental Hygienists, & Registered Dental Assistants

COURSE 03-4393-22056 | 3 CREDIT HOURS | LIVE INTERNET COURSE
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Introduction

This course will explore the antibiotics, analgesics, and local anesthetics that are commonly used in dentistry. Topics include different types of antibiotics and their best uses, bacteria resistance, and when to recommend antibiotic prophylaxis in cardiovascular, immune compromised and joint replacement patients.

Adverse reactions, common side effects and drug interactions will be reviewed. Types of local and topical anesthesia will be covered, as well as different onset and duration of local anesthetics. Pain medications, including opioids, will be addressed as well as discussing symptoms of overdose.

Disclosure of Relevant Financial Relationships:

Instructor: Dr. Kenneth Colerick – No relevant financial relationship to report

Education Advisory Committee (EAC): Members of the EAC have no relevant financial relationships to report.

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COURSE OBJECTIVES

AFTER COMPLETING THIS COURSE, THE CLINICIAN WILL LEARN:

1. What antibiotics are effective on oral bacteria.
2. What combination and dosages of antibiotics you can use.
3. How antibiotics work to remove bacteria.
4. How analgesics react to other drugs our patients are taking.
5. How analgesics affect our bodies; how they can become addictive.
6. How local anesthetics work and how they become sodium channel blockers.
7. Why vasoconstrictors are needed in local anesthetics.

ACCREDITATION

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Medications Used in Dentistry

Kenneth Colerick D.D.S.

This course will explore the Antibiotics, Analgesics, and Local Anesthetics that are commonly used in dentistry.

Antibiotics

History

In the 1920s thru the 1930s bacterial infections from staphylococcal and streptococcal infections were large killers along with pneumococcal and tubercular infections. Even small scratches could be very deadly. Tubercular infections were treated by isolating the patients in sanitarium and then waiting to see if the patient recovered or died. There was no cure until November 20th, 1944, when streptomycin was introduced by the Mayo Clinic. Today we use isoniazid, an antibiotic that stops the growth of bacteria.

Penicillin was first discovered in 1928 by Alexander Fleming. He was experimenting with a staphylococcal bacterium and discovered that the mold that had accumulated on his petri dish filled with the bacteria had an effect on it. He isolated the mold and identified it as a member of the Penicillium genus and called it penicillin. Later, he discovered it was not the mold but the juice the mold produced.

He found it difficult to produce the juice in large quantities until 1940 when he joined with Howard Florey and Ernst Chain. Then, in 1945 they were able to purify, and mass produce the antibiotic making it useful for World War II. It was the beginning of the golden era for antibiotics.

Between 1940 and 1962 most of the antibiotics used in medicines today were discovered and introduced into the market. Today we have over 170 modified versions of the previous types developed during the above period. There are very few novel antibiotics under development.

Now we have the problem of bacteria becoming resistant to the antibiotics we are using. Soon they will be by-passing the current antibiotics available.

The list of pathogens in the oral cavity is relatively long including cocci, bacilli, gram-positive and gram-negative organisms, aerobes, and anaerobes. The number of antibiotics is limited

and those that are used are becoming less effective. There are between 500 to 800 different species of bacteria in the oral cavity.

Bacterial Infections:

Most bacteria are not harmful, but the ones that are can infect parts of the body if they penetrate the body's protective epithelium and cortical bone. Pneumonia, meningitis, and food poisoning are a few examples of harmful bacteria. They come in three basic shapes: rod-shaped (bacilli), spherical (cocci), or helical (spirilla).

Bacteria may also be classified as gram-positive or gram-negative. Gram-positive bacteria have a thick cell wall, while gram-negative bacteria do not. Gram staining and bacterial cultures help identify the bacteria. This allows a more specific antibiotic to be used.

A sample of the patient's blood, skin tissue, wall of a cyst, etc. is given to the laboratory. Usually, the laboratory will furnish the container and suggest the method of transport.

The sample is placed on a blood agar dish and allowed to grow for 48 to 72 hours (for anaerobic bacteria). To determine the gram stain, a sample of the agar growth is subject to a series of dyes and stains, then the sample is placed under a microscope to determine if the stain took making it a gram positive, or a gram negative if it did not. The Gram staining also identifies the bacterium's shape and behavior.

- Cocci is round in shape
- Bacilli are rod-shaped
- Some bacteria form clusters whilst others form chains

Antibiotic sensitivity testing?

The cultured bacteria are also used for the antibiotic sensitivity testing to determine which antibiotics would be the most effective. This is done by applying various antibiotics to the agar plate and see which one prevents the bacteria from growing.

We want to determine:

- The effectiveness of particular antibiotics against particular bacteria
- Whether the bacteria are resistant to selected antibiotics
- To identify bacterial antibiotic resistance patterns.

Antibiotics

Classes of antibiotics we will be discussing in this paper:

- Sulfonamides (Sulfadiazine)
- Penicillin (Ampicillin)
- Cephalosporins (Keflex, Cefazoln)
- Aminoglycosides (Plazomicin)
- Tetracycline (Doxycycline)
- Macrolides (Erythromycin)
- Macrolides (Azithromycin (Z-Pac))
- Lincosamides (Clindamycin)
- Glycopeptides and lipoglycopeptides (such as vancomycin **1972**)

Sulfonamides (Sulfa Drugs)

1935 Gerhard Domagk, a German physician turned research scientist, created the first sulfa drugs or sulfonamides to be used on bacterial diseases. He was given credit for creating Prontosil (prontosil ruburm) that attacked Streptococcal and staphylococcal infections. He treated his daughter, who had a severe streptococcal infection from a used needle, with Prontosil. His daughter recovered, but she had to endure a permanent discoloration of the skin owing to the drug.

We know antibiotics have been around in ancient times by looking at human skeletons. The ancient bones and teeth during the Egypt and Roman eras left traces of tetracycline chelators. The antibiotic gives the teeth a purplish color. This is the main reason we do not give tetracycline to children under two or pregnant patients.

Sulfonamides:

- **Sulfadiazine**
- Sulfisoxazole (Gantrisin)
- Bactrim or Septra trimethoprim sulfamethoxazole
- Azulfidine (sulfasalazine)
- Zonegran (zonisamide

Sulfonamides are broad spectrum and attack the following bacteria:

- Streptococcus
- Staphylococcus
- Anaerobic bacteria
- Nocardia
- Enterobacter
- Salmonella and more

Sulfonamides, or "sulfa drugs," are a group of medicines used to treat bacterial infections.

- The drugs do not work on the cold or flu.
- They work by preventing the growth of bacteria in the body.
- They come in different formulations and may be taken as an oral, topical, vaginal, or ophthalmic (eye) medicine.
- These drugs may make your skin more sensitive to the sun. Avoid unnecessary exposure to sunlight, and wear sunscreen and protective clothing while outdoors.
- Sulfonamides may make you dizzy. Don't drive or perform activities that require alertness until you know how your medicine affects you.
- Check what other drugs the patient is taking?
- What are the interactions of the antibiotic with these drugs?
- If using more than one antibiotic, what are the interactions of the combined antibiotics?

Sulfadiazine - Sulfonamides

They eliminate bacteria that cause infections by stopping the production of folic acid (vitamin B9) inside the bacterial cell, and is commonly used to treat urinary tract infections and burns. They stop the growth of the bacteria by inhibiting the enzyme dihydropteroate synthetase.

The medication is taken by mouth with 8 ounces of water. It is important to take the water to avoid crystallization of the folic acid in the stomach.

If used during pregnancy, it could cause irreversible neurological damage.

Effective against beta hemolytic organisms (break down of the hemoglobin of the red blood cells in the vicinity of a bacterial colony).

Streptococcus Pyogenes
Streptococcus Aureus
Streptococcus GSms (pathogen passed to babies during birth.)

Used for:
Acute alveolar abscess, osteomyelitis of the jaws, cellulitis of the face or neck, or general sepsis of dental origin.

Toxicity: formation of small papules on the tongue, lips, cheeks, or palate, and occasionally involving the gingivae. Appearance is similar to that of a herpetic stomatitis

Effective against:
- Pseudomonas Aeruginosa a Gram-negative rod motile by means of a single polar flagellum.
- Enteric rod-shaped Gram-negative bacteria, rigid cell walls; motile types have flagella.

Penicillin

Fortunately, penicillin is still working well by inhibiting the bacterial cell wall synthesis making them bactericidal. There are many kinds of penicillin drugs, but they all have the **beta-lactam ring** in their makeup.

They are cross allergenic with cephalosporin (Keflex) because the cephalosporin has the **beta-lactam ring**.

Penicillins Developed:

- Penicillin G — IV, more sensitive to acid degradation
- Penicillin V — Oral
- Amoxicillin — broad spectrum
- Augmentin — amoxicillin Plus clavulanic acid (beta lactamase-resistant)
- Dicloxacillin — Beta lactamase-resistant
- Methicillin — Beta lactamase-resistant
- **Ampicillin** — best/broadest gram-negative spectrum
- Carbenicillin — used specifically against pseudomomonas

Ampicillin – Penicillin Discovered in 1958 became commercial in 1961

The ampicillin is probably one of the best broad-spectrum gram-negative antibiotic of the above group. It works by stopping the growth of bacteria. It inhibits the bacteria cell wall synthesis by inhibiting the enzyme transpeptidase the bacteria need to build their walls.

It is used to treat a wide variety of bacterial infections. They are also called **beta-lactams** because of the 4-member wall or the beta-lactam ring. In dentistry ampicillin is used for dental abscesses. It works well against streptococcus mutans, Lactobacillus, and Streptococcus sobrinus that create lactic acid that is responsible for dental decay.

It can be administered by intramuscular injections, Intravenous infusion, or oral form. IV injections must be given slowly, as rapid IV injections can lead to convulsive seizures

Administering:

Adults:

- Orally: 250-500 mg every 6 hours (bid)
- Intravenously/intramuscularly: 1-2 g every 4-6 hours or 50-250 mg/kg/day divided every 4-6 hours, not to exceed 12 g/day

Pediatric:

- 400 mg/kg/day intravenously/intramuscularly divided every 6 hours
- 50-100 mg/kg/day orally divided every 4-6 hours, not to exceed 12 g/day
- Severe infection: 200-400 mg/kg/day intravenously/intramuscularly divided every 6 hours
- Potential toxic dose: Children under 6 years: 300 mg/kg

Used to treat oral, urinary, respiratory, and GI infections, biliary tract infections, meningitis, salmonellosis, and endocarditis. Pregnant woman can take penicillin but it does cross over the placenta. In newborns ampicillin has a longer half-life because of the kidneys are not fully developed.

Overdose:

Ampicillin overdose can cause behavioral changes, confusion, blackouts, and convulsions, as well as neuromuscular hypersensitivity, electrolyte imbalance, and kidney failure.

Large doses of ampicillin can increase the risk of bleeding with concurrent use of warfarin and other oral anticoagulants, possibly by inhibiting platelet aggregation.

The most common side effects:

- Rashes
- Nausea

The drug is excreted mainly by the kidney and may determine the dosage if there is renal disfunction.

Ampicillin is distributed to the liver, bile, muscle, kidney, crop, and fat following absorption from the GI or injection site. It is excreted in the bile.

Ampicillin **should not be used** with other antibiotics such as erythromycin or tetracycline. Tetracyclines inhibit protein synthesis in bacteria, reducing the target against which ampicillin acts.

Clavulanic acid is a beta-lactamase inhibitor, which is added to **amoxicillin** and sold as **Augmentin** to help prevent antibiotic resistance.

Cautions:

- If you are allergy to penicillin, then you are also allergic to cephalosporins because they have the same **beta-lactam ring**.
- Renal failure can present with a rash that is difficult to distinguish from a hypersensitivity reaction to penicillin.
- Prophylaxis Penicillin use is for high-risk patient's only, example: endocarditis.
- Prolong use of penicillin can lead to fungal or superinfections.
- Must take on an empty stomach to increase absorption, which can cause stomach upset.
- Not recommended to be used for the cold or flu
- Birth control pills are less effective.
- Ampicillin can alter the normal bacteria in the colon and encourage overgrowth of some bacteria such as Clostridium difficile which causes inflammation of the colon (pseudomembranous colitis).

Cephalosporins

Cephalosporins are bactericidal by inhibiting cell wall synthesis. They are also a **Bata-lactam.**

1st generation = **Cephalexin (Keflex)**

2nd generation = Cefuroxime

3rd generation = Ceftriaxone

4th generation = Cefepime

5th generation = Ceftaroline

Cephalexin-(Keflex) - Cephalosporins
semisynthetic cephalosporin capsule

Works best on gram-positive bacterial infections.

Note: **Beta Lactam ring**

Cephalosporins are bactericidal by inhibiting cell wall synthesis. They are also a Bata-lactam similar to penicillin.

They are available in capsule, tablet, and suspension form and can be taken by mouth.

Keflex Capsule: 250, 500, 750 mg

Dosage: Treatment for 7 to 14 days

Adult

- 250 mg every six hours (Maximum of 4000mg/day)
- 500 mg every 12 hours (strep throat, skin infections, cystitis)

Child over 1 yr.

- 25 to 50 mg/ kg/day administered 7 to 14 days
- **Otitis media infection** (middle ear infection): 75-100 mg/kg/day

May be given with or without food.

Side Effects:

- Diarrhea (mild to fatal) *Clostridium difficile*-associated diarrhea (CDAD)
- Nausea
- Vomiting
- Gastritis
- Tiredness
- Headache
- Belching
- Redness of the skin
- Upset stomach

Drug Interactions

- Metformin (treat **type 2 diabetes)** increases plasma metformin concentrations and decreases renal clearance of metformin.
- Probenecid (**gout** and gouty **arthritis**)- renal excretion of Keflex is Inhibited by probenecid (a drug that acts on the kidneys to eliminate uric acid) to treat gouty arthritis
- Hypersensitivity Reactions: If the patient has hypersensitivity to other **Beta Lactam** drugs, they should avoid Keflex.

Prolong use of Keflex result in overgrowth of non-susceptible organisms

Nursing Mothers

- Cephalexin is excreted in human milk
- Do not take if pregnant, planning on getting pregnant, or breastfeeding

Renal Impairment:

- Drug is excreted by the kidney, risk toxic reaction

Overdose:

Include nausea, vomiting, epigastric distress, diarrhea, and hematuria (blood in the urine)

Excretion:

Cephalexin is excreted in the urine.

90% of the drug was excreted unchanged in the urine within 8 hours.

Bacteria Resistant to Keflex:

- Staphylococci
- Pseudomonas spp
- Enterobacter spp
- Morganella morganii
- Proteus vulgaris
- Any bacteria resistant to penicillin

Cephalexin (Keflex) are active against:

Gram-positive Bacteria

- Staphylococcus aureus (methicillin-susceptible isolates only)
- Streptococcus pneumoniae (penicillin-susceptible isolates)

- Streptococcus pyogenes

Gram-negative Bacteria

- Escherichia coli
- Haemophilus influenzae
- Klebsiella pneumoniae
- Moraxella catarrhalis
- Proteus mirabilis

Keflex is also used before dental procedures in patients with known endocarditis to prevent infections.

Before taking Cephalexin (Keflex) You need to check for:

- Allergies - since it has the same **Beta Lactam ring** as penicillin, the allergies would be very similar.
- Interactions with numerous medications such as warfarin, metformin, probenecid, other antibiotics, and certain vitamins.
- May increase clotting time.
- Use caution if diagnosed with a liver or kidney disease.
- Liquid cephalexin may interact with diabetes due to the sugar content.
- Discuss with a medical provider if you have a history of intestinal problems.

Aminoglycosides

Aminoglycosides are **bactericidal** in that they kill bacteria directly by inhibiting the protein synthesis. They are used for to treat serious infections caused by bacteria that either multiply very quickly or are difficult to treat. They are commonly prescribed for children.

They are broad-spectrum and used for **gram-negative bacteria**. They do **not** do well with Gram-positive and anaerobic Gram-negative bacteria.

There is synergy with Beta-Lactams and Vancomycin. If administered separately, aminoglycosides and ampicillin can potentiate each other.

It can be made less effective by other antibiotics, such as erythromycin, cephalosporins, and tetracyclines that inhibit protein synthesis in bacteria, reducing the target against which ampicillin acts.

Aminoglycosides members:

- Gentamicin
- Tobramycin
- Amikacin
- Plazomicin
- Streptomycin
- Neomycin
- Kanamycin
- Paromomycin

Plazomicin Aminoglycosides

Plazomicin Sulfate

As of 2019 Plazomicin Sulfate was sold under the brand name Zemdri. It is a semi-synthetic derived from sisomicin. It is a colorless-to-yellow liquid.

It is the most current antibiotic to come onto the market. This antibiotic should be reserve for the most stubborn bacteria. It is given via vein injections. It is an aminoglycoside and acts by binding the bacteria 30S ribosomal subunit, inhibiting the protein synthesis.

Administered: 500mg/10ml one intravenous injection once a day. (Vial contains water, sodium hydroxide, 500 mg of plazomicin.) Or

15mg/kg every 24 hours with infusion over 30 minutes for adults.

Duration: 7 to 10 days

Primarily renal elimination (kidneys) and requires dose adjustment for renal dysfunction.

Look for any discoloration.

Plazomicin is active against: Aerobic Bacteria - Gram-negative bacteria

No antagonism when used in combinations with **clindamycin**, or **vancomycin.**

Some Adverse Reactions:

- Diarrhea (mild to fatal)
- Hypertension
- Headache

- Nausea
- Vomiting
- Hypersensitive reactions
- Neuromuscular (weakness) problems especially for patients taking neuromuscular blocking agents
- Drug can cause fetal harm when administered to a pregnant woman.

Tetracyclines

Doxycycline –(Vibramycin) Tetracycline (Bacteriostatic/Protein Synthesis Inhibitors)

- Tetracycline has been on the market for over 60 years. Doxycycline is a synthetic (man-made) antibiotic derived from tetracycline. It is used in the treatment of many gram-negative and gram-positive infections.
- It should **not** be used on woman in their second and third trimesters, and on children under the age of eight because it will **cause permanent stains** of the **enamel** of the teeth. These can range from a light fluorescent yellow to a nonfluorescent brown or purple. The degree depends to the amount of time the drug was used. The staining is permanent and can extend deep into the enamel.
- It occurs because the **tetracycline binds to the calcium orthophosphate**. This gives a fluorescent yellow. Then upon eruption the teeth are exposed to light allowing the tetracycline to oxidize. This changes the color to nonfluorescent brown. It is recommended to avoid the sunlight or sunlamp to minimize the staining effect.
- Tetracycline is a bacteriostatic, broad-spectrum antibiotic that prevents the growth of bacteria by preventing the manufacturing of proteins in the bacteria.

Drug Interactions:

- Should **not** be used with penicillin (Tetracycline bacteriostatic stops grows and prevents penicillin from killing bacteria).
- Should **not be** taken with calcium-based antacids (Mylanta, Maalox, Tums). These medications bind doxycycline in the intestine and prevents absorption.
- Should **not be** taken with minerals such as iron, calcium, or with Pepto Bismol.
- Should **not b**e taken with methoxyflurane (Penthrane) (reducing pain as the result of trauma). It could result in fatal renal toxicity.

- Should **not be** used while pregnant or breastfeeding. (Toxic effect on bone and staining of teeth)
- Brand Names: **Vibramycin**, Atridox, Doxy, Monodox, Adoxa, Acticlate

Dosage:

- 200 mg on first day then 100mg every 12 hours for 7-14 days. Can take 200 mg once a day.
- For some infections tetracycline is required at 2g/day divided up in 2 to 4 times a day.
- Food and dairy products affect dosage. Therefore, wait two hours before and after meals.

Some Side Effects for: (usually these the drug is well tolerated)

Doxycycline:

- Diarrhea
- Nausea
- Abdominal pain
- Vomiting
- Discoloring teeth if patient under 8 years.
- Exaggerated sunburn (it is photosensitivity)

Interactions:

- Doxycycline has serious interactions with at least 67 different drugs.
- Doxycycline has moderate interactions with at least 51 different drugs.
- Doxycycline has mild interactions with at least 32 different drugs.
- Tetracyclines don't work as well if you take them at the same time as calcium, iron, antacids like Tums or Maalox, or foods such as milk, cheese, or nuts.

Arestin minocycline HC (Tetracycline)

Arestin Microspheres 1mg tetracycline are applied with pressure into periodontal pockets of 5 mm plus after the root planning has been performed. It remains for 30 days killing bacteria and reducing the depth of the periodontal pocket.

The cost is sometimes prohibitive. The dentist cost can be $15 per cartridge and the patient cost from $45 to $60 and upwards.

Kills bacteria by preventing their growth

Dental Side Effects:

- Tooth Pain
- Pain or Swelling in Your Gums
- Fever, Swollen Glands, Rash or Itching, Joint Pain or Swelling, Muscle Aches, General Ill Feeling
- **Severe Skin Reaction**--fever, sore throat, swelling in your face or tongue, burning in your eyes, skin pain followed by a red or purple skin rash that spreads (especially in the face or upper body) and causes blistering and peeling.
- Yeast Infections

Arestin should not be used during tooth development children, pregnant or nursing women because it may cause permanent discoloration of the teeth.

Macrolides

Erythromycin, Clarithromycin, Azithromycin (Zithromax, Z-Pac)

Erythromycin Macrolides

Erythromycin was isolate in 1952. The World Health Organization (WHO) describes this drug to the safest and most effective medicines needed in a health system. It is considered a generic medication.

Erythromycin is **bacteriostatic**. It stops the growth of bacteria by interfering with their ability to make protein while not affecting human cells.

It can be taken with food or milk. It has a bitter taste if crushed. Therefore, the tablet should be swallowed and not chewed.

It is excreted in the bile with 5% unchanged in the liver.

The drug can be administered by mouth, intravenous, intramuscular, topical, or eye drops.

The drug is used for patients who are allergic to penicillin, and those that have health issues that need dental work (endocarditis – valvular abnormalities of the heart).

Some Sided Effects:

- Abdominal cramps

- Vomiting
- **Diarrhea** is probably the most serious side effects if it develops into Clostridium difficile colitis.
- Liver problems

Dosage:

Adult:

- Tablet 250 mg every 6 hours
- Tablet 333 mg every 8 hours
- Tablet 500 mg every 12 hours
- Dosage can be increased to 4 g/day for severe cases.
- Suspension: 200 and, 400 mg/teaspoon.
- Tablet (Chewable): 200 mg. Powder: 100 mg/half-teaspoon and 200 mg/teaspoon.
- Granules: 200 and 400 mg/teaspoon.
- Powder for Injection: 500 mg and 1g.

Child:

- 30 to 50 mg/kg/day depending on the age, weight, and severity of the infection.

It is best to take the drug on an empty stomach (30 minutes to 2 hours before and after meals to obtain the best blood levels of the drug. Though it can be taken with food to ease the stomach reactions.

If **erythromycin and doxycycline (tetracycline)** are used together they have a synergistic effect for 72 hours that is greater than the sum of the two drugs used separately. Though after the 72 hours it shifts to be **less than** if the two drugs are administered separately killing less bacteria.

Erythromycin diffuses into most tissues and phagocytes that transport the erythromycin to the site of infection.

Erythromycin prevents the elimination of warfarin and raises its level in the blood leading to the risk of bleeding.

Erythromycin inhibits the breakdown of statins such as **Lipitor** by the liver leading to increased levels of statins in the blood that could result in severe myopathy (muscle damage) and kidney damage.

Erythromycin also can elevate blood levels of some anti-seizure drugs by preventing the breakdown of the drug by the liver, therefore you would need to reduce the doses of the anti-seizure drug

Before you administer erythromycin, you need to see what the patient is presently taking and adjust the drugs accordingly.

Grapefruit juice may prevent the breakdown of erythromycin, resulting in elevated levels of erythromycin in the blood. Therefore, it is important to avoid eating grapefruit or drinking grapefruit juice during treatment with erythromycin.

Erythromycin does cross the placenta, but there have been no active studies on its effect.

Erythromycin is excreted in breast milk. Therefore, caution should be exercised, but it is prescribed to women who are breastfeeding.

Erythromycin should be stored at temperatures below 86 F (30 C). It is important to protect tablets from moisture and excessive heat.

Azithromycin (Z-Pak) – Macrolides

Approved by the FDA in 1991. The drug is a **Bacteriostatic** drug (protein synthesis inhibitor), a semi-synthetic macrolide antibiotic. It prevents bacteria from multiplying and producing the proteins that are essential for their growth. The remaining bacteria are killed by the patient's immune system and not by the drug.

> In August 2018, the U.S. Food and Drug Administration warned of an increased risk of cancer relapse and death in some patients who take the drug long-term.
>
> Zithromax does not break down in the body as quickly. Instead, it floats freely in the blood. The drug molecules are picked up by white blood cells and taken to the bacteria where it becomes concentrated in the tissues surrounding the infection. The concentration helps it to remain in the tissues longer. Therefore, the patient needs fewer doses to beat their infections.

Dosage:

Orally: You are given six pills of 500 mg each. Take two to start then one pill a day for 4 days.

Intravenous: 500 mg for 2 days followed by 500 mg orally daily for an additional 5-8 days. Administer the solution by intravenous infusion over a period of 60 to 90 minutes.

Possible Side Effects of Zithromax: (Z-Pak)

- Diarrhea or loose stools
- Nausea
- Abdominal pain
- Stomach upset
- Vomiting

Drugs that react to Zithromax include:

Nelfinavir

A drug used to treat HIV infections. It can increase the amount of Zithromax in the blood.

Warfarin

is a blood thinner. Taking Warfarin with Zithromax increased the blood thinning effect.

Should not take the drug if you have had the following:

- Liver disease
- Kidney disease
- Myasthenia gravis
- A heart rhythm disorder
- Low levels of potassium in your blood

Do not take drugs that contain aluminum or magnesium (Maalox, Maldroxal, Milk of Magnesia) within two hours before or after.

Take Z-max extended-release liquid (oral suspension) on an empty stomach, at least 1 hour before or 2 hours after a meal.

Lincosamides

Clindamycin – Lincosamides

Clindamycin is a broad-spectrum antibiotic, bacteriostatic in that it is a protein synthesis inhibitor.

Clindamycin was first made in 1966 from lincomycin (injectable solution only). It is used to remove **aerobic and anaerobic bacteria** in dental infections. It is the drug of choice when people are hypersensitive to penicillin, but there is **four times the risk of colitis (inflammation or the colon).**

Clindamycin can alter the bacterial composition of the colon and cause an **overgrowth of the Clostridium difficile (C. difficile) bacterium**. The bacterium produces toxins that can cause

C. difficile associated diarrhea (CDAD). Therefore, it is considered a last resort medication. It is generally safe in pregnancy.

Depending on the type of infection and the dosage of clindamycin, the drug can either kill or stop the growth of bacteria.

It is used as a preventive treatment for endocarditis, an infection of the heart's lining that can occur after a dental procedure in people who are at risk.

Before undergoing surgery, some people need to take clindamycin to prevent surgical site infections.

It is most effective against:

- Aerobic Gram-positive cocci (Staphylococcus and Streptococcus pneumococcus and genera, but not enterococci.
- Anaerobic, Gram-negative rod-shaped bacteria (Bacteroides, Fusobacterium)
- Most aerobic Gram-negative bacteria are resistant to clindamycin

Dosage:

Adults:

- Infections, 150–300 mg capsule every 6 hours
- Severe infections, 300–450 mg capsule every 6 hours

The dosages for children who can swallow capsules are:

- Infections, 8–16 milligrams per kilogram (mg/kg) per day, divided into three or four equal doses
- Severe infections, 16–20 mg/kg per day, divided into three or four equal doses

For people who have difficulty swallowing, clindamycin comes in granules that a person can dissolve in water.

Patients with colitis possibilities, should take the injections.

Injection by injection into a vein

- Clindamycin phosphate injection 12 mg/ml (Infection 150 mg)
- Clindamycin phosphate injection 18 mg/ml (Infection 300 mg)
- Clindamycin phosphate injection 150 mg/ml (Serious Infection 450 mg))

Some Side Effects:

- Diarrhea
- Rash
- Abdominal Pain
- Irritation of The Esophagus
- Nausea and or Vomiting

Warning:

People with a history of pseudomembranous or ulcerative colitis should not take clindamycin.

A biopsy should be taken from the infection site and sent to the lab. This will identify the bacteria causing the infection and allow you to select the correct antibiotic to control it.

Glycopeptide antibiotics

Vancomycin – Glycopeptide

- Vancomycin is used to treat infections in the intestines (colitis) where the bad bacteria have taken control. When it is taken by the mouth, it stays in the intestine to stop the growth of bacteria that bring on the colitis symptoms. It works by inhibiting the bacterial cell wall biosynthesis.
- The oral Vancomycin used to treat intestinal infections that are caused by multidrug-resistant Gram-positive pathogens, such as Staphylococcus aureus, Enterococcus spp. and Clostridium difficile. It was first available in 1972.
- The IV Vancomycin should not be used for intestinal infections.
- Over 90% of the dose is excreted in the urine. Therefore, there is the possibility of kidney damage from overuse.
- Dosage: This depends on what the drug is treating, but the usual dosage for an adult is:
- 2 g divided either as 500 mg q6hr or 1-gram q12hr.
- The Initial daily dose should be no less than 15 mg/kg

Some Possible Side Effects:

- Bitter taste
- Reddish rash
- Low blood pressure accompanied by flushing

- Nausea
- Vomiting

Vancomycin has moderate interactions with at least 30 different drugs.

Vancomycin has **minor** interactions with at least 55 different drugs.

Conclusion:

Usually, the glycopeptide antibiotics are restricted to patients who are critically ill, hypersensitive to Beta-lactams, or who are infected with Beta-lactams resistant bacteria. Glycopeptides are very effective against gram-positive cocci, and bactericidal against enterococci. Glycopeptide do not penetrate all tissues especially cerebrospinal fluid.

Chlorohexidine Gluconate

The chlorhexidine molecule's positive charge, reacts with the microbial cell surface, destroys the integrity of the cell membrane, penetrates into the cytoplasm, and the cell dies. It is a board spectrum antibiotic.

It is used to treat periodontal disease (gingivitis - periodontitis), and as an irrigant for root canal therapy. It binds tightly to oral tissues and releases slowly providing a sustained effect. It can penetrate plaque biofilm and kill bacteria inhibiting plaque formation.

It comes in liquid form (Periogard .2%), gel, and periodontal chips.

Periogard (Peridex) is used for mouth rinses and for rinsing acute periodontal pockets after root planning has removed the debris.

Also used as a mouth rinse (15 ml undiluted), twice a day by swishing for 30 seconds after toothbrushing. Should avoid eating, drinking after using this medication

The **chlorhexidine gel** is for gingivitis conditions and necrotizing ulcerated gingivitis. It is spread over the infected condition after the debris has been removed. It can be used for treating gum disease, mouth ulcers, and oral thrush.

The **chlorhexidine chip** is used for reducing infection in periodontal pockets of 5 mm or more. It is known to work against a wide range of bacteria including: Porphyromonas (Bacteroides) gingivalis, Prevotella (Bacteroides) intermedia, Bacteroides forsythus.

The chip initially releases 40% of the chlorhexidine within the first 24 hours, the rest is slowly released over 7 to 10 days.

Placing the Perio Chip in an acutely abscessed periodontal pocket has not been researched and is not recommended.

Some Side Effects:

Most Common:

- Chlorhexidine gluconate can stain teeth, dentures, tooth restorations, your tongue, or the inside of your mouth.
- It may also stain anterior fillings requiring replacement.
- There is a change in taste.
- There may be an increase of calculus on the teeth.
- Dry mouth,
- Unusual or unpleasant taste in your mouth,
- Decreased taste sensation,
- Tongue swelling,
- Mouth sores.

Less Common:

- Mouth irritation
- swollen glands on side of face or neck
- tongue tip irritation

Chlorhexidine should not be used by anyone younger than18 years of age. It is unknown if it will harm the unborn baby.

The American Dental Association (ADA) recommends:

- Oral amoxicillin 500 mg three times a day for 3 to 7 days.
- Oral ampicillin (as a second option): 500 mg four times per day for 3 to 7 days.

If you have a mild penicillin allergy, the ADA recommends:

- Oral azithromycin (Z Pac): starting at 500 mg first day with 250 mg for four days.
- Oral clindamycin: 300 mg four times a day for 3 to 7 days.

If these antibiotics are not working, then use amoxicillin with clavulanate. Clavulanic acid is a beta-lactamase inhibitor, which is added to amoxicillin (Augmentin) to help prevent antibiotic resistance.

Drugs that are unrelated to penicillin (Allergic Patient).

- Tetracyclines (E.G., Doxycycline)
- Quinolones (E.G., Ciprofloxacin)
- Macrolides (E.G., Azithromycin)
- Aminoglycosides (E.G., Plazomycin)
- Glycopeptides (E.G., Vancomycin) – Used for intestinal bacteria only

Antibiotic Prophylaxis

Antibiotics Prophylaxis:

First Choice	Amoxicillin 2g	1 hr. before tx
Children, First Choice	Amoxicillin 50 mg/kg	1 hr. before tx
Penicillin allergy	Clindamycin 600 mg	1 hr. before tx
Children penicillin allergy	Clindamycin 20mg/kg	1 hr. before tx
Non oral IV or IM	Ampicillin 2g	30 min before tx
Children non oral IV or IM	Ampicillin 50 mg/kg	30 min before tx

Following Conditions:

Cardiovascular:

- Prosthetic heart valve
- History of endocarditis
- Heart transplant
- Congenital heart problems

Compromised immunity

- Organ transplant
- Neutropenia
- Cancer therapy

Infective Endocarditis
Joint Replacements

Antibiotic Prophylaxis is not required:

Cardiac Pacemaker

Rheumatic fever without valvular dysfunction

Mitral value prolapse without valvular regurgitation

Review: Drug Interactions:

Cidal and static drugs cancel each other out because the static drug prevent bacteria from growing making it difficult for the cidal drugs (penicillin) to kill bacteria when they are rapidly growing. It should be one or the other.

Tetracycline should **not** be used with antacids or dairy products because they will interfere with the absorption of the drug by 50 to 90 percent.

Broad spectrum antibiotics Cephalexin and Clindamycin have minimal interactions with anticoagulants (warfarin). Other antibiotics including the antifungal agents heightens warfarin's blood thinning ability. Both drugs need to be monitor for best results.

Macrolides (Z-Pac) effect on digoxin: Digoxin is commonly prescribed to elderly patients with heart failure and atrial fibrillation. The **macrolide antibiotics**, specifically the **erythromycin** and **clarithromycin** can increase the risk of serious ventricular arrhythmias and can increased the risk of sudden cardiac death. They markedly increase the risk of digoxin toxicity.

Superinfection is caused when microorganisms become resistant to the current antibiotic. This can be concurrent with the initial infection. This can also be a secondary infection after the antibiotic, especially a board spectrum antibiotic, has killed all of the protective bacteria.

Using antibiotics **can cause** the **bacterium Clostridium difficile** (C. diff) to grow and infect the lining of the intestine, which produces the inflammation and colitis. Certain antibiotics, like **penicillin, clindamycin, and the cephalosporins (Keflex),** make C. diff overgrowth more likely.

Vancomycin oral on the other hand can stop the growth of the bacteria that bring on the colitis symptoms.

High doses of intravenous tetracycline can induce fatty liver disease and may result in severe hepatic dysfunction, acute liver failure and death. This syndrome is more common among pregnant women, largely during the last trimester or early postpartum period. Other antibiotics that can cause liver damage are amoxicillin/clavulanic acid, flucloxacillin and erythromycin.

Clindamycin has excellent bone penetration. It can be used with other antibiotics to treat osteomyelitis.

- Amoxicillin-clavulanate 875 mg/125 mg PO q12h or.
- Ciprofloxacin **(Avelox)** 750 mg PO q12h plus **clindamycin** 300-450 mg PO q6h

Tetracycline – **gingival crevicular fluid** level are 2 to 4 times that in blood levels.

Tetracyclines appear to possess anti-inflammatory, anti-collagenase, wound-healing properties and reduce bone loss.

Beta-lactamase inhibitors prevent bacteria from destroying ampicillin.

- Dosing: Ampicillin-**sulbactam** (beta-lactamase inhibitor) 3 g intravenously (IV) every 6 hours
- Dosing: Amoxicillin-**clavulanate** (beta-lactamase inhibitor): 875 mg orally every 12 hours
- Macrolides (Azithromycin – Erythromycin) should not be the first line of antibiotics unless the patient has Penicillin or Cephalosporin (Keflex) allergy. Anaerobic bacteria such as Strepococci and Prevotella are establishing resistance to the antibiotics.

Clindamycin is a good option for patients with allergies to penicillin and cephalosporins (Keflex). Clindamycin has coverage against gram-positive organisms, anaerobes, B-lactam resistant organisms and has good bone penetration. It was demonstrated that Clindamycin was equally as effective in treating severe **odontogenic infections** as Penicillin V.

Dosing: Clindamycin 600 mg IV every 6 to 8 hours

Other antibiotics to use for the penicillin allergic patient:

- Tetracyclines (e.g., doxycycline)
- Quinolones (e.g., ciprofloxacin)
- Macrolides (e.g., Azithromycin)
- Aminoglycosides (e.g., Plazomicin)
- Glycopeptides (e.g., vancomycin)

Antibiotics for tooth infection include:

- Amoxicillin
- Ampicillin
- Cephalexin (Keflex)
- Clindamycin
- Azithromycin (Z Pac)

You can start with one of the drugs above, but a culture should be obtained as soon as possible to find the bacteria responsible for the infection and use the correct drug to counter it.

Usually this takes a couple of days. Therefore, one of the above drugs should be used in the meantime.

Drug Interactions

Antibiotics can interact with other drugs. Zithromax or Z-Pak (azithromycin), generally do not have many drug interactions.

Other antibiotics like fluoroquinolones and tetracyclines, do **not** do well if they are taken at the same time as calcium, iron, antacids like Tums or Maalox, or foods such as milk, cheese, or nuts. Therefore, the antibiotics should be taken a few hours before consuming these products.

Usual Dosage for odontogenic infections:

Antibiotic	Usual Adult Dosage	Usual Pediatric Dosage
Aminoglycosides	500 mg/10ml IV	
Amoxicillin	500 mg every 8 hr	25-50 mg/kg/day divided into 4 doses
Cephalosporin Keflex	500 mg every 12 hr	25-50 mg/kg/day divided into 4 does
Clindamycin	300-400 mg every 6 hr	10-30mg/kg/day divided into 3 or 4 doses
Erythromycin (ZPac)	500 mg 8hr,250 very 6 hr	30-50 mg/kg/day divided into 2-4 doses
Monobactam	75 mg IV / 8hr	
Vancomycin	500 mg q6hr	
Vibramycin(Tetracyline)	200mg Start 100mg/12hr	

Drugs Used in Dentistry, Analgesics

We usually do not use an excessive amount of analgesics in dentistry unless we are doing difficult extractions or surgeries that leave exposed bone or the tissues were torn excessively. Bone exposures after surgeries will cause the patient to have pain. This can usually be alleviated by covering the bone with tissue or periodontal packs.

Planning your surgeries to allow good coverage with the tissues available helps. Today we have bone and collagen membranes to cover the alveolar bone. This will help in alleviating pain.

Usually, we take patients out of pain, but there are occasions when this is not possible. This is where the analgesics come into play.

We will look into dosages and the health concerns before administering the analgesics. How will the analgesics react to other drugs our patients are taking? If taking a blood thinner such as warfarin, will the analgesics thin the blood more or will they do the opposite? We will start with the NSAID (Nonsteroidal Anti-inflammatory Drug)

The NSAID drugs can block the COX 1 and the COX 2 enzymes

COX 1 (**cyclooxygenase**) are responsible for acute inflammatory reaction of the tissues that is short lived and good for the body. These can be painful, and a fever may develop in its attempt to rid the body of bacteria. They also activate platelets and protect the stomach and intestinal lining by producing prostaglandins that are responsible for **gastric** mucosal protection through vasodilation, stimulation, and secretion of gastroduodenal mucus and bicarbonate, and forming a protective barrier to acid injury

These enzymes can be found in blood vessels, intestinal cells, smooth muscles, platelets, and mesothelial cells.

The COX 2 enzyme produce prostaglandins that are responsible for chronic inflammatory reactions that occur when bacteria are not present and become chronic when the bacteria are present making them bad for the body. These enzymes are found predominantly in the parenchymal cells (cells that make the heart function) or tissues like the heart.

NSAIDs

Aspirin	COX 1 and 2 blocker (irreversible)	GI
Ibuprofen (Motrin, Advil)	COX 1 and 2 blocker (reversible)	Kidney
Naproxen (Aleve)	COX 1 and 2 blockers (reversible)	
Celecoxib (Celebrex)	COX 2 blocker	
Meloxicam (Mobic)	COX 2 Blocker	

Aspirin NSAID

Aspirin (acetyl salicylic acid) blocks both COX 1 and 2. It is irreversible preventing the COX 1 and 2 from doing their job. It thins the blood and affects the gastrointestinal system giving an upset stomach.

Aspirin Low dose	81 mg/pill	4 to 8 pills/4hrs.	Not more than 48 pills/24 hrs.
Aspirin Reg Dose	325 mg/pill	1-2 pills/ 4 hrs. Or 3 pills/6 hrs.	Not more than 12 pills/24 hrs.
Aspirin Extra Strength	500 mg/pill	1 – 2 pills 4-6 hrs.	Not more than 8 pills/24 hrs.

Ibuprofen (Motrin, Advil) NSAID

Ibuprofen blocks Cox 1 and 2 but it is reversible meaning it binds to the COX enzyme rapidly inhibiting it. Then it undergoes a time dependent transition to an EI complex where the inhibitor dissociates slowly.

It blocks the prostaglandins that normally dilates the blood vessels leading to the kidneys. The vessels narrow decreasing flow of blood and oxygen to the kidneys while the drug is active. Prolong use of the drug can lead to kidney damage.

Dosage:

Ibuprofen (Motrin Advil)	200 mg/ pill	1 pill every 4 to 6 hrs.	Do not take more than 6 pills/ 24 hrs.

Acetaminophen Tylenol

Acetaminophen is a nonprescription drug primarily to be used as an analgesic to temporarily relieve minor aches and pains due to headache, muscular aches, backache, minor pain of arthritis, the common cold, **toothache**, and premenstrual and menstrual cramps. Acetaminophen can also be used to temporarily reduce fever.

Whereas the Ibuprofen and naproxen are primarily designed as anti-inflammatory drugs to reduce inflammation and swelling.

Some Side effects of Tylenol include:

- Nausea
- Stomach Pain
- Loss of Appetite
- Itching
- Rash
- Headache
- Dark Urine
- Clay-Colored Stools

People with liver problems should probably avoid acetaminophen, but it is safe for pregnant woman. Ibuprofen should be used with caution by people with heart disease, high blood pressure, clotting disorders, kidney problems and the elderly.

Other than those with liver problems, acetaminophen is considered safer because it does not have the side effects such as stomach pain and bleeding. Though if taken with alcohol it can lead to kidney and liver failure.

Acetaminophen Dosages

Tablet
- 325mg
- 500mg

Caplet (oblong tablets)

- 325mg
- 500mg
- 650mg

Caplet, extended release
- 650mg

Capsule
- 325mg
- 500mg

Tablet, oral disintegrating
- 80mg
- 160mg

Tablet chewable
- 80mg

Solution or suspension, oral
- 160mg/5mL

Liquid oral
- 160mg/5mL
- 500mg/5mL

Syrup oral
- 160mg/5mL

Regular Strength: 325 – 650 mg PO/PR q4hr PRN (By mouth/ as needed every 4 hrs) not to exceed 3250 mg/day.

Extra Strength: 1000 mg PO q6-8hr PRN; not to exceed 3000 mg/day. 4 g/day under supervision of a healthcare professional.

Extended release: 2 capsules (1300 mg) PO q8hr PRN; not to exceed 3.9 g/day

Maximum dose Not to exceed a cumulative dose of 3.25 g/day of acetaminophen. Under supervision of healthcare professional, daily doses of up to 4 g/day may be used.

When considering dosage, you should take into account the prescription and over the counter intakes.

Acetaminophen (Tylenol) has few side effects. Whereas Ibuprofen and naproxen can cause an upset stomach, kidney damage, high blood pressure, and inflammation or bleeding in the stomach. There is also a risk of heart attack in some patients. If you have **liver problems**, you should not take acetaminophen.

If the following symptoms appear call 911.

- Itching or Hives
- Wheezing or Trouble Breathing
- Tightness in Your Chest
- Swelling of Your Face, Hands, Lips, Mouth or Throat

Dual Action (Advil Plus Tylenol)

The FDA has approved pain relief medication that combines **Acetaminophen (Tylenol) and Ibuprofen (Advil, Motrin).** Combining these two allows you to take a lower maximum daily dose of each medication and now get up to 8-hours of relief.

Corticosteroids

- Prednisone
- Hydrocortisone
- Triamcinolone
- Dexamethasone

When the body is functioning normally, baseline levels of **prostaglandins** are **produced** by the action of cyclooxygenase 1. (COX 1). When injury occurs, the prostaglandins go to work creating inflammation to bring in the blood with the growth factors and platelets.

When the body is injured (or inflammation occurs in any area of the body), cyclooxygenase-2 (COX 2) is activated and produces extra **prostaglandins**, which help the body to respond to the injury, but they also continue to create inflammation when the bacteria are no longer present.

Steroids decrease the production of inflammatory mediators COX 1 and COX 2 by inhibiting the arachidonic acid synthesis.

They also suppress the spontaneous ectopic neural discharge originating in neuromas. The kinetics of corticosteroid suppression of neuroma discharge suggest a direct membrane action rather than an anti-inflammatory action. The Glucocorticoids have also been shown in vitro systems to inhibit the release of arachidonic acid metabolites, namely the prostaglandins (PGs) and leukotrienes.

Steroids inhibit the enzyme phospholipase A2 which inhibit Arachidonic Acid synthesis

Steroids inhibit #1 Arachidonic Acid. Aspirin inhibits #2 Prostaglandin G2 of the same pathway but at different points in the biosynthesis pathway.

In controlling inflammation, the major effect of **corticosteroids** is to **inhibit** the synthesis of multiple inflammatory proteins through suppression of the genes that encode them. Steroids alleviate inflammation while, at the same time, they permit multiplication of the offending microorganism within the phagocyte that require antibiotics to control. The inflammation brings with it blood and the white blood cells to kill the bacteria. By removing the inflammation, you are taking away the body's major defenses against bacteria.

Cautions

Combining aspirin, ibuprofen (Motrin) or other nonsteroidal anti-inflammatory agents (NSAIDS) with corticosteroids increases the risk of stomach related side effects like ulcers.

Prolong use of Corticosteroids can increase blood glucose levels and increase insulin resistance, which can lead to type 2 diabetes.

Narcotics/Opioids

- Morphine (Opiate)
- **Hydrocodone** (Vicodin) (Semi-synthetic opioids)
- Tramadol (Ultram) Similar to codeine, semi-synthetic
- Darvon and *Darvocet*

Opiate (Narcotic):

This refers to a drug derived from opium. Opium comes from the poppy plant that contains the alkaloid morphine. These alkaloid compounds are psychoactive. The morphine can be processed to produce heroin and the synthetic opioids (prescribed medicines). Within the poppy plant are specific compounds that include morphine, thebaine, and codeine.

Opioids

Opioids work in many of the same ways as opiates, but they aren't naturally occurring. Instead, they are semi-synthetic or synthetic, meaning they are manufactured using chemical processes. Semi-synthetic opioids are a combination of natural opiates that have gone through chemical changes, while synthetic opioids are entirely made from chemical processes. **Oxycodone** and **hydrocodone** are classified as semi-synthetic opioids, while synthetic opioids include **methadone** and **fentanyl.**

Both the opioids and opiates act on the opioid receptor systems in the central nervous system. They change how pain sensation is experienced, but they can also lead to drowsiness and overall depression of the central nervous system. This CNS depression is one of the reasons opioids and opiates can be dangerous, particularly in high doses.

When one is abusing opiates or opioids, it can slow their breathing to the point they nod off, lose consciousness, or die. They have similar side effects which include sedation, nausea, vomiting, and itchiness, and they can also lead to abuse and addiction.

Withdrawal from opiates or opioids can be severe. These include nausea, vomiting, sweating, fatigue, headache, anxiety, sleep disturbances, and diarrhea.

Hydrocodone (Vicodin)

Hydrocodone (Vicodin) is a semi-synthetic drug derived from codeine or thebaine that are natural alkaloids derived from the resin of poppy seeds. By itself, though, hydrocodone is only available in extended-release oral tablets. These come in many strengths that range from 10 mg to 120 mg.

Some of the extended-release tablets you take every 12 hours, and some you take every 24 hours, depending on the product. The higher strengths are only given to people who have been taking hydrocodone for a long time and who no longer get relief from the lower strengths.

Extended-release hydrocodone can be fatal for children. Taking even one tablet can be fatal. Keep your prescription medications locked and away from children.

Hydrocodone is often used with acetaminophen (Tylenol) under the brand name, **Norco**. Hydrocodone is an opioid (narcotic), and acetaminophen is an analgesic (pain reliever). Both drugs are used to reduce pain. They work in your brain to block pain signals.

Norco (Hydrocodone & Acetaminophen):

It comes as an oral tablet or solution to treat moderate to severe pain. It comes as 7.5mg to 10 mg hydrocodone/300 – 325mg acetaminophen (Tylenol). It is used when other pain relievers are not able to relieve the pain. Typically, you take a tablet every 4 to 6 hours as needed for pain.

Severe allergic reaction warning: This medication may cause a severe, potentially life-threatening allergic reaction, should seek medical help. The reaction can occur very quickly. Symptoms may include:

- Trouble breathing
- Swelling of your face, throat, and mouth
- Rash

If this occurs, you seek immediate emergency medical help.

This medication may cause your adrenal glands to not work as well.

Symptoms may include:

- Nausea
- Vomiting
- Loss of Appetite
- Tiredness
- Weakness
- Dizziness
- Lightheadedness

Acetaminophen-hydrocodone side effects

The oral tablet may make you feel sleepy, dizzy, or lightheaded. Avoid driving a car or using machinery until you know how your body reacts to this medication.

Other side effects for acetaminophen-hydrocodone include:

- Sleepiness or Drowsiness
- Feeling Dizzy or Lightheaded
- Nausea
- Vomiting
- Constipation

Can have Serious side effects resulting in 911 call:

Disclaimer:

These drugs affect people differently. If you are experiencing a side effect, you should consult with your doctor or pharmacist after giving them a list of all the drugs you are taking.

You should not drink alcohol while taking acetaminophen-hydrocodone.

Combining alcohol with this drug also increases your risk for liver damage.

The Health Conditions Taking Acetaminophen-Hydrocodone:

For people with head injury: If you have a head injury, hydrocodone may cause increased pressure in your brain and cause breathing problems.

For people with stomach problems: Use caution taking this drug if you have intestinal obstruction, ulcerative colitis, or constipation. This medication may worsen your symptoms.

For people with severe kidney disease: This drug may build up in your body, which can cause trouble breathing and other side effects.

For people with lung disease: If you have lung disease, you might have trouble breathing if you take this medication.

For people with severe liver disease: If you have severe liver disease, your risk of liver failure is increased. Also, this drug may build up in your body, which can cause trouble breathing and other side effects.

For people with prostate enlargement: If you have an enlarged prostate, taking acetaminophen-hydrocodone may cause increased difficulty in urination.

For people with asthma: If you have severe or uncontrolled asthma, do not use this medication without talking to your doctor. You may have to take the first few doses in a monitored setting.

For pregnant women: Tell your doctor if you are pregnant or plan to become pregnant. Babies born to mothers who regularly take opioids such as hydrocodone may be born physically dependent on this drug.

There's also an increased chance that the baby may have trouble breathing if this medication is given to the mother shortly before giving birth.

- For women who are breastfeeding: Acetaminophen is passed in small amounts in breast milk. Hydrocodone also passes into breast milk and may result in excessive tiredness and slowed breathing in a child who is breastfed.

Dosage for moderate to severe pain

Adult dosage (ages 18 years and older and weighing at least 101 pounds [46 kg])

Hydrocodone is only available in extended-release oral tablets.

These come in many strengths that range from 10 mg to 120 mg every 12 or 24 hours. The higher strength for people who have been taking the drug for long periods.

Hydrocodone with acetaminophen

- **5 mg or 2.5 mg hydrocodone / 300 mg or 325 mg acetaminophen:** The typical dosage is 1–2 tablets taken every 4–6 hours as needed. The maximum dosage is 8 tablets per day.
- **7.5 mg or 10 mg hydrocodone / 300 mg or 325 mg acetaminophen:** The typical dosage is 1 tablet taken 4–6 hours as needed. The maximum dosage is 6 tablets per day.

Overdosing hydrocodone/ acetaminophen Can Result In:

- Nausea and Vomiting
- Sweating
- An Overall Feeling of Fatigue

- Slowed or Stopped Breathing
- Slowed Heart Rate
- Very Low Blood Pressure
- Possible Coma
- Liver Damage or Failure

Tramadol (Ultram)

Tramadol is a synthetic opioid **analgesic** medication used to treat moderate to moderately severe pain in adults and adolescents 16 and older. Like opioid analgesics, it works in the brain to change how your body feels and responds to pain.

Tramadol has milder side effects compared to hydrocodone, but hydrocodone is more potent and produces more pain relief in some people. When tramadol is used for a long time, it may become habit-forming, causing mental or physical dependence

How Tramadol works:

Tramadol changes how the brain senses pain, similar to the endorphins that bind to receptors. The receptor decreases the pain messages that the body sends to the brain. Tramadol is effective for pain, but hydrocodone is more effective for intense pain.

Tramadol can stay in your system for up to 72 hours. Usually, the first dose is 50 to a 100 mg qid. This can increase as you become more tolerant, but it should not be more than 400 mg per day.

Dosage:

Tramadol tablets (37.5 mg/ 325 mg) are as effective as Codeine capsules (30 mg/300mg) for treating chronic nonmalignant low back pain. Available only with a prescription, it does work well when weaker painkillers fail. Tramadol can stay in your system for up to 72 hours.

Extended-Release Capsules or tablets (Ultram) 100 to 300 mg. Tablets should not be crushed, split, or dissolved.

Before prescribing Tramadol, all the other drugs the patient is taking should be evaluated to see if there will be any possible interactions.

Tramadol and acetaminophen combination used together provides better pain relief than either medicine used also. The risk of addiction to Tramadol is not high. It has many side effects that include:

- Constipation.
- Nausea.

- Dizziness.
- Vertigo.
- Headache.
- Drowsiness.
- Vomiting.
- Agitation.

Tramadol has moderate to serious interactions with over 300 different drugs. Prolong use of tramadol can be addicting. Mothers breastfeeding their babies can have problems with babies going through withdrawal symptoms. Tramadol should not be used by woman who are pregnant.

Meperidine (Demerol)

Meperidine (Demerol, Pethidine) was first used in 1942. It was the go-to drug to treat severe pain. Since then, it has been scaled back because of its inherent dangers and potential abuse.

Demerol is an opioid and works by changing the brain and nervous system response to pain. Its potency is similar to morphine and a controlled schedule II drug.

Darvon and Darvocet

Darvon and Darvocet contain a chemical known as **propoxyphene**, which is an opioid used to treat mild to moderate pain. It was approved by the FDA in 1957 and is sold by prescription under the name **Darvon** or when combined with acetaminophen, **Darvocet.**

Back in 1978 the FDA had received two requests to remove the drug, but it wasn't until November 19, 2010 that the FDA pulled the drug propoxyphene from the market because of its effect on the heart. There was evidence it interfered with the electrical activity of the heart. People who took the drug were experiencing irregular heartbeats, rhythm abnormalities and even cardiac arrest.

Conclusion:

Anyone who has a life-threatening reaction to any of the opioid drugs should be given **Naloxone** immediate to reverse the reaction (unable to breath). If the reaction is severe, then

more doses should be given every 2-3 minutes until the symptoms are reversed and the patient can breathe again. 911 should be called immediately when a person cannot breathe.

Naltrexone and Methadone are drugs used to treat addiction

All the lists described in this course concerning interactions of the drugs and the possible reactions from taking the drugs are only **partial lists.** Many of the drugs have hundreds of possible reactions and only the most common ones were listed in this course. Any reaction to taking the drugs listed in this course should be taken seriously.

Disclaimer

The drug information provided here does not cover every potential use, warning, drug interaction, side effect, adverse or allergic reaction.

Drug information is constantly changing therefore, the author makes no guarantees that the information provided is the most current.

The author assumes no responsibility for any healthcare worker administering drugs to a person based on the information found on this course. They should do their own research before administering medications.

Any missing drug warnings or information does not in any way guarantee the safety, effectiveness, or the lack of adverse effects of any drug. The drug information provided is intended for reference only and should not be used as a substitute for medical advice.

If you have specific questions regarding a drug's safety, side effects, usage, warnings, etc., you should contact your doctor or pharmacist, or refer to the individual drug monograph details found on the FDA.gov

Local Anesthetics

Local anesthetics are either amides, esters, or combination of the two. Esters are not used as often because they are more toxic than amides. In this course we will be dealing with the following:

Amides: Metabolizes in the liver.

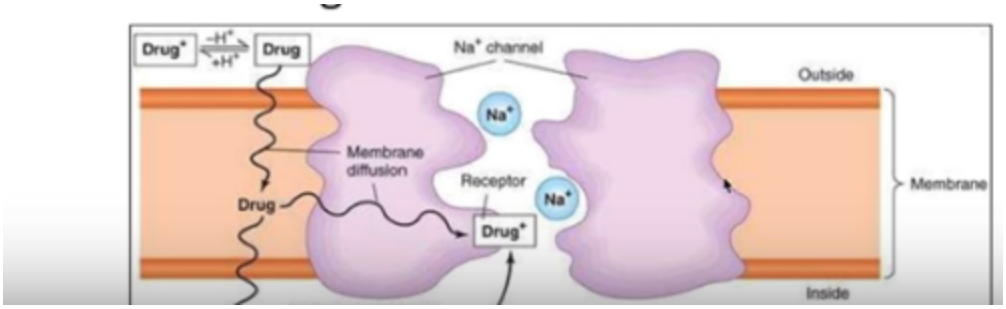
Lidocaine 2% (Xylocaine)	Safest for children
Bupivicaine 0.5% (Marcaine)	Not safe for children

	Longest duration
Mepivicaine 2 – 3% (Carbocaine, Polocaine)	Causes the least vasodilation
	Package without epinephrine
Articaine 4% Septocaine	Has one ester chain
	Metastasizes in liver and plasma
	Shortest duration of all anesthetics
Prilocaine (Citanest)	Linked to Methemoglobinemia
	Too little oxygen delivered to tissues

Esters Metabolizes in the plasma

Benzocaine Ester is a Topical gel anesthetic used prior to a local anesthetic injection

Local anesthetics are sodium channel blockers



Only **non-ionized** (free base) form can penetrate neuron membrane.

The sodium channel is in the membrane of a neuron. The channel can only be blocked from the inside. Therefore, the drug must penetrate the neuron to block the sodium channel. The drug has a charged ionized form and a noncharged nonionized form. Only the noncharged portion of the drug can penetrate the neuron membrane.

In low PH tissues such as inflamed tissues the acidic environment decreases the PH (acidic). This decreases the amount of nonionic form available to defuse through the membrane to block the sodium channel within. Therefore, inflamed tissues are difficult to numb.

Anesthesia is determined by:

- The more nerve that can be bathed in anesthetic, the better the anesthesia.
- Anesthetic enlarges the vessels increasing the blood flow to the site shortening the duration of the local anesthetic. Increase blood flow carries the drug away from the site.

- More drugs can diffuse through the hydrophobic (repeals water) interior of the membrane if it is more lipid soluble allowing the drug to bond to the receptor.
- The receptors are mostly protein. Therefore, if the drug is protein bonding, it will have greater attraction to the receptor sites.
- The lower the pKa of the drug, the stronger the acid is, and it will give up its protein faster and be in the nonionized form. This will allow the drug to diffuse through the membrane faster and have a faster onset of action.
    - Mepivicaine pKa 7.6
    - Lidocaine, Prilocaine, Articaine pKa 7.8
    - Bupivicaine pKa 8.1

Vasoconstrictor

Anesthetic normally enlarges the blood vessels in the area and allows the anesthetic to leave the area quickly. To slow this process, epinephrine is added to the anesthetic to constrict the vessels. This allows the anesthetic to remain in the tissues longer, increase the hemostasis and reduce the risk of toxicity.

There are two vasoconstrictors used in the United States, epinephrine and levonordefrin. Epinephrine is used with anesthetics lidocaine, articaine, prilocaine, and bupivacaine. Mepivicaine (Carbocaine) usually does not have epinephrine because Mepivicaine does not dilatate the vessels a great deal.

In U.S. dental cartridges, epinephrine is formulated in 1:50,000, 1:100,000, and 1:200,000 concentrations. 1:50,000 being the highest concentration of epinephrine. The duration of effect for pulpal and soft tissue anesthesia is essentially the same with all these vasoconstrictor concentrations, and therefore the lowest concentration available is recommended.

The highest concentration, 1:50,000, is recommended only when additional hemostasis is required and should be administered in very small volume as infiltration injections.

Levonordefrin is one-sixth as potent as epinephrine and is only available in 2% mepivacaine and 1:20,000 levonordefrin. It provides significantly less hemostasis than epinephrine.

Allergic reactions can occur from the bisulfites (antioxidants) in the anesthetic solutions. This is not common, but it can occur. Patients who have demonstrated a true allergy to bisulfites should not receive a local anesthetic agent containing vasoconstrictors.

Local Anesthetics

Lidocaine- Marketed in 1948, it was the first amide local anesthetic and presently holds 49 % of the market. It is compounded with epinephrine as 2% lidocaine, 1:100,000 epinephrine and 2% lidocaine, 1:50,000 epinephrine. It is contraindicated in patients with allergies to amide local anesthetics.

Mepivacaine (Carbocaine) -Marketed in 1960, it is available as 2% mepivacaine, 1:20,000 levonordefrin and 3% mepivacaine (plain). Mepivacaine has a milder vasodilatory effect than most other amides, so it may be useful with patients for whom vasoconstrictor is contraindicated. The duration action of 3% mepivacaine is short. It is contraindicated in patients with allergic reaction to amide type local anesthetics, and/or bisulfite allergies, and/or taking tricyclic antidepressants.

Prilocaine (Citanest) -Marketed in 1965, is less toxic and less potent than lidocaine or mepivacaine and provides a slightly longer duration of action. It is available as 4% prilocaine 1:200,000 epinephrine and 4% prilocaine (plain).

Since 4% prilocaine has a milder vasodilatory effect, it is a good choice for patients with vasoconstrictor contraindications (heart patients). It only gives an intermediate duration of action.

Prilocaine should not be used for patients who are at risk for methemoglobinemia (low oxygen in the blood) such as sickle cell anemia, cardiac/respiratory failure. Also, for patients taking acetaminophen or phenacetin because methemoglobin levels are increased.

Prilocaine metabolized more easily by the liver than lidocaine or mepivacaine. In addition, it clears the kidneys more rapidly than other the other amides.

Prilocaine is contraindicated in patients with allergies to amide type local anesthetics.

Articaine (Septocaine)-Articaine has been available in Europe since 1976 but was not marketed in the United States until 2000. It is the second most popular local anesthetic in the U.S., currently holding 35.6% of the U.S. market share, and is the leading dental anesthetic in Canada and Europe.[4]

Its popularity has been attributed to:

- Increased lipid solubility giving higher injection success rates related to increased lipid solubility

- Its diffusion through hard and soft tissues, including palatal root anesthesia with buccal injections
- Can obtain mandibular anesthesia with infiltration injections.
- It has more profound and longer duration of anesthesia.

It is classified as an amide with amide and ester characteristics. It is 1.5 times more potent than lidocaine and has similar toxicity. It is compounded with epinephrine as 4% Articaine, 1:100,000 epinephrine and 4% Articaine, 1:200,000 epinephrine.

Aticaine is eliminated in the plasma (being part of an Ester) and by the liver (being part of the amide). 50% of the drug is eliminated in the blood in 27 to 44 minutes twice as fast as the other amides. This makes it more desirable for children and medically compromised patients.

Articaine is contraindicated in patients with a known history of hypersensitivity to local anesthetics of the amide type, or in patients with known bisulfite allergy. In a recent in vitro local anesthetic neurotoxicity study, it was concluded that Articaine was the least neurotoxic and had the most favorable safety profile compared with lidocaine, mepivacaine, and prilocaine

Most paresthesia problems are related to mechanical trauma rather than chemical. Where the needle is placed is still very important.

Bupivacaine 0.5% (Marcaine) is a potent local anesthetic with unique characteristics from the amide group. It was first discovered in 1957. It has a slower onset of action (about 5-10 minutes after injection) but its effects last for about 4-8 hours. The duration of anesthetic can be prolonged by the addition of epinephrine 1:200,000. It is not to be used on children under 12 years of age.

liposomal bupivacaine is a long-acting, amide local anesthetic FDA approved for single-dose infiltration into the surgical site to produce postsurgical analgesia. It can last 1-3 days. It was approved by the FDA in October 2011 for single-dose infiltration into the surgical site to produce postsurgical analgesia.

Local anesthetics are bound to plasma proteins in varying degrees. Generally, the lower the plasma concentration of drug the higher the percentage of drug bound to plasma proteins.

Topical Anesthetic

Benzocaine is a topical gel anesthetic used prior to local anesthetic injection. The onset time of 30 seconds and duration is five to 15 minutes

These are **usually more concentrated to facilitate infiltration**. Therefore, they are more likely to have toxic effects, particularly in children.

- Severe Symptoms (life threatening) anaphylaxis
- Intramuscular or subcutaneous epinephrine 0.3–0.5 mg
- Patient should lie flat unless he is having breathing difficulties, then he should sit up.

Lidocaine 2 % topical onset time is three to five minutes, and its duration is 15 minutes.

Cetacaine is a combination of three ester topical anesthetics, 2% tetracaine, 14% benzocaine and 2% butamben. The onset time is typically 30 seconds, and it has a duration of 30 to 60 minutes. It is not approved by the FDA.

Oraqix is an amide topical anesthetic consisting of 2.5% lidocaine and 2.5% prilocaine. The onset time is 30 seconds, and it has a 20-minute duration subgingivally. It is not recommended for patients under 18 years of age.

Adverse Injection Reactions

Old anesthetics have a higher acidity causing a burning sensation when given locally (injection into loose tissue and slowly to avoid a burning sensation)

Injection into Nerve with anesthetic plus epinephrine

Electric Shock effect causing the patient to jerk head causing injury to the nerve.

- It can leave an extremely painful possible Facial Nerve Penetration Paresthesia.
- The anesthetic wears off leaving the patient with a facial nerve paralysis.
- The nerve damage may take months to repair itself depending upon the damage
- The nerve is filled with the anesthetic creates a neurotoxicity.
- Bupivacaine or 2% lidocaine usually are not as severe. Low daily doses of multivitamin ‘B’ is helpful.

The symptoms are:

- Tongue biting
- Drooling
- Loss of taste
- Speech impediment

Injection into Vein with anesthetic plus epinephrine

- Tachycardia Vessels contract
- Raise the blood pressure
- Heart to beat faster trying to accommodate the sudden contraction of the vessels. (tachycardia)
- Blood flows faster in the body raising the blood pressure.
- Throbbing headache
- Feeling nervous, anxious, or fearful
- Breathing problems
- Loss of Consciousness
- Pale skin, sweating
- Nausea and vomiting
- Dizziness
- Weakness or tremors

Injection into Artery with anesthetic plus epinephrine

Blood flows into the tissues creating a hematoma until the pressure builds up sufficiently to stop the bleeding artery.

Postanesthetic ulceration of palate

Tissue necrosis can occur one to two days after the tissue was injected with an anesthetic. It is unclear what actually caused the necrosis. The center of the ulcer is covered with whitish yellow necrotic slough.

Possible causes:

- Poor blood supply to the area
- Blanching of the tissue with the anesthetic if it is given rapidly
- Vasoconstrictor in the anesthetic reduces the supply of oxygen to the injected tissue promoting a buildup of acidic by-products.
- Therefore, repeatedly giving palatal injections with epinephrine of 1:50,000, or 1:30,000 should be avoided.
- A topical application of an anesthetic agent for long duration can result in desquamation of the epithelial tissue.

- Using anesthetic that is past its expiration date can leave excessive acid in the anesthetic that can have a detrimental effect on the tissues. Therefore, you should only purchase your anesthetic from a retriable dental supply company.
- Healing generally occurs within 8 to 10 days after the onset of the lesion.
- Orabase paste can be administered to quell the pain.
- Rinses made up with equal amounts of diphenhydramine and milk of magnesia can also help to reduce the pain.

Lack of effect

- Poor technique especially when the inferior alveolar injection is given.
- Atypical development of the nerves, or location of the foreman.
- Bone density when the infiltration injections are given.
- Local inflammation is present. The anesthetic only increases the fluid in the tissues diluting the anesthetic.

Soft Tissue Injury

- Chewing the lip, cheek, and tongue while the patient is numb occurs in very young children.
- Performing the dental operations without anesthetic,
- Use a less amount of anesthetic
- Keep the patient in the chair until the numbness wears off.
- Or only give infiltration anesthetic that numbs a small portion of the mouth.

Lidocaine Dosage

What is the maximum dosage? 1/10th cartridge per kilo (2.2 pounds)

(1 cartridge = 10 kilo = 22 lbs)

Adult: Cartridge 2ml (2000 mg)

- 21 mL (0.35 mL/kg × 60 kg) or 11 cartridges.

For cardiac patients, no more than:

- 4 mL (2 cartridges) of 2% lidocaine with 1:100,000 epinephrine
- 2 mL (1 cartridge) of 2% lignocaine with 1:50,000 epinephrine should be used for any dental procedure for older adults

A higher lidocaine dosage can produce systemic vasoconstriction leading to myocardial ischemia in high-risk cardiac patients. Before you select an anesthetic, you need to check the dosage for insure a safe outcome. Bupivicaine should not be used on children under 12 years.

Conclusion:

No attempt has been made to cover all the drugs we use in dentistry; rather this course discussed the most popular drugs, their interactions and uses. The list of side effects can be very long for some of the drugs listed. This course highlighted many, but not all the possible side effects of these drugs. It is probably best to observe your patient and expect that any unusual symptoms could be a drug side effect. There are also many drug interactions - this course has listed a few, but before you use a drug, you should research the possible adverse effects and the possible interaction with other drugs and physical conditions of your patients.

You need to do a comprehensive medical evaluation of your patients before you start administering drugs. This may entail contacting the patient's physician and obtaining a fax of your patient's condition. All too often, we start our treatment without proper investigation into the patient's medical records.

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Only complete this Exam Sheet if you did NOT complete the examination online:

If you are unable to complete your examination online, you may complete this paper examination and then return the completed answer sheet found on the final page.

1. Between 1940 and 1962 most of the antibiotics used in medicines today were discovered and introduced into the market.
    a. True
    b. False

2. Penicillin is bactericidal because it inhibits the synthesis of the bacterial cell wall.
    a. True
    b. False

3. Cephalosporin (Keflex) will have the same allergic reactions as penicillin because they have the same beta-lactam ring.
    a. True
    b. False

4. Clavulanic acid is a beta-lactamase inhibitor, which is added to amoxicillin (Augmentin) to help prevent antibiotic resistance.
    a. True
    b. False

5. World Health Organization (WHO) describes Erythromycin to be the safest and most effective medicine needed in the health system.
    a. True
    b. False

6. Vancomycin is used to treat infections in the intestines (colitis) where the bad bacteria have taken control.
    a. True
    b. False

7. COX 1 (cyclooxygenase) are responsible for acute inflammatory reactions of the tissues that are short lived and good for the body.
    a. True
    b. False

8. Aspirin (acetyl salicylic acid) blocks both COX 1 and 2. It is irreversible preventing the COX 1 and 2 from doing their job.
    a. True
    b. False

Examination Continued...

9. Combining Acetaminophen (Tylenol) and Ibuprofen (Advil, Motrin) allows you to take a lower maximum daily dose of each medication and now get up to 8-hours of relief.
    a. True
    b. False

10. Opiate refers to a drug derived from opium.
    a. True
    b. False

11. Which of the following statements are correct regarding Opioids?
    a. Opioids are not naturally occurring.
    b. Opioids are semi-synthetic or synthetic.
    c. Hydrocodone is classified as semi-synthetic.
    d. All of the above statements are correct.
    e. None of the above statements are correct

12. Extended-release hydrocodone can be fatal for children.
    a. True
    b. False

13. Tramadol is a synthetic opioid analgesic medication used to treat moderate to moderately severe pain in adults and adolescents 16 and older.
    a. True
    b. False

14. Demerol is an opioid and works by changing the brain and nervous system response to pain.
    a. True
    b. False

15. The FDA pulled Darvocet from the market on November 19, 2010 because of its effect on the heart (irregular heartbeats).
    a. True
    b. False

Medications Used In Dentistry

Advanced Continuing Education Systems (ACES)

COURSE 03-4393-22056 | 3 CREDIT HOURS | LIVE INTERNET WEBCAST COURSE

MAIL FORM TO:
1262 Kettner Blvd. #2204 San Diego, CA 92101 **or FAX FORM to** 949.363.6167 **or EMAIL to** aces@aces4ce.net

ONLY COMPLETE THIS DOCUMENT IF YOU ARE CHOOSING NOT TO COMPLETE YOUR EXAM ONLINE

ANSWER SHEET:

1.	A	B			
2.	A	B			
3.	A	B			
4.	A	B			
5.	A	B			
6.	A	B			
7.	A	B			
8.	A	B			
9.	A	B			
10.	A	B			
11.	A	B	C	D	E
12.	A	B			
13.	A	B			
14.	A	B			
15.	A	B			

CERTIFICATE DELIVERY PREFERENCE:

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PARTICIPANT INFORMATION:

Licensee's Name: _____

Licensee's Type: _____

License #: _____

Home Address: _____

City: _____

State: _____ **Zip Code:** _____

Phone: (_____) _____

Signature _____

Course Date: _____

QUESTIONNAIRE:

	NO				YES
1. This unit fulfilled the course objectives.	1	2	3	4	5
2. The information was clearly presented.	1	2	3	4	5
3. This course met my learning objectives.	1	2	3	4	5
4. I would recommend this course to others.	1	2	3	4	5

5. What suggestions do you have to improve this course?

_____

_____

6. What topics would you like to see ACES present?

_____

7. How do you feel about taking live CE seminars online?

_____

8. Please make additional comments:

_____