Guide to Understanding Antibiotics Prescribed in Your Doctor's Office

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Guide to Understanding Antibiotics Prescribed in Your Doctor's Office

By Raymond Lengel

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About the Author

Raymond Lengel, a certified family nurse practitioner, has worked in multiple fields of nursing. For the last seven years he has worked in primary care. In addition to being a certified family nurse practitioner he is a registered nurse with the state of Ohio.

Initially, Raymond received a Bachelor of Science degree in exercise science from the Ohio State University. Then he attained a Bachelor of Science degree in nursing from the Allen College of Nursing in Waterloo, Iowa. After working for a number of years as an exercise physiologist/registered nurse he enrolled at Otterbein College in Westerville, Ohio and got a Master of Science degree in nursing.

His writing career includes over 80 on-line continuing educational courses developed for nurses. Two articles in the magazine Long Term Care Interface and one in Clinical Reviews have been published.

He is also the author of one print book and five ebooks.

Raymond has also presented a number of lectures on a multitude of health care topics including influenza, cardiac risk reduction, stress management, exercise and nutrition.
Disclaimer

This book is designed to provide basic information about the health care system and the patient’s role in helping to manage his or her own health. It is sold with the understanding that each individual is unique and the book cannot provide individual advice to any one person.

This book is meant to compliment and enhance your interaction with the health care system not to serve as an alternative to medical advice or care. Utilize the system presented in this book, but be sure to work with your doctor. Your doctor is the best source of health care information for you and the unique set of conditions that are present in your body. The goal of this book is to help you with the interaction between you and your doctor, not replace it.

The author has extended every effort to make sure this book is complete and as accurate as possible. Medicine is an evolving field and ongoing research may raise some questions about some of the data in the book. There may be mistakes, both in content and typographical. The book should be used as a general guide and not as the final source for your health care information. Information is current only up to the printing date.

The goal of this book is to educate and entertain. The author and publisher will not have liability or responsibility to any person or entity for any loss or damages that have been caused by information in this book.
Introduction

This book is meant to complement your understanding of common health issues that are handled by your primary care provider.

It will start by looking at common illness that bring patients into the primary care office. It will not provide an extensive look at this as it is described in another book – *Cough, Sniffle, Sneeze: How to Get Optimal Health Care for Common Health Problems*.

The book will then look at 6 major classes of commonly used antibiotics, some miscellaneous antibiotics and topical antibiotics that doctors prescribe when you go to the primary care office.

The antibiotics looked at in this course are antibiotics that you take by mouth. A few injection medications that are used in the primary care office will be discussed.

You may be asking yourself why you need to understand antibiotics – that is your doctors job. The short answer is: people’s knowledge strongly influences prescribing patterns of doctors.

In my experience, most people go to the doctor with false perceptions of the ideal antibiotic to treat their infection. One common example is the use of the z-pak. The z-pak is the commonly used term for the antibiotic azithromycin. It is a very good antibiotic, but it gets over used.

The reason that this medication is overused is because it is a once a day antibiotic for five days (some infections can be treated with a three day course). This is convenient for people and is often requested. While the z-pak is commonly a good choice to treat many infections, it is not always the ideal choice. There is currently a lot of resistance to this antibiotic.

A major goal of this book is to educated people about antibiotics and their proper use. I want to inform people, because they have a strong influence over their medical care. If you are armed with proper knowledge you will receive better care.

The objectives of this book are to:

- Give you a brief overview of each major class of antibiotic commonly used in the primary care office
- Understand common side effects of antibiotics
- Understand which antibiotics treat which infections
Chapter 1: Common Illnesses

Of the top ten diagnoses made in a family medicine practice, six of them are caused by a bacteria or virus. The use of antibiotics is a major part of the primary care doctor's practice.

It is often a knee jerk reaction for primary care doctors to prescribe antibiotics for any infectious illness, but many illnesses do not need antibiotics.

What are common problems you visit the primary care provider for?

- Sore throat
- Cough
- Earache
- Congestion
- Upper respiratory tract infection
- Sinus infection
- Urinary tract infection
- Bronchitis

The common cold

The common cold is a common cause of head congestion. The common cold is a virus and antibiotics do NOT treat a common cold. Over 200 different viruses can cause the common cold and because of the variety of germs that may cause the condition, it can present in a variety of ways.

Rhinovirus is one of the most common viruses that cause the common cold and it typically presents with a sore throat, nasal congestion, low-grade fever and cough. The fever typically resolves within two to three days. Nasal discharge often accompanies a cold and is clear and thin, but often becomes thick and turns yellow or green after a few days.

Many people think that thick discolored mucus indicates a bacterial infection and an antibiotic is needed. It is common to have thick off-colored nasal discharge for a few days, but it should revert back to clear discharge or the discharge should stop by day 5-7. Nasal congestion and cough may continue for 2 weeks after the onset of a cough.

Understanding the natural course of the common cold is essential. The common cold can make you feel terrible – it can lead to tremendous head pressure and a significant reduction in productivity. Even though it makes you feel bad, antibiotics do not help the common cold.
The common cold is sometimes followed by complications that may require antibiotics. Everyone should understand the common path of the common cold and know when an antibiotic will be helpful.

The average adult is plagued with 2-4 colds each year and children are afflicted with 6-8 colds each year (1). The common cold is associated with symptoms that make you feel sick – sinus pressure, sinus congestion, sneezing, runny nose and fever. Symptoms usually improve over a 3-7 day period and if they do not get better or get worse, a bacterial sinus infection may be present.

When symptoms persist beyond 10-14 days bacteria may be causing some of the symptoms and the use of antibiotics may resolve the infection. Some patients may actually clear their infection without the assistance of antibiotic even if symptoms have persisted beyond 10-14 days (2).

**Ear infections**

The majority of inner ear infections will clear in 1-2 weeks without antibiotics (3). Many people should consider a delay in antibiotics when diagnosed with an ear infection. It has become an unwritten social standard that antibiotics are needed for ear infections. But, this is not true. Some people will heal the infection without antibiotics. By avoiding antibiotics the patient will reduce the risk of side effects and lessen the burden of antibiotic resistance.

It is important for the public to have an understanding about when antibiotics are needed for ear infections and when their use can be delayed or avoided. The doctor needs to determine who has severe versus non-severe infection and those who have certain versus uncertain diagnosis. In addition to these factors age needs to be looked at.

If you know these three pieces of information, you can use the chart below to determine if you need an antibiotic.

**Table 1: Treatment for Ear Infections**

<table>
<thead>
<tr>
<th>Less than 6-months-old</th>
<th>6 months to 2-years-old</th>
<th>Over 2-years-old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat for ear infection if the diagnosis is suspected.</td>
<td>Certain diagnosis and/or severe disease – treat with antibiotics</td>
<td>Treat with antibiotics if there is severe illness when the diagnosis is certain.</td>
</tr>
<tr>
<td>Uncertain diagnosis</td>
<td>If the diagnosis is</td>
<td></td>
</tr>
</tbody>
</table>
As you can see from the above table, not everyone with a diagnosed ear infection needs to be treated with antibiotics. Some patients may participate in the wait and see approach to ear infections.

The wait and see approach involves monitoring the disease for 48-72 hours. Over this period of time the person with the ear infection is given pain medications including: acetaminophen, ibuprofen or numbing eardrops.

In most cases the body will heal itself while pain medications are given to treat the symptoms during the healing process. If the patient worsens over that period of time than a re-evaluation should ensue. Worsening is indicated by: worsening pain or increased fever.

These new guidelines are endorsed by the Center for Disease Control and focus on judicious use of antibiotics. Inner ear infections are a common reason for an antibiotic prescription in the United States for children. In Europe the standard is initial observation. With the rising concern about antibiotic resistance it is important that antibiotics are used appropriately. Over 80% of patients with ear infections will clear the infection without antibiotics.

**Outer ear infections**

Swimmer’s ear – also known as otitis externa (OE) – is a common problem that afflicts mostly children who are involved in water activities. Its cause is usually bacteria, but sometimes fungus grows in the ear or allergy or trauma causes the problem. The condition should be prevented if possible but treatment of active disease will reduce the duration of the disease and reduce the risk of complications.

Sometimes the ear canal needs to be cleaned out by the health care provider so a more compete look at the ear can be done. This will also improve the ability of any medication prescribed to penetrate deeper into the ear. Cleaning the ear can be painful in some and may not be possible.

The mainstay of treatment is antibiotic eardrops. Certain eardrops are dangerous if there is a tear in the eardrum.
**Conjunctivitis**

Conjunctivitis is an inflammation of part of the eye called the conjunctiva. The most common causes of conjunctivitis include allergic, bacterial and viral. It must be remembered that a red eye may be related to other causes such as trauma, foreign body, herpes simplex or a blocked tear duct.

While school aged children are more likely to be afflicted by a viral cause of conjunctivitis, children under the age of six-years-old are more likely to be afflicted with a bacterial conjunctivitis (4).

The most common cause of viral conjunctivitis is adenovirus. This is very contagious and no treatment is available for preventing its replication. It may be contagious for over a week.

Bacterial conjunctivitis is often self-limiting but is associated with significant symptoms. Although bacterial conjunctivitis is much more common in younger children there are occasional outbreaks in adults. Untreated bacterial conjunctivitis lasts about 8-10 days.

Conjunctivitis presents with redness, discharge, swelling, burning and grittiness of the eye. These symptoms are common to all types of conjunctivitis. The degree of the symptoms may vary with the severity of the disease or the type of conjunctivitis. Certain factors help differentiate the type of conjunctivitis.

Bacterial conjunctivitis is associated with discomfort/pain, redness and discharge from the eye. Bacterial infections typically start in one eye and then spread to the other. Thick, purulent discharge is typically noted and it is associated with the eyes being stuck together in the morning.

Viral conjunctivitis can cause mild pain and mild discomfort in bright light. Like bacterial infections, symptoms may start in one eye, but often spreads. Diffuse redness with a stringy white discharge is often noticed. It usually occurs in someone with an upper respiratory tract infection. Adenovirus is a common cause of conjunctivitis and it can present very similarly to bacterial conjunctivitis.

Allergic conjunctivitis is often secondary to allergens. The most common symptom in allergic conjunctivitis is itching with clear watery discharge. It usually affects both eyes and is not associated with pain.

**Strep throat**

Pharyngitis is the term doctors use to describe sore throat and it accounts for 10-15 percent of all pediatric office visits. Group A beta-hemolytic streptococcal pharyngitis (GABHS), more commonly known as strep throat, is a primary concern of a person with a
sore throat. GABHS is more common in children than adults. In both kids and adults viruses are the most common cause of sore throat.

Because group A beta-hemolytic streptococcal (GABHS) pharyngitis could result in heart complications it should be recognized and treated. Certain factors will help predict if the cause of the sore throat is GABHS or a viral infection. The factors are not perfect and the use of a throat culture is needed in many cases in order to rule out strep throat.

Important factors to know about strep include:
- It most commonly affects children between 5-15 years old.
- It does not commonly affect children under three years old.
- It has an incubation period of 2-5 days. This means that if you have been in contact with someone who is infected and are infected your disease may not show up for 2-5 days.
- Respiratory secretions (saliva/mucus) spread the infection.

**Bronchitis**

Antibiotics should not be prescribed for bronchitis in healthy patients with acute bronchitis. Almost every case of acute bronchitis is viral. The overuse of antibiotics in bronchitis is a common reason for antibiotic resistance.

It is essential to differentiate acute bronchitis from pneumonia. Individual with pneumonia do need antibiotics, as do those with other health problems who are unable to tolerate a bacterial infection. Patients who are sick for more than 10 days or those with a specific type of infection (Mycoplasma) warrant antibiotics.

**Pneumonia**

Pneumonia is an inflammation in the lung caused by microorganisms. It is one of the most common causes of death due to infectious disease. Signs and symptoms can be variable depending on the severity of the disease as well as the organism affecting the patient. The disease often starts with the onset of a productive cough with purulent sputum, shortness of breath, increased heart rate, chest pain, fever and chills. The symptoms come on over a 1 to 10-hour period. Other symptoms that may be present include: headache, diarrhea, nausea, vomiting and malaise.

Young healthy patients without distress do not need to be hospitalized. Hospitalization is indicated for patients who are older and have other medical problems.
**Urinary tract infections**

Urinary tract infections (UTI) are a common and costly medical problem. Urinary tract infections occur eight times more commonly in women than in men. It is responsible for 6 to 11 million office visits in the United States each year (5, 6). Over half of women experience a urinary tract infection at least once in their life (5) but only 13% of men have a UTI in their lifetime (6).

On average, UTIs cause symptoms that disrupt the lives of women for 6 days, restricts activity for 2.5 days, causes one day of missed work and a half a day of bed rest (7). Kidney infections are responsible for 250,000 hospitalizations each year in America. They occur one time to every 18-28 cases of UTI. Bacteria invading the urinary tract cause UTIs. The most common community acquired bacteria that causes UTIs is *Escherichia coli* (responsible for 85% of UTIs that occur outside of the hospital).

Certain individuals are at higher risk for UTIs than others including those with urinary tract tumors or stones, congenital anomalies and those who were recently catheritized. Women are at greater risk than men as they have a shorter straighter urethra, which allows easier ascent of bacteria. Other risk factors for women include: intercourse, antibiotic use, pregnancy, use of spermicides and low estrogen levels.

Classic signs and symptoms of a UTI include painful urination, the need to urinate urgently and frequently. Other signs/symptoms that characterize a UTI include: having to urinate at night, blood in the urine, urinary incontinence and pain over the bladder.

UTIs are managed with antibiotics, but other measures may be used to help the healing process. Simple UTIs should be treated with rest and adequate fluid intake. Symptom management is important and can be accomplished with the use of pain medications. Ibuprofen can provide some mild relief. Pain medication for the bladder - Phenazopyrdine (Pyridium) is a prescription dosed at 200 mg three times a day for two days - may be more effective. The use of cranberry juice is also recommended as a treatment option for patient. It may decrease the ability of bacteria to adhere to the wall of the bladder as well as preventing inflammation of the bladder (5).

Antibiotics are usually needed to treat UTIs, even though some will go away on their own (8). Since you cannot know who will spontaneously resolve their UTI, it is standard care to treat everyone with a UTI with antibiotics.
**Skin infections**

Skin infections caused by bacteria are common. They are most commonly caused by *Staphylococcus aureus* and *streptococcus*. Cellulitis is a dangerous form of bacterial skin infection. It is contracted when there is a break in the skin via cut, scrap or ulcer. The bacteria leaks into the skin and infection results.

Cellulitis will typically cause fever and fatigue. The area of the skin is red, tender and warm. Red streaks coming from the infected area and lymph nodes that become swollen indicate a more severe infection. Adults often get cellulitis in the legs or arms while kids often get it in the neck or head.

Based on the clinical exam the diagnosis is often made. The use of blood work is often needed to evaluate the severity of the infection. Pus from the wound can sometimes be cultured to determine the bacteria that is causing the infection.

Treatment of the infection is with antibiotics. Oral antibiotics are given for mild infections and intravenous antibiotics are given for severe infections. A patient who is sick, who also has diabetes or peripheral artery disease is classified as having a serious infection.

To prevent infections it is important to take care of good care of any skin wound. Including cleaning the wound, applying topical antibiotics and keeping it covered with a bandage.

Other types of skin infections include:

- **Erysipelas**, which is a bacterial infection in the top layers of the skin. It is very painful and it burns. It is characterized by a well-defined border with normal skin surrounding the wound.
- **Folliculitis** is an infection of the hair follicles. It presents with a group of little red bumps that can be filled with pus.
- **Impetigo** is an infection in the top layer of the skin. It presents with honey-colored crusts and is treated with topical antibiotics.

Antibiotics commonly used for the treatment of minor skin infections are cephalexin, dicloxacillin, TMP-SMZ and doxycycline.

**Vaginal infections**

There are multiple causes of vaginal infections. They typically present with a constellation of vaginal discharge, irritation and foul odor. Severe infections can present with pain. Below is a listing of some common causes of vaginal infections and the medications used to treat them. The antibiotic listed below will be described in more detail during in the book.
• Yeast infections – known as vaginal candidiasis – are treated with either over the counter topical medications or a one time oral dose of fluconazole (Diflucan).
• Trichomoniasis is treated with oral metronidazole.
• Bacterial vaginosis is treated with oral metronidazole.
• Cervicitis can be caused by gonorrhea or chlamydia. It is treated based on the cause of the cervicitis.
• Pelvic inflammatory disease is a more serious disease that causes abdominal pain, fever and vaginal discharge. It can be treated with a shot of ceftriaxone and oral doxycycline for 2 weeks. Quinolones are sometimes used in combination with metronidazole. Gonorrhea is not treated as well with quinolones due to increasing resistance.

Antibiotics are the mainstay of treatment for a variety of infections. Your role in understanding the antibiotic is critical in the proper management of disease.
Chapter 2: Problems with Antibiotic Use

An antibiotic is a powerful medicine that treats bacterial infections in two major ways. One, it kills bacteria. Two, it slows down the growth of bacteria to allow your natural body defenses to kill the bacteria. Different antibiotics work through different mechanisms.

Antibiotics do not work against viruses, fungus or parasites. They are not helpful for the common cold, and many other illness that are caused by viruses. Even though most people understand this, many people feel the need to get an antibiotic when they are sick irregardless of whether bacteria or a virus causes the infection.

Risks of antibiotics

Antibiotic resistance

The frequent use of antibiotics has lead to the development of resistant bacteria. There are over 150 antibiotics currently developed to fight disease. The use of antibiotics for infections that are not caused by bacteria have greatly contributed to resistance.

Resistance is not a new phenomenon; it was noticed shortly after penicillin was developed. *Methicillin-resistant Staphylococcus aureus* (MRSA) is a well known resistant bacteria. It was only seen in the hospital, but over recent years it has been found in the community.

Proper use of antibiotics is critical to prevent the spread of antibiotic resistance. As bacteria becomes more resistant to antibiotics, people may die from infections that were once easily treatable. In addition, illness will last longer and will be more contagious.

When common antibiotics are unable to fight infection because of antibiotic resistance more powerful antibiotics will be needed to combat disease. These more powerful antibiotics are often associated with more severe side effects. When the more powerful antibiotics become resistant, there may be no antibiotic that can fight that disease.

Illness will be more costly, in both time and money, as antibiotic resistance increases. It will require the use of hospitalization, for intravenous therapy, laboratory monitoring and time away from the family.

What is the patient’s role?

Antibiotics must be used correctly if we want to reserve the future efficacy of antibiotics. Here are some things that you can do to promote the proper use of antibiotics.

- Understand when antibiotics should be used. Do not expect to take antibiotics every time you’re sick. Antibiotics treat most bacterial infections, but not viral infections, such as the common cold.
as colds, acute bronchitis, or the flu. Some common bacterial illnesses, such as mild ear infections or sinus infections, do not benefit much from antibiotics.

- Do not insist on antibiotics from your doctor. Talk to your doctor about how to relieve the symptoms of your viral illness — a saline nasal spray to clear a stuffy nose, for instance, or a mixture of warm water, lemon and honey to temporarily soothe a sore throat.
- Take antibiotics exactly as prescribed in regards to times a day and for how long.
- Don’t stop antibiotics early, this only kills the most vulnerable bacteria and allows the stronger ones to survive contributing to antibiotic resistance.
- Don’t take antibiotics without a prescription. You are not qualified to determine if you need the antibiotic – only your health care provider is.
- Prevent infection. The number one thing you can do is to wash your hands regularly.

Antibiotic resistance is everybody’s problem. Almost all bacteria has some resistance to antibiotics. Individuals who do not use antibiotics correctly contribute to the problem. Proper use of antibiotics not only affects your health, but the health of the community at large.

**Allergy to antibiotic**

Allergy to antibiotics is a common problem. Health care consumers can be allergic to any medication, but some medications are more likely to cause an allergy. To highlight allergy to antibiotics, two common medications that cause allergy will be discussed: penicillin and sulfa drugs.

Allergy to penicillin is common, but serious reactions to penicillin are not. About 90% of people who report an allergy to penicillin are either not allergic or the allergy diminished or went always over time. Only twenty percent of people are allergic to penicillin ten years after their allergic reaction if they have not taken the antibiotic over that time. On the other hand, 10% of people who report allergy have serious allergy.

Another common allergy is sulfa. Common antibiotics that have sulfa in them are Bactrim, Septra and Pediazole. About 3% of the population has allergy to sulfa antibiotics. Some individuals are more commonly affected with sulfa allergy such as those with diseases of the immune system such as HIV or AIDS.

Common sulfa reactions include:
- Rash
- Stevens-Johnson syndrome
- Sensitivity to sun
- Hives
- Liver problems
- Kidney problems
- Breathing difficulty
- Worsening asthma
- Reduced blood cells

Those who are allergic to sulfa antibiotics are often allergic to many other drugs. Other than the drugs already listed the following drugs may also cause problems in those that are allergic to sulfa:

- Sulfasalasine
- Sulfacetamide eye drops
- Silver sulfadiazine cream
- Some diuretics – hydrochlorothiazide
- Diabetic medications such as sulfonylureas (glyburide, glipizide)
- Celecoxib (Celebrex)
- Sumatriptan (Imitrex)

Some people with allergy to antibiotics need to be treated anyways. A doctor who is experienced with this should treat these people. It can be handled in a couple of ways.

If the side effects are mild the antibiotic can be given and the patient is monitored closely. Mild allergic reactions would include a mild rash or sun sensitivity. These patients would be watched and given treatment to deal with the allergic reaction. For example, if the allergic reaction was an itchy rash, anti-histamines - such as Benadryl – would be given to manage the symptoms.

Desensitization can also be done. This means that a small amount of the drug is given while the dosage is increased over a period of time to allow the person to tolerate the drug. This is rarely done, but sometimes needs to occur to allow a patient to be treated with the proper antibiotic.

**Adverse drug reactions**

Drugs cause people to get sick, especially the older population. Adverse drug reactions occur many times every day. It is estimated that 1.5 million people are admitted to the hospital and 100,000 deaths occur every year because of adverse drug reactions (9).

**Medication Errors**

The causes of medication errors are varied and vary by health care setting. In the
outpatient setting a common error is the pharmacist filling the wrong prescription due to inability to read the physician’s handwriting. Patients not understanding the instructions to take the medicine are another common cause of error. Communication with the doctor and pharmacist can reduce errors in the outpatient setting.

As the patient, it is essential that your doctor communicates with you about the drug he or she is prescribing. A critical step in reducing errors is knowing how to communicate with doctors. Take notes on any new drug prescribed by the doctor. If you have good notes on what the doctor prescribed, you will be able to question the pharmacy if any inconsistency is noted.

In the hospital, errors often result from lack of attention rather than lack of knowledge. The nursing staff is often overworked and make errors in administering medicine. Another common cause of hospital errors is not getting an accurate history from the patient. The doctor performing the initial work-up on the patient may not get an accurate list of the medications the patient takes. This results in the patient not getting medications that are needed.

**Side Effects**

Not all adverse drug reactions are a result of error. Medicines are dangerous substances and great care must be taken when they are prescribed. All medicines have side effects and many side effects are known and considered normal. Some medicines have more side effects than others. Some side effects get better when the patient gets used to the drug while others persist indefinitely. Some side effects are easy to spot such as diarrhea and others are subtler, such as fatigue.

Side effects vary by drug and can range from a mild inconvenience to life threatening. Common side effects include: fatigue, diarrhea, constipation, nausea, vomiting, decreased appetite, memory impairment and kidney dysfunction. Life threatening side effects include: abnormal heart rhythms and lung damage. Some medications have more side effects than others and it is important to discuss side effects with your doctor when you are being placed on a new drug.

Reporting the side effects is an important aspect to drug therapy. Some side effects are expected and if present will not change the course of treatment. Other side effects may be life threatening or so severe that the risk of therapy is not worth the benefit of treatment.

Knowing about the new drug is a key feature to health care responsibility. Understanding why the drug is taken, its side effects, and follow up needed for the drug is essential. Always
ask the questions listed in Table 2 when you are prescribed a new drug.

**Table 2: Questions to know about newly prescribed antibiotics**

- What is this medicine for?
- Does my age affect the dose needed to treat me properly?
- Are there any restrictions with this drug? For example, could this make me drowsy so I should not drive after taking the drug?
- How will it help me? How will I know if it is working?
- When should I take the medicine? In the morning, at night etc.
- Should I take the medicine with food or on an empty stomach?
- What are the common side effects with this medicine? Are the benefits of this drug worth the side effects and drug interactions?
- Could I benefit from taking yogurt or a pill to maintain the good bacteria in my body while on this antibiotic?
- Are there any necessary follow-ups either by exam or laboratory evaluation for monitoring this medicine?
- How much does it cost? Are there any cheaper alternatives to this medicine? Is there a generic version that has equal effectiveness?
- Can this medicine interact with any of my other medicines?
- How long has this medicine been on the market?
- Are there any severe risks with this medicine?
- What should I do if I miss a dose of the medicine?
- Can I drink alcohol while on this medicine?

**Drug Interactions**

Drug interactions are negative effects resulting from the mixing of two or more medications. Drugs have variable effects on other drugs - they can intensify or blunt the desired effect of another medication.

For example, patients on a blood thinner called coumadin need to have tight control of the blood level requiring frequent laboratory evaluation to assure the drug is therapeutic. The addition of an antibiotic has the potential to increase or decrease the amount of drug in the blood, placing the patient at elevated risk for bleeding complications if levels become too high or risk of clots if levels are too low. Individual variation is common with drug interactions. Certain medications will interact more in one individual than another individual with variation being explained by individual body chemistry.
Medical science lacks extensive research on drug interactions, especially when patients are on more than two or three drugs. The addition of medication to any patient has the potential for negative outcomes. The interaction between the other drugs, disease states and the individual’s body chemistry is variable.

Drug interactions are a complex topic - entire books have been written about the topic. Whenever you are started on a new drug, talk to the doctor and pharmacist about any potential interactions. The pharmacist may have a better idea of the interactions present because they have computer programs available to help sort out complicated drug regimes.

Complications

Complications are adverse events from drugs that cannot be classified as a side effect, interaction or error. A bacterial infection causing severe diarrhea secondary to antibiotic therapy, called *Clostridium difficile* (also known as C. diff.), is one common complication. *Clostridium difficile* is a bacterium that invades the gastrointestinal tract causing severe diarrhea.

*Clostridium difficile* is one of the great concerns of antibiotic therapy. The use of yogurt or a probiotics supplement may be helpful in preventing c. diff.

Summary

Antibiotics have saved many lives, but they are not without risk. Keep in mind that antibiotics are not benign drugs and they need to be used cautiously.
Chapter 3: Penicillin

Penicillin – which was derived from fungus - was first discovered in 1928. It was not produced for use until the early 1940's. While it was the second major class of antibiotic available it was very important because it was able to combat many illness that were not previously treatable including: syphilis, pneumonia, staph infections and tuberculosis.

While the drug was initially hard to produce in large quantities, a technique was developed using a moldy cantaloupe that allowed scientists to be able to mass-produce the antibiotic by 1944.

Interestingly, resistance to penicillin was noticed only three years after is was introduced as a medicine to fight infection. Penicillin resistance is a major problem today.

Penicillin is made up of 4 generations. Each generation has a little bit different coverage. This chapter will look at the three most common penicillin antibiotics prescribed in the doctor's office: Penicillin V Potassium, amoxicillin and amoxicillin-clavulanate.

Penicillin kills bacteria by attacking the bacteria's cell wall. Many bacteria are now resistant to penicillin. It has done this by producing an enzyme that prevents the antibiotic from breaking down the cell wall.

Consequently, some derivatives of penicillin have been developed that have another substance meant to combat this resistance. Amoxicillin-clavulanate is one example of this. Many of the intravenous forms of antibiotics have added an antibiotic that combats the problem of antibiotic resistance.

What do they treat?

Penicillin treats a wide range of conditions. Penicillin V potassium has the most narrow spectrum of action, followed by amoxicillin and amoxicillin-clavulanate can cover the widest range of infections.
Table 3: Practical use of penicillin antibiotics

<table>
<thead>
<tr>
<th>Drug</th>
<th>Common uses in the doctor’s office</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin V Potassium</td>
<td>Its main use in the doctor’s office is in the first line treatment of strep throat.</td>
<td>Best taken one hour before or 2 hours after meals. Most common side effects are diarrhea, vomiting, nausea and rash.</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Sinus infections, ear infection, bronchitis, strep throat and treats bacteria that causes stomach ulcers.</td>
<td>Can be taken with or without food. Most common side effects are nausea, vomiting, rash and diarrhea.</td>
</tr>
<tr>
<td>Amoxicillin-Clavulanate (Augmentin)</td>
<td>Sinus infections, pneumonia, ear infections, other respiratory infections and skin infections.</td>
<td>Should be taken with food, as it is more likely to cause stomach upset.</td>
</tr>
</tbody>
</table>

Common side effects

Penicillin is the most likely antibiotic to cause a severe allergic reaction, but the reaction is not as common as generally believed. Many people who report an allergy to penicillin are not actually allergic - either because the allergy went away or lessened over time. It is estimated that 10% of the population is allergic to penicillin.

The most common side effects include:

- Rash
- Nausea
- Diarrhea
- Hives
- Candida infection (Thrush, vaginal yeast infection)
Less common side effects include:

- Fever
- Seizure
- Swelling of the throat
- Severe diarrhea from *Clostridium difficile*

Most side effects of penicillin are mild. Immediate medical attention must be obtained if there is any swelling of the throat, breathing difficulty or wheezing.

Allergy, while not a side effect, is common with penicillin. When the allergy is hives, decreased blood pressure, or difficulty breathing due to swelling in the mouth and throat than the allergy is considered severe and any antibiotic that is close to penicillin should not be given.

Many of those allergic to penicillin are also allergic to cephalosporins (see next chapter), but some evidence suggests that there is no or little cross reactivity to later generation cephalosporins.

Those who have a mild allergic reaction, such as a rash, may be tried on other antibiotics in a similar class (Cephalosporins) and watched closely. If there is a serious allergic reaction to penicillin – such as difficulty breathing or hives – then the use of cephalosporins is not recommended.

<table>
<thead>
<tr>
<th>Life saving key point</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you are allergic to penicillin, you may also be allergic to another class of medications known as cephalosporins.</td>
</tr>
</tbody>
</table>

**The individual drugs**

The main first generation penicillin is Penicillin V Potassium. While it can treat a wide range of infections (see table 3), it is the drug of choice in strep throat. The oral suspension of this drug has a bitter taste and therefore amoxicillin suspension is often substituted in children for strep throat.

The main second generation penicillin in oral form is dicloxacillin. This drug is not commonly used in medicine today except it is used to treat skin infections.
The third-generation penicillin group is the most popular generation used in the doctor’s office. The two major oral antibiotics here are amoxicillin and amoxicillin-clavulanate (Augmentin).

Amoxicillin is used as a first-line treatment for sinus infections, ear infections, strep throat (especially in children because the suspension tastes much better than penicillin). Amoxicillin adds some gram-negative coverage to the good gram-positive coverage of the first and second-generation penicillin group (see table 4).

Amoxicillin-clavulanate (Augmentin) is commonly used in the treatment of many respiratory infections. It is associated with similar side effects, but the side effects are more prevalent. Side effects are mainly gastrointestinal. Common side effects include: diarrhea and upset stomach. This drug should be taken with food to lessen the risk of side effects.

Amoxicillin-clavulanate is often used as a second-line drug for those with many of the same illnesses that amoxicillin covers. This means that if amoxicillin does not work than on a return visit to the doctor, he/she may place you on amoxicillin-clavulanate. It is not recommended as a first-line agent because it has a broader range of coverage and has more side effects.

Amoxicillin treats many of the same infections just as effectively. Therefore, why use a more powerful antibiotic. Overuse of powerful antibiotics have the potential to lead to resistance of those antibiotics.

The main difference between amoxicillin and amoxicillin-clavulanate is obviously the clavulanate. What is the clavulanate? It is a medication called a beta-lactamase inhibitor and it prevents some bacteria from destroying the penicillin. It will often treat an infection that is resistant to amoxicillin.

Common uses of amoxicillin-clavulanate (Augmentin) include:

- Sinus infections
- Ear infections
- Pneumonia
- Skin infections
- Urinary tract infections
Fourth generation penicillins treat more severe infections but are only available in the intravenous form. They are associated with more side effects including bleeding disorders and electrolyte imbalances.

**Key Points**

- Penicillin comes in 4 generations with each generation offering different coverage
- Allergy is common to penicillin
- If you are allergic to penicillin, caution must be used when using other medications in a similar class - cephalosporins.
- Penicillin V Potassium is the drug of choice for strep throat
- Amoxicillin suspension is used as an alternative to Penicillin V Potassium in children as Penicillin V Potassium has a bitter taste
- Amoxicillin is a first-line treatment for ear infections and sinus infections
- Amoxicillin-clavulanate is used in more severe infections and in some infections when a course of amoxicillin has not worked

**Table 4: Gram-positive and Gram-negative**

Gram-positive and gram-negative are terms that health care providers use to classify bacteria into two large groups. When the health care personal stains the bacteria, they can differentiate between two types of bacteria based on the physical and chemical properties of their cell wall.

It is helpful to make this differential as gram-positive organisms and gram-negative organisms respond to different antibiotics.

There are currently much more definitive ways to determine the exact bacteria that is causing the infection, but they do not provide results as quickly as the gram stain. It takes minutes to tell if the bacterium is gram-positive or gram-negative. It can take days for a culture to determine the exact bacterial cause of the infection.

It therefore has good use in serious infection. It helps the doctor determine which antibiotic is likely going to have some effectiveness over the bacteria, while the doctor waits for the return of the more definitive culture.
Chapter 4: Cephalosporins

The first cephalosporin was developed in 1964. The compounds that were used to develop these antibiotics were isolated from a sewer on an island in the Mediterranean sea by an Italian scientist. Like the penicillins, there are four classes of cephalosporins. As mentioned above there is some cross reactivity between penicillin and cephalosporins in regard to allergies.

The first-generation cephalosporins have approximately a 10% cross reactivity with penicillin. It is a question of debate whether there is cross reactivity with second or third-generation cephalosporins. If the reaction is severe, such as breathing difficulty, swelling of the throat or hives, then the use of cephalosporins should not be used in the face of a penicillin allergy.

Two commonly used oral first generation cephalosporins are (see table) cephalexin (Keflex) and cefadroxil (Duricef). First-generation cephalosporins cover gram-positive bacteria well and have limited activity against gram-negative bacteria.

Second or third-generation cephalosporins work well for many different bacterial infections. The second and third-generation cephalosporins add coverage of gram-negative bacteria.

There is one fourth-generation cephalosporin that is given through the IV. It is used for urinary tract infections, kidney infections, pneumonia, skin infections and abdominal infections.

What do they treat?

The most commonly used first generation cephalosporin is cephalexin (Keflex). It effectively treats gram-positive infections. This means that it is effective for the treatment of many streptococcal infections and staphylococcal infections.

It is commonly used for skin infections as well as some respiratory infections such as strep throat. It is not a commonly used drug for most respiratory infections other than strep throat. While it is very effective in the treatment of strep throat it is not recommended as a first-line drug.
Second-generation cephalosporins retain gram-positive coverage but adds in some gram-negative coverage. This means that they can treat more infections. They are commonly used for respiratory tract infections including sinus infections and ear infections.

The third-generation cephalosporins have even better gram-negative coverage. This class is made up of some oral medications and a commonly used injectable medication called ceftriaxone (Rocephin). Rocephin is a popular drug in this class as it is used with some frequency in the doctor's office for more severe infections. Other medications in this class are available as an intravenous (IV) preparation.

This class is used to treat many respiratory tract infections. There is a lot of variability within this class. Some of the drugs are only given through the IV and are used for some very severe infections. Some antibiotics in this class are used to treat kidney infections, pneumonias, gonorrhea, meningitis and some infections in the stomach.

See the antibiotic table for a breakdown of specific medications commonly used in the doctor’s office and what they treat.

**Common side effects**

As a class, side effects from cephalosporins are not common. Common side effects include:

- Diarrhea
- Nausea
- Rash

Less common side effects include:

- Dizziness
- Electrolyte disturbance
- Headache
- Thrush
- Vaginal yeast infections
- Diarrhea secondary to *Clostridium difficile*
- Fever
• Vomiting

Some specific side effects to be aware of include:
• Cefdinir (Omnicef) can turn the stool especially if taken with iron.
• Ceftriaxone (Rocephin) can cause considerable pain upon injection and it is sometimes mixed with a numbing agent such as lidocaine.
• Loracarbef (Lorabid) and cefprozil (Cefzil) cause the least amount of diarrhea.
• Loracarbef (Lorabid) and cefpodoxime (Vantin) are the best tasting antibiotics.

**Key points**
• Cephalosporins have four generations.
• If you have a skin infection the use of cephalexin (Keflex) is a good choice.
• Cephalosporins do not cover methicillin-resistant Staphylococcal Aureus, which is a common cause of skin infections.
• The second-generation cephalosporins cover a wide range of infections and can be used in a variety of respiratory infections.
• Ceftriaxone is often used in someone who is very sick in the doctor's office with a bad ear infection or pneumonia. It is sometimes given everyday and will require daily visits to the doctor's office. This is often done in someone who is on the border of being hospitalized.
Chapter 5: Macrolides

Macrolides have been around since early 1950’s. The first macrolide was erythromycin and was available commercially in 1952. Due to the multiple side effects of erythromycin other macrolides have been developed. The two most commonly used newer macrolides are: clarithromycin (Biaxin) and azithromycin (Zithromax). These medications were developed in the 1970’s and 1980’s respectively.

This class of medication has similar coverage (it actually covers a few more infections) to penicillin and is often used as an alternative to those with allergy to penicillin.

Bacterial resistance is becoming a larger problem with the macrolides. This is particularly problematic in patients with strep throat and sinus infections.

What do they treat?

Macrolides treat a wide range of conditions. They are able to cover more infections than penicillins, but there is some resistance, as previously noted. They are commonly used for upper respiratory tract infections, skin infections, soft tissue infections, some pneumonias, diarrhea infections and some sexually transmitted diseases.

They are sometimes used when there is an allergy to penicillin in conditions such as strep throat, ear infections or sinus infections.

Azithromycin is used to treat ear infections, sinus infections (there is an increased rate of resistance in sinus infections), pneumonia, throat infections, exacerbation of chronic bronchitis, skin infections and some sexually transmitted diseases.

Clarithromycin is used for sinus infections, exacerbation of chronic bronchitis, pneumonia, throat infections, ear infections and skin infections

Telithromycin (Ketek) is indicated for only mild to moderate pneumonia

Common side effects

Common side effects include:

- Nausea
- Diarrhea
- Abdominal pain
- Abnormal taste (Clarithromycin)

Less common side effects include:
- Ringing in the ear
- Deafness
- Severe rash
- Liver damage (especially in pregnant women with erythromycin)
- Bad dreams

The use of cholesterol lowering medications called statins (Lipitor, Zocor, Mevacor) along with macrolides may increase the risk of a condition called myopathy. Myopathy is a condition associated with muscle breakdown.

Another serious side effect is cardiac arrhythmias and is more common when combined with other medications and with the use of erythromycin and clarithromycin.

**The individual drugs**

**Erythromycin**

Erythromycin is not as commonly used due to its significant gastrointestinal side effects. It comes in multiple formulations. It is dosed between two and four times a day. It is associated with many drug interactions, so use caution with this antibiotic when on other medications.

**Azithromycin**

Azithromycin (Zithromax), known commonly as the z-pak, is the most popular macrolide. This drug provides many advantages over other macrolides. It is dosed once a day for 3-5 days. There is even a one-time dose of this medication for some infections. It has the fewest side effects and the fewest drug interactions in the class. It is least likely to lead to cardiac rhythm problems.

**Clarithromycin**

Clarithromycin (Biaxin) is very similar to azithromycin in regard to what it treats. It is less commonly used because it requires a 7-14 day course of therapy and is dosed once (in the extended release form – which may be more
expensive) or twice a day (in the standard form) compared to once a day dosing for 3-5 days with azithromycin.

Clarithromycin is associated with unique side effects. It is more likely to lead to interactions with cholesterol lowering drugs and lead to myopathy. It is also more likely to lead to cardiac rhythm disturbances. It is also associated with an abnormal (metallic) taste in the mouth.

**Telithromycin (Ketek)**

Telithromycin is technically not a macrolide, but it is closely related and will be discussed here. It is not used as frequently because it is associated with liver problems. It is reserved for cases when nothing else works. It is indicated for mild to moderate pneumonia.

**Practical use**

- Erythromycin is the oldest macrolide and is associated with the most side effects – mainly gastrointestinal.
- The two most commonly used macrolide antibiotics are azithromycin (Zithromax/z-pack) and clarithromycin (Biaxin).
- Azithromycin and clarithromycin are commonly used for mild-moderate cases of pneumonia.
- The newer macrolides cover a wide range of respiratory infections including: ear infections, sinus infections, pneumonia and throat infections.
- There is increasing resistance to macrolide antibiotics. Therefore, these drugs are at times not effective in eradicating infections.
- Macrolides are over prescribed for many infections due their convenience and lack of side effects.
Chapter 6: Quinolones

I am starting to sound like a broken record, but there are four generations of quinolone antibiotics. The first-generation quinolones are almost never used and they will not be discussed.

The first quinolone was developed in 1962 - nalidixic acid. It was developed to treat kidney infections. Other first-generation drugs were developed in the 1970’s.

The most popular second-generation quinolone is ciprofloxacin (Cipro). Ofloxacin and norfloxacin are other second-generation quinolones that are sometimes used.

Third-generation quinolones treat a wide variety of infections. Fourth-generation quinolones are rarely used because of significant liver problems, but can cover more infections than the third-generation quinolones.

Quinolones are powerful medications and should be reserved for more serious infections. Few infections in the doctor’s office – pneumonia and urinary tract infections being the most common – use quinolones as a first-line medication.

What do they treat?

Quinolones treat a wide range of infections. Common infections that they treat include: urinary tract infections, pneumonia, acute exacerbation of chronic bronchitis and sinus infections.

Second-generation quinolones, in oral form, are used most frequently for urinary tract infections and some infections that are caused by a bacteria called pseudomonas. They are not commonly used for respiratory tract infections.

The third-generation quinolones do not cover infections caused by pseudomonas as well but do cover pneumonia and other respiratory tract infections. The third-generation quinolones are effective for treated sinus infections, pneumonia and urinary tract infection (Moxifloxacin does not work for urinary tract infections).
Fourth-generation quinolones cover many of the same infections as the third generation quinolones but add coverage of anaerobic bacteria. Anaerobic infections commonly occur in the stomach, mouth or vagina.

Moxifloxacin and gatifloxacin treat chronic bronchitis, pneumonia, diabetic foot infection and bone infections. Gatifloxacin can treat urinary tract infections.

One nice feature of quinolones is that they reach equal levels in the blood when given by mouth or by IV.

Some of the drugs in this class come in eye and eardrop form (see chapter on topical antibiotics) for the treatment of bacterial eye infections and outer ear infections.

**Common side effects**

Quinolones are well-tolerated drugs. Common side effects include:

- Nausea
- Diarrhea
- Rash
- Sensitivity to the sun
- Cartilage growth interference (these drugs are rarely recommended in those who are growing – under 18-years-old or pregnancy/lactation)
- Itching
- Taste disturbance

Serious side effects are rare, but can include:

- Tendon rupture. Quinolones can cause tendon rupture especially when combined with corticosteroids in older adults (over 60), and those who have had a heart, lung or kidney transplant. Even though it is rare, you should not exercise vigorously while on (and for a few weeks after taking) these antibiotics.
- Cardiac arrhythmia. Quinolones can lead to cardiac rhythm disturbances. This commonly occurs in individuals on other medications that exacerbate this problem. Levofloxacin is the least likely to do this.
- Abnormal blood sugar (most common with gatifloxacin)
Some quinolones have been pulled from the market due to serious side effects included liver failure, blood clotting problems and kidney problems.

Neurological effects including seizures (especially when used with non steroidal anti-inflammatory medications [Motrin, Advil, Aleve]), confusion, dizziness and headache

These drugs should be used cautiously in those with liver disease and the elderly. They should not be used in those with a history of seizures, brain tumor, inflammation the central nervous system or after a stroke.

These drugs are not approved in children, pregnancy and breast-feeding. It is believed that these antibiotics adversely affect the joints and cartilage in those whose cartilage and joints are still developing. This has been shown in animal studies, but this class is sometimes used in humans with cystic fibrosis and cartilage damage has not been seen. Anthrax is the only approved use for quinolones in children.

**Interactions**

As a class, there are many considerations about what else is consumed while the patient is on quinolones.

Side effects are made worse when quinolones are combined with: caffeine, non-steroidal anti-inflammatory drugs and theophylline.

Sometimes these medications do not work. This can happen when the drug is taken with high levels of calcium, magnesium, iron or zinc. If you take any of these substances make sure the antibiotic is taken 2 hours before ingesting these substances or 8 hours afterwards.

Calcium and magnesium are found in many foods but are often found in antacids and is some anti-diarrhea medications. Iron is found in pills that people take when they have a certain type of anemia. Zinc may be found in vitamin supplements or even some homeopathic cold remedies (levels are probably to low in cold remedies (Zicam) to have a significant effect, but I still would not recommend taking quinolones with any zinc product).

Other drugs that may interact include: probenecid, cimetidine, warfarin, some seizure drugs and some immunosuppresnat drugs (cyclosporine).
Resistance

Resistance is becoming a larger problem with this drug. Some cases of strep throat and staphylococcus aureus have developed resistance to quinolones. The use of this drug significantly increases the risk of a future infection with a bacteria that is resistant to quinolones. Resistance has been noticed to strains of streptococcus, staphylococcus and gonorrhea.

Quinolones are very potent medications and should be used only in those who are seriously ill. The overuse of these drugs is contributing to the antibiotic resistance.

These drugs should not be used for unapproved uses such as ear infections, upper respiratory tract infections and acute bronchitis.

The individual drugs

Ciprofloxacin (Cipro) is the most popular second-generation quinolone. It is commonly used for urinary tract infections and selected respiratory tract infections. Ciprofloxacin (Cipro) is often used as it has good gram-negative coverage and some gram-positive coverage. Generally, quinolones are more expensive which can limit their use, but ciprofloxacin comes in a generic form and it is not expensive.

Norfloxacin (Noroxin) is another second-generation quinolone that is used for UTIs, prostate infections and some sexually transmitted diseases. It should be taken on an empty stomach and is given 400 mg every 12 hours.

Levofloxacin (Levaquin) is a popular third-generation quinolone. It is used for pneumonia, sinus infections, urinary tract infections, kidney infections and skin infections.

Moxifloxacin (Avelox) can be used for pneumonia, chronic bronchitis exacerbations, sinus infections, skin infections and abdominal infections. It is dosed 400 mg once a day and is used for 5-21 days depending on the type of infection.

Gemifloxacin (Factive) is a third-generation quinolone that is dosed 320 mg once a day. It is used for five days in bronchitis and 5 to 7 days in pneumonia.

Key Points

- There are four generations of quinolones
• First generation quinolones are rarely used
• The most popular second-generation quinolone is ciprofloxacin (Cipro) and is used commonly in urinary tract infections. It is also used (often in combination with other medications) to treat a variety of other infections including bone/joint infections, intra abdominal infections and skin infections.
• Third-generation quinolones are used to treat many infections including respiratory tract infections, urinary tract infections and skin infections.
• Third-generation quinolones are often used first-line for pneumonia that is not treated in the hospital.
• Other than the above two points, quinolones are rarely used as a first-line drug.
• Those who have used quinolones in the past are at higher risk for developing an infection that is resistant to quinolones.
• Quinolones have significant interactions that need to considered.
• Quinolones are associated with severe adverse reactions, but they are not common.
Chapter 7: Tetracyclines

Tetracyclines cover a wide range of bacterial infections and have been around since the late 1940’s. Increased bacterial resistance has been noticed with this antibiotic. There are three main types of tetracycline antibiotics: tetracycline, doxycycline and minocycline.

What do they treat?

Tetracyclines cover many types of infections. Some infections that they are used for include:

- Acne
- Some pneumonias
- Some cases of bronchitis
- Some sinus infections
- Some ear infections
- Gonorrhea (not a first line drug)
- Some sexually transmitted diseases (Chlamydia, syphilis)
- Some urinary tract infections
- Lyme disease

While this is a long list of indications, this class is not used commonly. Many infections can be caused by a variety of organisms. A bacteria called *Streptococcus pneumoniae* is a very common cause of pneumonia, sinus infections and ear infections. While drugs in the tetracycline class may be able to treat this bacteria, it does not do so reliably.

When pneumonia is caused by *Streptococcus pneumoniae* it can be deadly. It is therefore not recommended as a treatment option if this bacteria is suspected unless there is evidence on a lab test (such as a culture of the mucus) that shows that tetracycline will work or in a patient who likely does not have *Streptococcus pneumoniae*.

Whereas if another antibiotic is chosen – quinolones - there is a very high probability that the infection will be eradicated.

In addition to the above disease states it covers a variety of other rare infections such as:
• Tularemia
• Rocky Mountain spotted fever
• The Plague

Common side effects

As a class, this drug can discolor teeth in young children and therefore the drug should not be used in children, pregnant or breastfeeding women.

Tetracyclines should be used with caution in those with liver impairment and may worsen renal failure (more common with tetracycline). They may increase muscle weakness in myasthenia gravis and exacerbate systemic lupus erythematosus.

Common side effects include:
• Sensitivity to the sun - increased risk of sun burn (more so with tetracycline and doxycycline)
• Stomach upset
• Diarrhea
• Rash

Uncommon side effects
• Headache
• Vision problems
• Dizziness
• Lupus-like syndrome
• Joint pain
• The gums in the mouth become discolored

Interactions

Antacids and milk-products reduce the absorption of tetracyclines. Tetracyclines may reduce the effectiveness of oral contraceptives, even more than other antibiotics, but this is a question of debate. It is recommended that if you use antibiotics (especially tetracycline) that you use a back method of contraception, unless you are trying to conceive.

Other drugs that may have an interaction with tetracyclines include:
• Penicillin – Penicillin will not work well when both are combined
• Blood thinners (warfarin) – The combination of the two medications increase the risk of bleeding

**The individual drugs**

**Tetracyclines**

Tetracycline is taken between one and four times a day. It is given in the oral form only. While it can be used for many different types of infections, it is not used often.

**Doxycycline**

Doxycycline is usually given 1-2 times a day. It is safe to take if you have some degree of kidney dysfunction as opposed to tetracycline, which is excreted through the kidney. Those with heartburn should not take Doryx. Doryx is an enteric-coated form of doxycycline and it is expensive.

**Minocycline**

Minocycline gets into the body tissues well. This drug has some troublesome side effects including dizziness, a permanent blue/black discoloration of the skin (that may be permanent) and tooth discoloration.

**Practical use**

• Tetracyclines have been around a long time, but are not used commonly
• They are used for some respiratory tract infections, but do not reliably cover many bacteria that cause respiratory infections
• Acne is one of the most common uses of this class
• The most common side effect is sensitivity to the sun, so if patients on this drug go out in the sun, the use of clothing to cover the skin and sunscreen should be applied
Chapter 8: Sulfa Drugs

Sulfa drugs were the first antibacterial agent brought to market in the mid 1930’s. It was around for the second world war and helped save many lives, but not as many as penicillin. It was able to treat a wide range of bacterial infections when taken orally. The trade name was Prontosil.

Sulfamethoxazole – sometimes combined with trimethoprim in a product called Bactrim – is a common drug used in the management of common problems in the outpatient setting.

Many other drugs are sulfa-based. Some have antibacterial properties and some do not.

What do they treat?
Sulfa drugs treat many infections including:

• Urinary tract infections
• Some respiratory tract infections (either alone or in combination with another antibiotic)
• Ear infections in kids
• Skin infections caused by MRSA
• Acne
• Some illnesses that result in diarrhea such as travelers’ diarrhea
• Some infections common in patients with HIV/AIDS

Common side effects
Sulfa drugs are commonly associated with side effects as well as allergic reactions. Those with HIV have a higher prevalence of adverse reactions.

Common side effects include:

• Rash (some can be serious)
• Stomach upset

Uncommon side effects

• Stevens-Johnson Syndrome (severe skin reaction)
• Hives
• Urinary tract disorders
• Blood disorders
• Toxic epidermal necrolysis (severe skin reaction)

Those who are on this drug for long periods of time should have their blood counts monitored to watch for any blood disorders.

The individual drugs

Sulfamethoxazole-Trimethoprim (Bactrim, Septra) is used in the treatment of bladder infections. It is dosed twice a day and can be given for three days in uncomplicated infections. It increases the risk of yeast infections.

The most common bacteria that causes bladder infection is *E. coli*. Some communities are seeing a large increase in *E. Coli* resistance and therefore this drug is sometimes not used in the management of bladder infections.

Risk factors for resistance to Bactrim include: those who are currently on an antibiotic when diagnosed with a bladder infection, on Bactrim with in the last three months, those who have traveled to Mexico, and recent hospitalization.

Because of this resistance to sulfa drugs, quinolones are becoming a more popular choice for the treatment of urinary tract infections.

Practical use

• This drug is falling out of favor
• It is often used in urinary tract infections, but with the increasing of bacterial resistance it is being used less often
• It is used for some respiratory tract infections, but is not often used because of increasing bacterial resistance
Chapter 9: Miscellaneous Drugs

Nitrofurantoin

Nitrofurantoin is a drug that is only useful for urinary tract infections. It covers most bacterium (including *E. Coli*) that cause urinary tract infections.

This antibiotic does not cover common bacterium that cause urinary tract infections in men and some older women. It is therefore recommended to be used only for uncomplicated urinary tract infections in young women.

It should not be used in those who have kidney problems or who do not make urine. Individuals with a G6P deficiency should not use this drug. It has not been studied thoroughly in pregnancy and should be used with caution in pregnant women.

The extended release form is typically dosed 100 mg taken twice a day for 7 days. The standard form is dosed four times a day in the treatment of urinary tract infections.

Nitrofurantoin (Macrobid) has no significant serum level and has been used extensively in the management of UTIs. It does require 7 days to treat uncomplicated UTIs. This is opposed to many of the other antibiotics used in the treatment of UTIs being a three-day course.

Common side effects include:
- Nausea
- Dizziness
- Headache

Those who use it long-term may be afflicted with lung or blood disorders. Therefore, monitoring kidney and lung function is critical in those who use this drug long-term. It is used long-term in the suppression of recurrent UTIs.

Rare side effects include:
- Liver failure
- Severe rash
- Damage to the optic nerve
**Metronidazole**

Metronidazole (Flagyl) is a drug that is given orally, intravenously, topically or intra vaginally. It covers anaerobic bacteria. Anaerobic infections are unique infections that cause problems in the stomach, mouth or vagina. This medication also provides some anti-protozoal activity. It is used for:

- Bacterial vaginosis (a vaginal infection that presents with a vaginal discharge and a fishy odor)
- Diarrhea secondary to *Clostridium difficile* or *giardia lamblia*
- Pelvic inflammatory disease (with other antibiotics such as quinolones)
- Intra-abdominal abscess
- Peritonitis (infection in the stomach)
- Diabetic foot ulcer
- Brain abscess
- Acne rosacea
- Trichomonas vaginalis (a sexually transmitted disease that presents with greenish-yellow vaginal discharge and vaginal itching)
- *Helicobacter pylori* (bacteria that causes stomach ulcers) - it is not used as a first-line drug
- Acute gingivitis/dental abscess
- Pneumonia, lung abscess or aspiration pneumonia. Aspiration pneumonia occurs when there is a oral or gastrointestinal fluid that gets into the lungs and causes infection. It is more common in those who are older and have problems with swallowing. Individuals who are drunk and throw up can be afflicted with aspiration pneumonia.

**Side effects**

Common side effects (with oral therapy)

- Nausea
- Diarrhea
- Metallic taste in the mouth

Uncommon side effects include:

- Rash
- Fever
- Seizure
- Itching
- Dizziness
- Vomiting
- Headache
- Numbness
- Inflammation of the tongue

Long-term use of metronidazole may cause:
- Low white blood cells
- Black hairy tongue
- Nerve damage
- Possibly increase the risk of cancer (only shown in animals)

Topical therapy is associated with:
- Redness
- Skin irritation
- Dry skin
- Eye watering if put near the eyes

This antibiotic should NOT be consumed with alcohol. It can cause a severe reaction that presents with nausea, vomiting, increased heart rate, flushing of the skin and shortness of breath. No alcohol should be drunk while the patient is on the antibiotic and for two days afterwards.

**Clindamycin**

Oral clindamycin is available as a generic and under multiple trade names, including: Clindacin, Cleocin, and Evoclin. It is also available in topical form – combined with benzoyl peroxide in products called: Duac and BenzaClin.

It is used for many of the same infections that are responsive to penicillin. It is not used as a first-line medication most of the time because it is associated with more side effects. It is used in some specific infections and in those with multiple antibiotic allergies. Clindamycin treats infections with anaerobic bacteria and some non-bacterial infections such as malaria.

Common reasons it is used include:
• Acne (especially in topical form)
• Skin infections including methicillin-resistant *Staphylococcus aureus* (MRSA) infections
• Bacterial vaginosis during early pregnancy – treatment with Clindamycin reduces risk of premature births
• Respiratory tract infections
• Bone and joint infections
• Peritonitis
• Serious infections such as toxic shock often in combination with vancomycin (a powerful IV drug)

**Side effects**

A serious side effect is *Clostridium difficile*-associated diarrhea. While any antibiotic can lead to this infection, it is very common with clindamycin. The incidence of *Clostridium difficile*-associated diarrhea is one of the main reasons that this drug is not used often for infections.

Other common side effects include:

• Nausea
• Vomiting
• Abdominal cramps
• Abdominal pain
• Itching
• Rash
• Metallic taste (high doses)
• The topical formulation can cause redness of the skin
• Rare side effects include: liver toxicity, arthritis, blood disorders and breathing difficulty
Chapter 10: Topical Antibiotics

This chapter will look at topical antibiotics that are used to manage common infections. This chapter will address three classes of antibiotics: skin applied antibiotics, antibiotics in the ear and antibiotics in the eye.

Skin applied antibiotics

There are three major over the counter antibiotics for the skin: Neosporin, Bacitracin and Polysporin. These medications are fairly similar. Over the counter topical antibiotics decrease the risk of skin infection in a minor wound, but are not used to treat established skin infections.

Neosporin is a triple antibiotic that contains, neomycin, bacitracin and polymyxin. This topical medications comes in an ointment and cream form. It is the broadest of the topical antibiotics as it contains three antibiotics. Many health care providers do not like to use this medication, as the neomycin is associated with a lot of allergic potential. It often makes the skin red and painful and it may be more harmful than helpful in many people.

On the positive side, the addition of neomycin provides coverage against bacteria that are not covered by the other medications.

Bacitracin contains only one antibiotic – bacitracin. Bacitracin covers the most common causes of skin infections – staphylococcal and streptococcal infections. Its coverage is not as broad as Neosporin, but is associated with less allergic potential.

Polysporin contains two antibiotics – bacitracin and polymyxin.

Bactine is an over the counter product that contains benzalkonium (antiseptic) and lidocaine (pain reliever). It is used for the prevention of bacterial infection and a reduction in discomfort associated with cuts and scrapes.

Antiseptic agents are different than antibacterial agents. Antiseptic agents reduce the growth or microorganisms. They do not target a specific agent and can work on a variety of different agents including viruses, bacteria and protozoa. There is also less chance for drug resistant bacteria to develop to antiseptics.
On the down side there is some concern that antiseptics can damage healthy cells and inhibiting wound healing. Although, most antiseptics have not demonstrated this negative effect in humans.

Hydrogen peroxide can also be used, but is not recommended for the use of minor wounds. It is an antiseptic agent that can kill bacteria but has the potential to harm healthy tissue. Of all antiseptics, hydrogen peroxide demonstrates the least effectiveness in the management of reducing bacterial counts.

Limited studies compare antiseptic agents to antibacterial agents in the management of minor cuts and wounds. Most doctors currently recommend the use bacitracin or bacitracin/polysporin in the management of minor wounds. This does not mean that Neosporin (unless you are sensitive to it) or the use of antiseptics are inappropriate. More research is needed before a definitive answer can be given.

Mupirocin (Bactroban, Centany) is a topical prescription antibiotics. Its claim to fame is in treating impetigo as well as MSRA. It can also be used to treat wounds that become infected. This drug treats the bacteria *Streptococcus pyogenes* and *Staphylococcus aureus*.

Individuals who are colonized with MRSA often use a nasal preparation of this antibiotic to eliminate it from their system. This is especially important before going in for elective surgery.

Retapamulin (Altabax) is a newer topical ointment used in the treatment of impetigo. Its major side effect is application site irritation.

**Eye antibiotics**

Many options are available in the management of bacterial infections in the eye. Many doctors treat with quinolones (which have the lowest level of resistance) particularly moxifloxacin (10) (see Table 5). Moxifloxacin has a low level of resistance and good coverage against organisms responsible for conjunctivitis. Moxifloxacin also has a rapid onset of action and remains in the conjunctiva cell much longer than other antibiotics. Moxifloxacin has shown to provide a quicker cure – by 48 hours – when compared to polymyxin/trimethoprim (11).
Quinolones (applied in the eye) can be used in children as young as one.
Little gets into the blood stream and systemic effects are minimal and not a concern. There is less concern for resistance to develop with the use of later generation topical antibiotic than with oral antibiotics (10).

Azithromycin is a newer medication used to treat bacterial conjunctivitis. It has an improved dosing schedule, which may help improve compliance. It has been shown to be similarly efficacious to tobramycin (12).

Older antibiotics such as sulfacetamide based products and Gentamicin have a tendency to burn and sting. Other antibiotics, such as gatifloxacin (Zymar), are dosed very frequently (drops every two hours for 48 hours and then four times a day) and compliance becomes an issue.

Most antibiotics for bacterial eye infections are used for 5-7 days. See table five for a listing of antibiotics used in the treatment of bacterial eye infections.

**Table 5: Antibiotics for Bacterial Eye Infections**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dosing</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythromycin</td>
<td>Ointment: four times a day for 7 days</td>
<td>Does not cover all infections, some resistance</td>
</tr>
<tr>
<td>Sulfacetamide</td>
<td>Solution: 1-3 drops every 2-3 hours for 7 days</td>
<td>Stings, bacterial resistance</td>
</tr>
<tr>
<td></td>
<td>Ointment: four times a day for 7 days</td>
<td></td>
</tr>
<tr>
<td>Gentamicin</td>
<td>Solution: 1-2 drops four times a day for 7 days</td>
<td>Does not cover all infections, may eye</td>
</tr>
<tr>
<td></td>
<td>Ointment: four times a day for 7 days</td>
<td></td>
</tr>
<tr>
<td>Tobramycin</td>
<td>Solution 1-2 drops four times a day for 7 days</td>
<td>Limited activity against gram-positive infections</td>
</tr>
<tr>
<td></td>
<td>Ointment: four times a day</td>
<td></td>
</tr>
<tr>
<td>Medicine</td>
<td>Dosage</td>
<td>Onset of Action</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Trimethoprim/polymyxin B</td>
<td>Solution: four times a day for 7 days Ointment: Four times a day for 7 days</td>
<td>Slow onset of action, some resistance</td>
</tr>
<tr>
<td>Ciprofloxacin/Ofloxacin</td>
<td>Solution: 1-2 drops four times a day for 7 days</td>
<td>Slow onset of action</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>Solution: 1 drop twice a day for two days, than one drop once a day for five days</td>
<td>Newer medication</td>
</tr>
<tr>
<td>Gatifloxacin</td>
<td>Solution: 1 drop every 2 hours for 48 hours than four times a day for 5 days</td>
<td>Expensive, best over all coverage, no resistance</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>Solution: 1 drop three times a day for 5-7 days</td>
<td>Expensive, best over all coverage, no resistance</td>
</tr>
</tbody>
</table>

**Topical ear antibiotics**

Topical ear antibiotics are used for infections of the ear canal. The most common infection that uses topical ear antibiotics is swimmers ear.

For mild cases 2% acetic acid is a possible first-line choice. It may cause the ear canal to burn and irritate the skin and is therefore rarely used. The addition of a steroid to acetic acid is accomplished in the product acetic aid/propylene glycol/hydrocortisone (VoSol HC).

Hydrocortisone/polymyxin/neomycin is more commonly used in the treatment of swimmers ear. Hydrocortisone/polymyxin/neomycin should not be used if there is a tear in the ear drum as it can damage hearing. Neomycin is irritating to the skin in a number of people who use this preparation.
More expensive options include quinolone antibiotics with or without steroids. Ofloxacin is dosed 10 drops two times a day for adults and 5 drops two times a day for kids for 7 days. Ciprofloxacin/hydrocortisone (Cipro HC otic) is dosed 3 drops twice a day for those over the age of one. Ciprofloxacin/dexamethasone (Ciprodex Otic) is dosed 4 drops twice a day for those over the age of 6 months. Ciprofloxacin/dexamethasone is indicated for patients with ear tubes and may be used if there is a tear in the ear drum.

Improvement should be noted in 2-3 days. Resolution should occur in 7-10 days. If there is no improvement noted a follow up appointment should be encouraged for a re-evaluation. Sometimes preservatives in topical medications can incite local irritation leading to an unresolved infection. Other times fungal infection is present – which do not respond to antibacterial medications.

When the ear is swollen it may not be possible to deliver drops into the lower part of the ear. In this case the use of an ear wick will allow delivery of medication into the ear canal. The health care provider will place a small piece of cotton into the ear that will allow ear drops to penetrate into the lower ear canal.

Before putting the drops in the ear they should be warmed. The patient should lie on his or her side with the affected ear up. The drops should ideally be placed by another person and the flap of skin covering the ear canal – called the tragus – should be pushed a couple of times after the drops are inserted. The person should lie on the side for 5-10 minutes to assure adequate penetration of the medication.
Practical points

- There are three over the counter topical antibiotics and multiple antiseptic agents.
- Neosporin contains neomycin, which can be very irritating to the skin.
- Topical antibiotics for the skin can be helpful in preventing infections.
- Over the counter topical agents are used to prevent infection, not treat them.
- Prescription topical antibiotics are used to treat infections including impetigo.
- Eye drops are helpful in the management of bacterial infections of the eye.
- Antibacterial eardrops can treat ear infections including swimmers ear.
Chapter 11: Summary

Antibiotics are powerful weapons in the fight against infectious disease. Unfortunately, they are overused and this overuse may eventually result in them not working in the future. The role of the patient is to have a basic understanding about when antibiotics are needed and when they are not.

Many health care conditions can be managed without antibiotics, but with time, home remedies and some over the counter medications.

It is the responsibility of the patient to have a basic understanding when antibiotics are needed and when they are not. The patient needs to partner with their doctor in order to get the best health care experience possible.

The goal of this book was to help the reader understand basic antibiotics prescribed in the doctor’s office. As a summary to the book, below is a list of common diseases and which antibiotics should be considered. Many factors need to be considered when an antibiotic is prescribed, but this chart will help the reader understand antibiotics that are appropriate in the management of common diseases.

The chart lists a disease and then a primary and secondary antibiotic. This chart is used for the management of common diseases that present typically in the average person. There are times that a doctor will need to stray from the recommendations.

It describes first-line treatment. This means that a disease is being treated for the first time. When antibiotics fail the first time a second-line treatment is often needed. This chart does not dive into that.

The primary antibiotic is the recommended antibiotic for most cases of the infection. The secondary antibiotic is another consideration if there is an allergy or another problem with the primary choice.

These conditions will, at times, be treated with other antibiotics. There are many reasons for this. For example, the first antibiotic did not work, the patient had an allergy, the patient had another underlying condition that may alter the course of treatment, and sometimes the doctor does not know the guidelines.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Primary antibiotic</th>
<th>Secondary antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strep throat</td>
<td>Penicillin</td>
<td>Cephalosporins – if mild allergy</td>
</tr>
<tr>
<td></td>
<td>Amoxicillin is OK in kids who need the liquid form</td>
<td>Macrolide if severe allergy</td>
</tr>
<tr>
<td>Sore throat that is not strep or another bacterial infection</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Sinus Infection</td>
<td>Amoxicillin</td>
<td>Cephalosporins – if mild allergy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Macrolide if severe allergy (increased resistance).</td>
</tr>
<tr>
<td>Cold (Nasal congestion of less than 7 days)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Inner ear infection</td>
<td>Amoxicillin</td>
<td>Cephalosporins – if mild allergy</td>
</tr>
<tr>
<td></td>
<td>Amoxicillin-Clavulanate</td>
<td>Macrolide if severe allergy</td>
</tr>
<tr>
<td></td>
<td>Sometimes no antibiotic is needed - only pain control</td>
<td></td>
</tr>
<tr>
<td>Outer ear infection</td>
<td>Hydrocortisone/polymyxin/neomycin,</td>
<td>Another choice from:</td>
</tr>
<tr>
<td></td>
<td>Ciprofloxacin/hydrocortisone (Cipro HC otic),</td>
<td>Hydrocortisone/polymyxin/neomycin,</td>
</tr>
<tr>
<td></td>
<td>Ciprofloxacin/dexamethasone</td>
<td>Ciprofloxacin/hydrocortisone (Cipro HC otic),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ciprofloxacin/dexamethasone</td>
</tr>
<tr>
<td>Acute Bronchitis</td>
<td>Most cases are viral and do not need an antibiotic</td>
<td>Amoxicillin, sulfa drug, macrolide if a bacterium is suspected</td>
</tr>
<tr>
<td>Pneumonia (that does not need to be treated in the hospital)</td>
<td>Macrolide or quinolone</td>
<td>Doxycycline</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>Sulfamethoxazole-trimethoprim, nitrofurantoin and ciprofloxacin</td>
<td>Antibiotic based on the culture and sensitivity report</td>
</tr>
<tr>
<td>Condition</td>
<td>Treatment Options</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Bacterial conjunctivitis</td>
<td>Multiple eye drops or ointments (see chart)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Another option from the eye drop/ointment chart</td>
<td></td>
</tr>
<tr>
<td>Skin infections (Not caused by MRSA)</td>
<td>Cephalexin (Keflex), Dicloxacillin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clindamycin, Macrolide</td>
<td></td>
</tr>
</tbody>
</table>
# Antibiotic Chart

<table>
<thead>
<tr>
<th>Generic antibiotic name</th>
<th>Brand name</th>
<th>Side effects</th>
<th>Common uses in the outpatient setting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Penicillin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin V Potassium</td>
<td>Veetids</td>
<td>GI upset, nausea, vomiting, diarrhea</td>
<td>Strep throat</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Trimox, Amoxil</td>
<td>GI upset, nausea, vomiting, diarrhea</td>
<td>Strep throat, sinus infection, bronchitis, ear infection</td>
</tr>
<tr>
<td>Amoxicillin – clavulanic acid</td>
<td>Augmentin</td>
<td>GI upset, Sinus infections, pneumonia, some abdominal pain, rash, bronchitis, skin infections, ear infections, strep throat</td>
<td></td>
</tr>
<tr>
<td><strong>Cephalosporins</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>First Generation</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalexin</td>
<td>Keflex</td>
<td>GI upset, nausea, diarrhea</td>
<td>Skin infections, strep throat, some respiratory infections</td>
</tr>
<tr>
<td>Cefadroxil</td>
<td>Duricef</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Second generation</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefaclor</td>
<td>Ceclor</td>
<td>GI upset, nausea, diarrhea</td>
<td>Respiratory infections, sinus infections, ear infections, skin infections, bronchitis</td>
</tr>
<tr>
<td>Loracarbef</td>
<td>Lorabid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefprozil</td>
<td>Cefzil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>Ceftin</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Third generation</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefdinir</td>
<td>Omnicef</td>
<td>GI upset, nausea, diarrhea</td>
<td>Multiple respiratory infections, skin infections, throat infections, ear infections, some pneumonias</td>
</tr>
<tr>
<td>Cefixime</td>
<td>Suprax</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>Vantin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone - Injection</td>
<td>Rocephin</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quinolones</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Cipro</td>
<td>GI upset, headache, rash, Urinary tract infections, some dizziness, Abdominal pain, drowsiness, vomiting, constipation, lightheaded Nausea, diarrhea, headache</td>
<td>Sinus infections, pneumonia, some bronchitis, skin infections</td>
</tr>
<tr>
<td>Levofoxacin</td>
<td>Levaquin</td>
<td>GI upset, headache, rash, Urinary tract infections, some dizziness, Abdominal pain, drowsiness, vomiting, constipation, lightheaded Nausea, diarrhea, headache</td>
<td>Sinus infections, pneumonia, some bronchitis, skin infections</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>Avelox</td>
<td>GI upset, headache, rash, Urinary tract infections, some dizziness, Abdominal pain, drowsiness, vomiting, constipation, lightheaded Nausea, diarrhea, headache</td>
<td>Sinus infections, pneumonia, some bronchitis, skin infections</td>
</tr>
<tr>
<td>Generic name</td>
<td>antibiotic</td>
<td>Brand name</td>
<td>Side effects</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>Macrolides</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erythromycin</td>
<td></td>
<td>Ery-tab, Eryped</td>
<td>GI upset, nausea, diarrhea</td>
</tr>
<tr>
<td></td>
<td>Azithromycin</td>
<td>Zithromax</td>
<td>Nausea, rash, abdominal pain</td>
</tr>
<tr>
<td></td>
<td>Clarithromycin</td>
<td>Biaxin</td>
<td>Nausea, abnormal taste, rash, headache</td>
</tr>
<tr>
<td><strong>Sulfa medications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim-sulfamethoxazole</td>
<td>Bactrim, Septra</td>
<td>Allergic reactions, rash, loss of appetite, Ear infections, urinary tract infections, diarrhea, nausea, infections, chronic bronchitis with itching, headache, bacterial exacerbations, vomiting, dizziness</td>
<td></td>
</tr>
<tr>
<td><strong>Tetracycline</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetracycline</td>
<td>Sumycin</td>
<td>Nausea, sensitivity to sun, rash, tooth</td>
<td>Some respiratory infections, acne discoloration</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>Doryx, Monodox</td>
<td>Nausea, sensitivity to sun, rash, tooth</td>
<td>Some respiratory infections, acne discoloration</td>
</tr>
<tr>
<td>Minocycline</td>
<td>Minocin</td>
<td>Nausea, rash, tooth discoloration, dizziness, a permanent blue/black discoloration of the skin</td>
<td>Some respiratory infections, acne</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td>Cleocin</td>
<td>Diarrhea, nausea, rash, Infections of the respiratory tract jaundice, renal and skin when other antibiotic are not able to be used</td>
<td>GI upset, metallic taste, headache, seizure, Some respiratory infections, some gastrointestinal infections constipation</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>Flagyl</td>
<td>Nausea, dizziness, headache</td>
<td>Urinary tract infections</td>
</tr>
</tbody>
</table>
References