chapter 7

Penicillins

Key Terms

anaphylactic shock
angioedema
bacterial resistance
bactericidal
bacteriostatic
cross-allergenicity
cross-sensitivity
culture and sensitivity tests
glossitis
hypersensitivity
leukopenia
nonpathogenic
normal flora
penicillinase
phlebitis
prophylaxis
pseudomembranous colitis
stomatitis
superinfection
thrombocytopenia

Chapter Objectives

On completion of this chapter, the student will:

- Identify the uses, general drug actions, and general adverse reactions, contraindications, precautions, and interactions of the penicillins.
- Discuss hypersensitivity reactions and pseudomembranous colitis as they relate to antibiotic therapy.
- List some nursing diagnoses particular to a patient taking penicillin.
- Identify important preadministration and ongoing assessment activities the nurse should perform on the patient taking penicillin.
- Discuss ways to promote optimal response to therapy, nursing actions to minimize adverse effects, and important points to keep in mind when educating patients about the use of penicillin.

The development of the sulfonamide antibiotics was a breakthrough in the treatment of bacterial infections. Since that time, there has been a quest to develop new and more effective antibiotic drugs. The antibacterial properties of natural penicillins were discovered in 1928 by Sir Arthur Fleming while he was performing research on influenza. Ten years later, British scientists studied the effects of natural penicillins on disease-causing microorganisms. However, it was not until 1941 that natural penicillins were used clinically for the treatment of infections. Although used for more than 50 years, the penicillins are still an important and effective group of antibiotics for the treatment of susceptible pathogens (disease-causing microorganisms).

There are four groups of penicillins: natural penicillins, penicillinase-resistant penicillins, aminopenicillins, and the extended-spectrum penicillins. See the Summary Drug Table: Penicillins for a more complete listing of the penicillins. Display 7-1 gives examples of the various groups.

DISPLAY 7-1 • Examples of Penicillins

Natural penicillins—penicillin G and penicillin V
Penicillinase-resistant penicillin—cloxacillin, dicloxacillin, nafcillin
Aminopenicillins—ampicillin, amoxicillin, bacampicillin
Extended-spectrum penicillins—mezlocillin, piperacillin, ticarcillin

DRUG RESISTANCE

Because the natural penicillins have been used for many years, drug-resistant strains of microorganisms have developed, making the natural penicillins less effective than some of the newer antibiotics in treating a broad range of infections. Bacterial resistance has occurred within the penicillins. **Bacterial resistance** is the ability of bacteria to produce substances that inactivate or destroy the penicillin. One example of bacterial resistance is the ability of certain bacteria to produce **penicillinase,** an enzyme that inactivates penicillin. The penicillinase-resistant penicillins were developed to combat this problem.

The natural penicillins also have a fairly narrow spectrum of activity, which means that they are effective against only a few strains of bacteria. Newer penicillins have been developed to combat this problem. These penicillins are a result of chemical treatment of a biologic precursor to penicillin. Because of their chemical modifications, they are more slowly excreted

SUMMARY DRUG TABLE PENICILLINS

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
Natural Penicillins				
penicillin G (aqueous) *pen-i-sill'-in*	Pfizerpen, *generic*	Infections due to susceptible microorganisms; syphilis, gonorrhea	Glossitis, stomatitis, gastritis, furry tongue, nausea, vomiting, diarrhea, rash, fever, pain at injection site, hypersensitivity reactions, hematopoietic changes	Up to 20–30 million U/d IV or IM; dosage may also be based on weight
penicillin G benzathine	Bicillin L-A, Permapen, *generic*	Infections due to susceptible microorganisms, syphilis; prophylaxis of rheumatic fever or chorea	Same as penicillin G	Up to 2.4 million U/d IM
penicillin G procaine, IM	Wycillin	Infections due to susceptible organisms	Same as penicillin G	600,000–2.4 million U/d IM
penicillin V	Beepen VK, Pen-Vee K, Veetids, *generic*	Infections due to susceptible organisms	Same as penicillin G	125–500 mg PO q6h or q8h
Semisynthetic Penicillins				
Penicillinase-Resistant Penicillins				
cloxacillin sodium *klox-a-sill'-in*	Cloxapen, Tegopen, *generic*	Same as penicillin G	Same as penicillin G	250–500 mg PO q6h
dicloxacillin sodium *dye-klox-a-sill'-in*	Dynapen, Dycill, Pathocil, *generic*	Same as penicillin G	Same as penicillin G	125–250 mg PO q6h
nafcillin *naf-sill'-in*	Unipen, Nallpen	Same as penicillin G	Same as penicillin G	250 mg–1 g PO, 500 mg IM q4–6h; 3–6 g/d IV for 24–48 h only
oxacillin sodium *Ox-a-sill'-in*	Bactocill, *generic*	Same as penicillin G	Same as penicillin G	500 mg–1 g PO q4–6h; 250 mg–1 g q4–6h IM, IV
Aminopenicillins				
amoxicillin *a-mox-i-sill'-in*	Amoxil, Trimox, Wymox, *generic*	Same as penicillin G	Same as penicillin G	250–500 mg PO q8h or 875 mg PO BID
amoxicillin and clavulanate acid *a-mox-i-sill'-in/ klah-view-lan'-ate*	Augmentin	Same as penicillin G	Same as penicillin G	250–500 mg PO q8h or 875 mg q12h**
ampicillin, oral *am-pi-sill'-in*	Omnipen, Principen, Totacillin, *generic*	Same as penicillin G	Same as penicillin G	250–500 mg PO q6h
ampicillin sodium parenteral	Omnipen-N, *generic*	Same as penicillin G	Same as penicillin G	1–12 g/d IM, IV in divided doses of q4–6h
ampillicin/sulbactam *am-pi-sill'-in/ sull-bak'-tam*	Unasyn	Same as penicillin G	Same as penicillin G	0.5–1 g Sulbactam with 1–2 g ampicillin IM or IV q6–8h
bacampicillin *bak'-am-pi-sill-in*	Spectrobid	Same as penicillin G	Same as penicillin G	400–800 mg PO q12h, may also be given based on weight

SUMMARY DRUG TABLE PENICILLINS (*Continued*)

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
Extended-Spectrum Penicillins				
mezlocillin sodium *mez-loe-sill'-in*	Mezlin	Same as penicillin G	Same as penicillin G	200–300 mg/kg/d IV or IM in 4–6 divided doses; up to 350 mg/kg/d
piperacillin sodium and tazobactam sodium *pi-per-a-sill'-in/ tay-zoe-back'-tam*	Zosyn	Same as penicillin G	Same as penicillin G	12 mg/1.5 g IV given as 3.375 g q6h
piperacillin sodium *pi-per-a-sill'-in*	Pipracil	Same as penicillin G	Same as penicillin G	3–4 g q4–6h IV or IM; maximum dosage, 25 g/d
ticarcillin disodium *ty-kar-sill'-in*	Ticar	Same as penicillin G	Same as penicillin G	150–300 mg/kg/d IV q3, 4, or 6h; maximum dosage, 24 g/d; maximum dosage IM, 2 g/d
ticarcillin and clavulanate potassium *ty-kar-sill'-in*	Timentin	Same as penicillin G	Same as penicillin G	3.1 g IV q4–6h or 200–300 mg/kg/d IV in divided doses q4–6h

*The term *generic* indicates the drug is available in generic form.
**Tablets are not interchangeable. For example, two 250-mg tablets are not equivalent to one 500-mg tablet.

by the kidneys and, thus, have a somewhat wider spectrum of antibacterial activity. Penicillin β-lactamase inhibitor combinations are a type of penicillin that have a wider spectrum of antibacterial activity. Certain bacteria have developed the ability to produce enzymes called β-lactamases, which are able to destroy a component of the penicillin called the β-lactam ring. Fortunately, chemicals were discovered that inhibit the activity of these enzymes. Three examples of these β-lactamase inhibitors are clavulanic acid, sulbactam, and tazobactam. When these chemicals are used alone, they have little antimicrobial activity. However, when combined with certain penicillins, they extend the spectrum of penicillin's antibacterial activity. The β-lactamase inhibitors bind with the penicillin and protect the penicillin from destruction. Examples of the combinations of penicillins with the β-lactamase inhibitors are seen in Display 7-2. See the Summary Drug Table: Penicillins for more information on these combinations.

DISPLAY 7-2 ● β-Lactamase Inhibitor Combinations

Augmentin—combination of amoxicillin and clavulanic acid
Timentin—combination of ticarcillin and clavulanic acid
Unasyn—combination of ampicillin and sulbactam
Zosyn—combination of piperacillin and tazobactam

Herbal Alert: Goldenseal

Goldenseal, also called Hydrastis canadensis, *is an herb found growing in the certain areas of the northeastern United States, particularly the Ohio River Valley. Goldenseal has long been used alone or in combination with echinacea for colds and influenza. However, there is no scientific evidence to support the use of goldenseal for cold and influenza or as a stimulant as there is for the use of echinacea (see Chap. 54). Similarly, goldenseal is touted as an "herbal antibiotic," although there is no scientific evidence to support this use either. Another myth surrounding goldenseal's use is that taking the herb masks the presence of illicit drugs in the urine.*

There are many traditional uses of the herb, such as an antiseptic for the skin, mouthwash for canker sores, wash for inflamed or infected eyes, and the treatment of sinus infections and digestive problems, such as peptic ulcers and gastritis. Some evidence supports the use of goldenseal to treat diarrhea caused by bacteria or intestinal parasites, such as Giardia. *The herb is contraindicated during pregnancy and in patients with hypertension. Adverse reactions are rare when the herb is used as directed. However, this herb should not be taken for more than a few days to a week. Because of widespread use, destruction of its natural habitats, and renewed interest in its use as an herbal remedy, goldenseal was classified as an "endangered" plant in 1997 by the US government.*

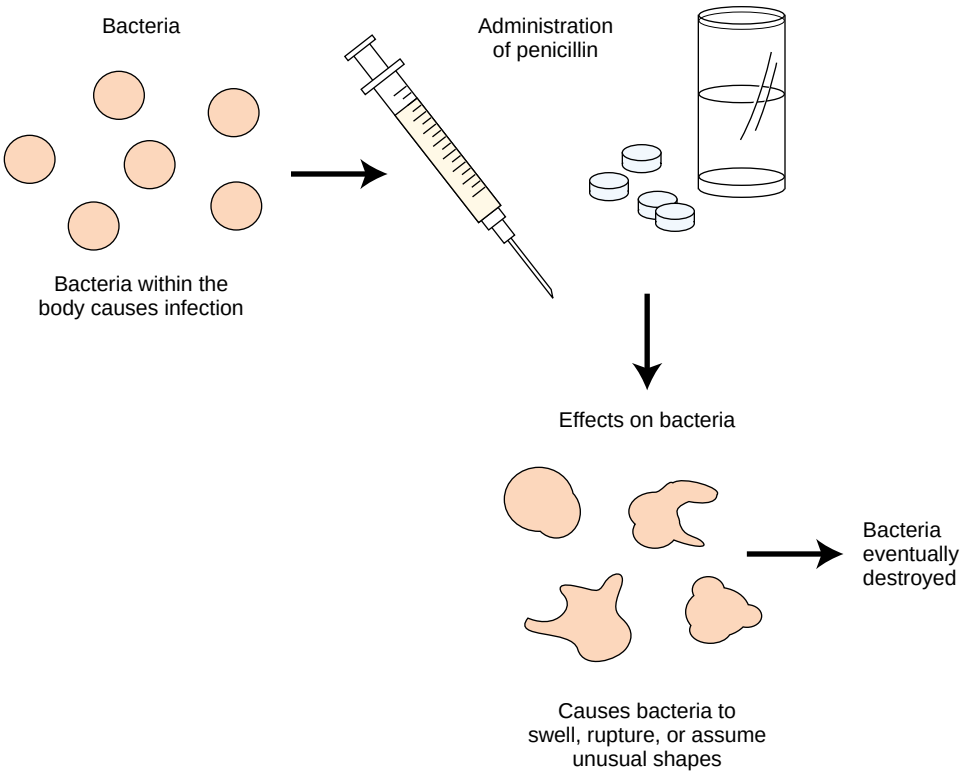


FIGURE 7-1. Action of penicillin.

ACTIONS

The penicillins have the same type of action against bacteria. Penicillins prevent bacteria from using a substance that is necessary for the maintenance of the bacteria's outer cell wall. Unable to use this substance for cell wall maintenance, the bacteria swell, rupture, assume unusual shapes, and finally die (Fig. 7-1).

The penicillins may be **bactericidal** (destroy bacteria) or **bacteriostatic** (slow or retard the multiplication of bacteria). They are bactericidal against sensitive microorganisms (ie, those microorganisms that will be affected by penicillin) provided there is an adequate concentration of penicillin in the body. An adequate concentration of any drug in the body is referred to as the blood level. An inadequate concentration (or inadequate blood level) of penicillin may produce bacteriostatic activity, which may or may not control the infection.

Identifying the Appropriate Penicillin

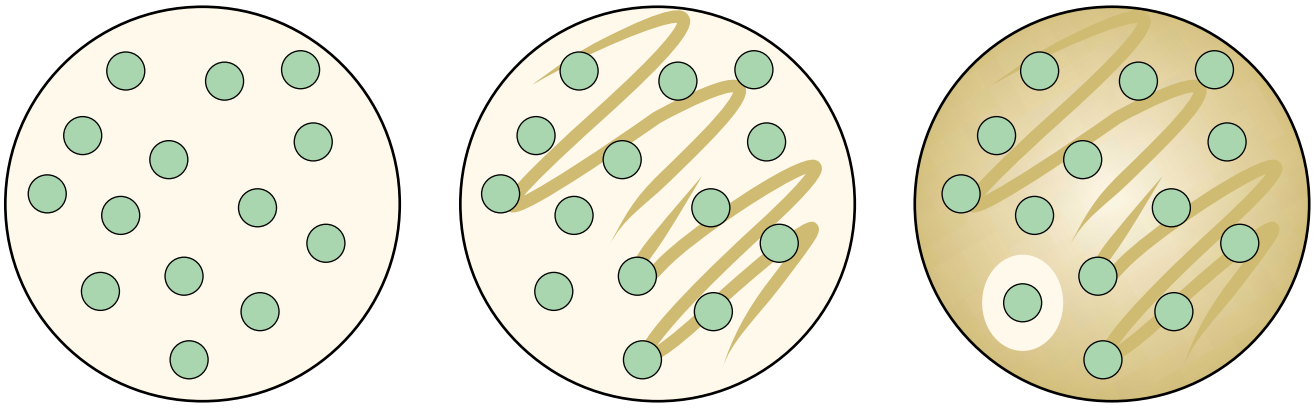
To determine if a specific type of bacteria is sensitive to penicillin, **culture and sensitivity tests** are performed. A culture is performed by placing infectious material obtained from areas such as the skin, respiratory tract, and blood on a culture plate that contains a special growing medium. This growing medium is "food" for the bacteria. After a specified time, the bacteria are examined under a microscope and identified. The sensitivity test involves placing the infectious material on a separate culture plate and then placing small disks impregnated with various antibiotics over the area. After a specified time, the culture plate is examined. If there is little or no growth around a disk, the bacteria are considered sensitive to that particular antibiotic. Therefore, the infection will be controlled by this antibiotic (Fig. 7-2). If there is considerable growth around the disk, then the bacteria are considered resistant to that particular antibiotic, and the infection will not be controlled by this antibiotic.

After a culture and sensitivity report is received, the strain of microorganisms causing the infection is known, and the antibiotic to which these microorganisms are sensitive and resistant is identified. The primary health care provider then selects the antibiotic to which the microorganism is sensitive because that is the antibiotic that will be effective in the treatment of the infection.

USES

Infectious Disease

The natural and semisynthetic penicillins are used in the treatment of bacterial infections due to susceptible microorganisms. Penicillins may be used to treat infections such as urinary tract infections, septicemia, meningitis, intra-abdominal infection, gonorrhea, syphilis, pneumonia, and other respiratory infections. Examples of infectious microorganisms (bacteria) that may respond to penicillin therapy include gonococci, staphylococci,



A. Culture plate with small disks containing various antibiotics.

B. Infectious material is spread on the culture plate.

C. After a specific time, the culture plate is inspected. If there is little or no growth around a disk, the bacteria is said to be sensitive to that antibiotic. That antibiotic is considered a drug that will control the infection.

FIGURE 7-2. Sensitivity testing.

streptococci, and pneumococci. Culture and sensitivity tests are performed whenever possible to determine which penicillin will best control an infection caused by a specific strain of bacteria. A penicillinase-resistant penicillin is used as initial therapy for any suspected staphylococcal infection until culture and sensitivity results are known.

Prophylaxis

Penicillin is of no value in the treatment of viral or fungal infections. However, the primary health care provider occasionally will prescribe penicillin as **prophylaxis** (prevention) against a potential secondary bacterial infection that can occur in a patient with a viral infection. In these situations the viral infection has weakened the body's defenses and the person is susceptible to other infections, particularly a bacterial infection. Penicillin also may be prescribed as prophylaxis for a potential infection in high-risk individuals, such as those with a history of rheumatic fever. Penicillin is taken several hours or, in some instances days, before and after an operative procedure, such as dental, oral, or upper respiratory tract procedures that can result in bacteria entering the bloodstream. Taking penicillin before and after the procedure will usually prevent a bacterial infection in these high-risk patients. Penicillin also may be given prophylactically on a continuing basis to those with rheumatic fever and chronic ear infections.

ADVERSE REACTIONS

Common adverse reactions include mild nausea, vomiting, diarrhea, sore tongue or mouth, fever, and pain at injection site. Penicillin can stimulate a **hypersensitivity** (allergic) reaction within the body. Another adverse reaction that may be seen with penicillin, as well as with almost all antibiotics, is a **superinfection** (a secondary infection that occurs during antibiotic treatment).

Hypersensitivity Reactions

A hypersensitivity (or allergic) reaction to a drug occurs in some individuals, especially those with a history of allergy to many substances. Signs and symptoms of a hypersensitivity to penicillin are highlighted in Display 7-3.

Anaphylactic shock, which is a severe form of hypersensitivity reaction, also can occur (see Chap. 1). Anaphylactic shock occurs more frequently after parenteral administration but can occur with oral use. This reaction is likely to be immediate and severe in susceptible

DISPLAY 7-3 • Signs and Symptoms of Hypersensitivity to Penicillin

Skin rash
Urticaria (hives)
Sneezing
Wheezing
Pruritus (itching)
Bronchospasm (spasm of the bronchi)
Laryngospasm (spasm of the larynx)
Angioedema (also called angioneurotic edema)—swelling of the skin and mucous membranes, especially around and in the mouth and throat
Hypotension—can progress to shock
Signs and symptoms resembling serum sickness—chills, fever, edema, joint and muscle pain, and malaise

individuals. Signs of anaphylactic shock include severe hypotension, loss of consciousness, and acute respiratory distress. If not immediately treated, anaphylactic shock can be fatal.

Once an individual is allergic to one penicillin, he or she is most likely allergic to all of the penicillins. Those allergic to penicillin also have a higher incidence of allergy to the cephalosporins (see Chap. 8). Allergy to drugs in the same or related groups is called **cross-sensitivity** or **cross-allergenicity.**

Superinfections

Antibiotics can disrupt the **normal flora** (nonpathogenic microorganisms within the body) causing a superinfection. This new infection is "superimposed" on the original infection. The destruction of large numbers of **nonpathogenic** bacteria (normal flora) by the antibiotic alters the chemical environment. This allows uncontrolled growth of bacteria or fungal microorganisms, which are not affected by the antibiotic being administered. A superinfection may occur with the use of any antibiotic, especially when these drugs are given for a long time or when repeated courses of therapy are necessary. A superinfection can develop rapidly and is potentially serious and even life threatening. Bacterial superinfections are commonly seen with the administration of the oral penicillins and occur in the bowel. Symptoms of bacterial superinfection of the bowel include diarrhea or bloody diarrhea, rectal bleeding, fever, and abdominal cramping.

Fungal superinfections commonly occur in the vagina, mouth, and anal and genital areas. Symptoms include lesions of the mouth or tongue, vaginal discharge, and anal or vaginal itching. **Pseudomembranous colitis** is a common bacterial superinfection; candidiasis or moniliasis is a common type of fungal superinfection.

Gerontologic Alert

Older adults who are debilitated, chronically ill, or taking penicillin for an extended period of time are more likely to develop a superinfection. Pseudomembranous colitis is one type of a bacterial superinfection. This potentially life-threatening problem develops because of an overgrowth of the microorganism Clostridium difficile. *This organism produces a toxin that affects the lining of the colon. Signs and symptoms include severe diarrhea with visible blood and mucus, fever, and abdominal cramps. This adverse reaction usually requires immediate discontinuation of the antibiotic. Mild cases may respond to drug discontinuation. Moderate to severe cases may require treatment with intravenous (IV) fluids and electrolytes, protein supplementation, and oral vancomycin (Vancocin).*

Nursing Alert

Pseudomembranous colitis may occur after 4 to 9 days of treatment with penicillin or as long as 6 weeks after the drug is discontinued.

CANDIDIASIS OR MONILIASIS. Another type of superinfection may occur due to an overgrowth of the yeastlike fungi that usually exist in small numbers in the vagina. The multiplication rate of these microorganisms is normally slowed and kept under control because of the presence of a strain of bacteria (Döderlein's bacillus) in the vagina. If penicillin therapy destroys these normal microorganisms of the vagina (Döderlein's bacillus), the fungi are now uncontrolled, multiply at a rapid rate, and cause symptoms of a fungal infection called candidiasis (or moniliasis). Symptoms include vaginal itching and discharge.

Candida fungal superinfections also occur in the mouth and around the anal and genital areas. Signs and symptoms include lesions in the mouth or anal/genital itching.

Other Adverse Reactions

Other adverse reactions associated with penicillin are hematopoietic changes such as anemia, **thrombocytopenia** (low platelet count), **leukopenia** (low white blood cell count), and bone marrow depression. When penicillin is given orally, **glossitis** (inflammation of the tongue), **stomatitis** (inflammation of the mouth), dry mouth, gastritis, nausea, vomiting, and abdominal pain occur. When penicillin is given intramuscularly (IM), there may be pain at the injection site. Irritation of the vein and **phlebitis** (inflammation of a vein) may occur with intravenous (IV) administration.

CONTRAINDICATIONS

Penicillins are contraindicated in patients with a history of hypersensitivity to penicillin or the cephalosporins.

PRECAUTIONS

Penicillins should be used cautiously in patients with renal disease, pregnancy (Pregnancy Category C), lactation (may cause diarrhea or candidiasis in the infant), and in those with a history of allergies. Any indication of sensitivity is reason for caution. The drug is also used with caution in patients with asthma, renal disease, bleeding disorders, and gastrointestinal disease.

INTERACTIONS

Some penicillins (ampicillin, bacampicillin, penicillin V) may interfere with the effectiveness of birth control pills that contain estrogen. There is a decreased effectiveness of the penicillin when it is administered with the tetracyclines. Large doses of penicillin can increase bleeding risks of patients taking anticoagulant agents. Some reports indicate that when oral penicillins are administered with beta-adrenergic blocking drugs (see Chap. 23), the patient may be at increased risk for an anaphylactic reaction. Absorption of most penicillins is affected by food. In general, penicillins should be given 1 hour before or 2 hours after meals.

NURSING PROCESS

The Patient Receiving Penicillin

ASSESSMENT

Preadministration Assessment

Before the administration of the first dose of penicillin, the nurse obtains or reviews the patient's general health history. The health history includes an allergy history, a history of all medical and surgical treatments, a drug history, and the current symptoms of the infection. If the patient has a history of allergy, particularly a drug allergy, the nurse must explore this area to ensure the patient is not allergic to penicillin or a cephalosporin.

The nurse should take and record vital signs. When appropriate, it is important to obtain a description of the signs and symptoms of the infection from the patient or family. The nurse assesses the infected area (when possible) and records findings on the patient's chart. It is important to describe accurately any signs and symptoms related to the patient's infection, such as color and type of drainage from a wound, pain, redness and inflammation, color of sputum, or presence of an odor. In addition, the nurse should note the patient's general appearance. A culture and sensitivity test is almost always ordered, and the nurse must obtain the results before giving the first dose of penicillin.

Ongoing Assessment

The nurse evaluates the patient daily for a response to therapy, such as a decrease in temperature, the relief of symptoms caused by the infection (such as pain or discomfort), an increase in appetite, and a change in the appearance or amount of drainage (when originally present). Once an infection is controlled, patients often look better and even state that they feel better. It is important to record these evaluations on the patient's chart. The nurse notifies the primary health care provider if signs and symptoms of the infection appear to worsen.

Additional culture and sensitivity tests may be performed during therapy because microorganisms causing the infection may become resistant to penicillin, or a superinfection may have occurred. A urinalysis, complete blood count, and renal and hepatic function tests also may be performed at intervals during therapy.

Nursing Alert

The nurse should observe the patient closely for a hypersensitivity reaction, which may occur any time during therapy with the penicillins. If it should occur, it is important to contact the primary health care provider immediately and withhold the drug until the patient is seen by the primary health care provider.

NURSING DIAGNOSES

Drug-specific nursing diagnoses are highlighted in the Nursing Diagnoses Checklist. Other nursing diagnoses applicable to these drugs are discussed in Chapter 4.

PLANNING

The expected outcomes of the patient depend on the reason for administration of penicillin but may include an optimal response to drug therapy, management of common adverse reactions, and an understanding of and compliance with the prescribed drug regimen.

IMPLEMENTATION

Promoting Optimal Response to Therapy

The results of a culture and sensitivity test take several days because time must be allowed for the bacteria to grow on the culture media. However, infections are treated as soon as possible. In a few instances, the primary health care provider may determine that a penicillin is the treatment of choice until the results of the culture and sensitivity tests are known. In many instances, the primary health care provider selects a broad-spectrum antibiotic (ie, an antibiotic that is effective against many types or strains of bacteria) for initial treatment because of the many penicillin-resistant strains of microorganisms.

Nursing Diagnoses Checklist

- ✓ **Diarrhea** related to adverse reaction to penicillin
- ✓ **Risk for Impaired Skin Integrity** related to adverse reaction to penicillin
- ✓ **Risk for Impaired Oral Mucous Membrane** related to adverse reaction to penicillin
- ✓ **Risk for Imbalanced Body Temperature**

Penicillin is ordered in units or milligrams. The exact equivalency usually is stated on the container or package insert. When preparing a parenteral form of penicillin, the nurse should shake the vial thoroughly before withdrawing the drug to ensure even distribution of the drug in the solution. Some forms of penicillin are in powder or crystalline form and must be made into a liquid (reconstituted) before being withdrawn from the vial. The manufacturer's directions regarding reconstitution are printed on the label or package insert. The manufacturer indicates the type of diluent to be used when reconstituting a specific drug. Some powdered or crystalline drugs, when reconstituted with a given amount of diluent, may yield slightly more or less than the amount of the diluent added to the vial. If there is any question regarding the reconstitution of this or any drug, the nurse consults with a pharmacist. In some health care facilities the drug is prepared in the pharmacy and delivered to the nurse for administration.

Nursing Alert

The nurse questions the patient about allergy to penicillin before administering the first dose, even when an accurate drug history has been taken. It is important to tell patients that the drug they are receiving is penicillin because information regarding a drug allergy may have been forgotten at the time the initial drug history was obtained. If a patient states he or she is allergic to penicillin or a cephalosporin, the nurse withholds the drug and contacts the primary health care provider.

Adequate blood levels of the drug must be maintained for the agent to be effective. Accidental omission or delay of a dose results in decreased blood levels, which will reduce the effectiveness of the antibiotic. It is best to give oral penicillins on an empty stomach, 1 hour before or 2 hours after a meal. Bacampicillin (Spectrobid), penicillin V (Pen-Vee K), and amoxicillin (Amoxil) may be given without regard to meals.

When administering penicillin IM, the nurse warns the patient that there may be a stinging or burning sensation at the time the drug is injected into the muscle. Discomfort at the time of injection occurs because the drug is irritating to the tissues. The nurse inspects previous areas used for injection for continued redness, soreness, or other problems. It is important to inform the primary health care provider if previously used areas for injection appear red or the patient reports pain in the area.

Monitoring and Managing Adverse Drug Reactions

Treatment of minor hypersensitivity reactions may include administration of an antihistamine such as Benadryl (for a rash or itching). Major hypersensitivity reactions, such as bronchospasm, laryngospasm, hypotension, and angioneurotic edema, require immediate treatment with drugs such as epinephrine, cortisone, or an IV antihistamine. When respiratory difficulty occurs, a tracheostomy may need to be performed.

Nursing Alert

After administering penicillin IM in the outpatient setting, the nurse asks the client to wait in the area for at least 30 minutes. Anaphylactic reactions are most likely to occur within 30 minutes after injection.

The nurse also closely observes the patient for signs of a bacterial or fungal superinfection in the vaginal or anal area. It is important to report any signs and symptoms of a superinfection to the primary health care provider before administering the next dose of the drug. When symptoms are severe, additional treatment measures may be necessary, such as administration of an antipyretic drug for fever or an antifungal drug.

DIARRHEA. Diarrhea may be an indication of a superinfection of the gastrointestinal tract or pseudomembranous colitis. The nurse inspects all stools and notifies the primary health care provider if diarrhea occurs because it may be necessary to stop the drug. If diarrhea does occur and there appears to be blood and mucus in the stool, it is important to save a sample of the stool and test for occult blood using a test such as Hemoccult. If the stool tests positive for blood, the nurse saves the sample for possible further laboratory analysis.

IMPAIRED SKIN INTEGRITY. Dermatologic reactions such as hives, rashes, and skin lesions can occur with the administration of penicillin. In mild cases or where the benefit of the drug outweighs the discomfort of skin lesions, the nurse administers frequent skin care. Emollients, antipyretic creams, or a topical corticosteroid may be prescribed. An antihistamine may be prescribed. Harsh soaps and perfumed lotions are avoided. The nurse instructs the patient to avoid rubbing the area and not to wear rough or irritating clothing. It is important to report a rash or hives to the primary health care provider because this may be a precursor to a severe anaphylactic reaction (see Hypersensitivity Reactions). In severe cases, the primary health care provider may discontinue penicillin therapy.

IMPAIRED ORAL MUCOUS MEMBRANES. The administration of oral penicillin may result in a fungal superinfection in the oral cavity. With impaired oral mucous membranes there will be varying degrees of inflamed oral mucous membranes, swollen and red tongue, swollen gums, and pain in the mouth and throat. To detect this problem early, the nurse inspects the patient's mouth

daily for evidence of glossitis, sore tongue, ulceration, or a black, furry tongue. The nurse can explain that, if the diet permits, yogurt, buttermilk, or acidophilus capsules may be taken to reduce the risk of fungal superinfection.

The nurse inspects the mouth and gums often and gives frequent mouth care with a nonirritating solution. A soft bristled toothbrush is used when brushing is needed. A nonirritating soft diet may be required. The nurse monitors the dietary intake to assure the patient is receiving adequate nutrition. Antifungal agents and/or local anesthetics are sometimes recommended to soothe the irritated membranes.

FEVER. The nurse takes vital signs every 4 hours or more often if necessary. It is important to report any increase in temperature to the primary health care provider because additional treatment measures, such as administration of an antipyretic drug or change in the drug or dosage, may be necessary. An increase in body temperature several days after the start of therapy may indicate a secondary bacterial infection or failure of the drug to control the original infection. On occasion the fever may be caused from an adverse reaction to the penicillin. In these cases the fever can usually be managed by using an antipyretic drug.

Educating the Patient and Family

Any time a drug is prescribed for a patient, the nurse is responsible for ensuring that the patient has a thorough understanding of the drug, the treatment regimen, and adverse reactions. Some patients do not adhere to the prescribed drug regimen for a variety of reasons, such as failure to comprehend the prescribed regimen or failure to understand the importance of continued and uninterrupted therapy. The nurse describes the drug regimen and stresses the importance of continued and uninterrupted therapy when teaching the patient who is prescribed an antibiotic.

The nurse teaches the following information to patients prescribed an antibiotic:

- Prophylaxis—Take the drug as prescribed until the primary health care provider discontinues therapy.
- Infection—Complete the full course of therapy. Do not stop taking the drug, even if the symptoms have disappeared, unless directed to do so by the primary health care provider.
- Take the drug at the prescribed times of day because it is important to keep an adequate amount of drug in the body throughout the entire 24 hours of each day.
- Penicillin (oral)—Take the drug on an empty stomach either 1 hour before or 2 hours after meals (exceptions: bacampicillin, penicillin V, amoxicillin).
- Take each dose with a full glass of water.
- To reduce the risk of superinfection, take yogurt, buttermilk, or acidophilus capsules.
- Notify the primary health care provider immediately if any one or more of the following should occur: skin rash; hives (urticaria); severe diarrhea; vaginal or anal itching; sore mouth; black, furry tongue; sores in the mouth; swelling around the mouth or eyes; breathing difficulty; or gastrointestinal disturbances such as nausea, vomiting, and diarrhea. Do not take the next dose of the drug until the problem is discussed with the primary health care provider.
- Oral suspensions—Keep the container refrigerated (if so labeled), shake the drug well before pouring (if so labeled), and return the drug to the refrigerator immediately after pouring the dose. Drugs that are kept refrigerated lose their potency when kept at room temperature. A small amount of the drug may be left after the last dose is taken. Discard any remaining drug because the drug (in suspension form) begins to lose its potency after a few weeks (7–14 days).
- Women prescribed ampicillin, bacampicillin, and penicillin V who take birth control pills containing estrogen should use additional contraception measures.
- Never give this drug to another individual even though the symptoms appear to be the same.
- Notify the primary health care provider if the symptoms of the infection do not improve or if the condition becomes worse.
- When a penicillin is to be taken for a long time for prophylaxis, you may feel well despite the need for long-term antibiotic therapy. There may be a tendency to omit one or more doses or even neglect to take the drug for an extended time. Never skip doses or stop therapy unless told to do so by the primary health care provider. (See Patient and Family Teaching Checklist: Preventing Antibiotic Resistance.)

EVALUATION

- The therapeutic drug effect is achieved and the infection is controlled.
- Adverse reactions are identified, reported to the primary health care provider, and managed successfully through appropriate nursing interventions.
- The patient and family demonstrate understanding of the drug regimen.

● Critical Thinking Exercises

1. *Ms. Barker had a bowel resection 4 days ago. After a culture and sensitivity test of her draining surgical wound, the primary health care provider orders penicillin G aqueous IV as a continuous drip. Determine what questions you would ask Ms. Barker before the penicillin is added to the IV solution.*

Patient and Family Teaching Checklist

Preventing Antibiotic Resistance

The nurse:

- ✓ Reviews the reason for the drug and the prescribed drug regimen, including drug name, correct dose, and frequency of administration.
- ✓ Stresses the importance of continued and uninterrupted therapy, even if the patient feels better after a few doses.
- ✓ Instructs the patient to continue taking the drug until all the drug is finished or the prescriber discontinues therapy.
- ✓ Urges the patient and family to discard any unused drug once therapy is discontinued or completed.
- ✓ Warns the patient not to use any leftover antibiotic or to take another family member's antibiotic as self-treatment for a suspected infection.
- ✓ Reviews the possible adverse reactions and the signs and symptoms of a new infection or of a worsening infection, both verbally and in writing.
- ✓ Instructs the patient and family to notify the health care provider at once should the patient experience any adverse reactions or signs and symptoms of infection.

2. *After administering penicillin to a patient in an outpatient setting, you request that the patient wait about 30 minutes before leaving. The patient is reluctant to stay, saying that she has a busy schedule. Discuss how you would handle this situation.*
3. *A 28-year-old married woman with three children is prescribed bacampicillin (Spectrobid) for an upper respiratory infection caused by Streptococcus pneumoniae. What information would be important for you to obtain from this woman? What special instructions would you give her because of her gender and age?*

Review Questions

1. When reviewing Ms. Robertson's culture and sensitivity test results, the nurse learns that the bacteria causing Ms. Robertson's infection are sensitive to penicillin. The nurse interprets this result to mean that _____.
   - **A.** Ms. Robertson is allergic to penicillin
   - **B.** penicillin will be effective in treating the infection
   - **C.** penicillin will not be effective in treating the infection
   - **D.** the test must be repeated to obtain accurate results
2. Mr. Thomas, who is receiving oral penicillin, reports he has a sore mouth. Upon inspection the nurse notes a black, furry tongue and bright red oral mucous membranes. The primary care provider is notified immediately because these symptoms may be caused by _____.
   - **A.** a vitamin C deficiency
   - **B.** a superinfection
   - **C.** dehydration
   - **D.** poor oral hygiene
3. The nurse correctly administers penicillin V _____.
   - **A.** 1 hour before or 2 hours after meals
   - **B.** without regard to meals
   - **C.** with meals to prevent gastrointestinal upset
   - **D.** every 3 hours around the clock
4. After administering penicillin in an outpatient setting the nurse _____.
   - **A.** asks the patient to wait 10 to 15 minutes before leaving the clinic
   - **B.** instructs the patient to report any numbness or tingling of the extremities
   - **C.** keeps pressure on the injection site for 10 minutes
   - **D.** asks the patient to wait in the area for at least 30 minutes

Medication Dosage Problems

1. A patient is prescribed amoxicillin for oral suspension. The drug is reconstituted to a solution of 250 mg/5 mL. Answer the following questions: How much amoxicillin will 1 teaspoon contain? _____ The primary care provider prescribes 500 mg. How many milliliters (mL) will the nurse administer? _____
2. The primary care provider orders 500 mg of Augmentin oral suspension. Read the label below to answer the following questions:

How much water will be required for reconstitution? _____ Describe the process you would go through to reconstitute this drug. _____ When reconstituted, what will be the strength of the solution? _____