chapter 1

General Principles of Pharmacology

Key Terms

additive drug reaction
adverse reaction
agonist
allergic reaction
anaphylactic shock
angioedema
antagonist
antibodies
antigen
biotransformation
botanical medicine
controlled substances
cumulative drug effect
drug idiosyncrasy
drug tolerance
half-life
hypersensitivity
macromolecule
nonprescription drugs
pharmaceutic
pharmacodynamics
pharmacogenetic disorder
pharmacokinetics
pharmacology
physical dependency
polypharmacy
prescription drugs
psychological dependency
receptor
synergism
teratogen
toxic

Chapter Objectives

On completion of this chapter, the student will:

- Define pharmacology.
- Discuss drug development in the United States.
- Identify the different names assigned to drugs.
- Distinguish between prescription drugs, nonprescription drugs, and controlled substances.
- Discuss the laws governing the manufacture, distribution, and sale of drugs.
- Discuss the various types of drug reactions produced in the body.
- Identify factors that influence drug action.
- Define drug tolerance, cumulative drug effect, and drug idiosyncrasy.
- Discuss the types of drug interactions that may be seen with drug administration.
- Discuss the nursing implications associated with drug actions, interactions, and effects.
- Discuss the use of botanical medicines.

Pharmacology is the study of drugs and their action on living organisms. A sound knowledge of basic pharmacologic principles is essential if the nurse is to safely administer medications and to monitor patients who receive these medications. This chapter gives a basic overview of pharmacologic principles that the nurse must understand when administering medications. The chapter also discusses drug development, federal legislation affecting the dispensing and use of drugs, and the use of botanical medicines as they relate to pharmacology.

DRUG DEVELOPMENT

Drug development is a long and arduous process, taking anywhere from 7 to 12 years, and sometimes even longer. The United States Food and Drug Administration (FDA) has the responsibility of approving new drugs and monitoring drugs currently in use for adverse or toxic reactions. The development of a new drug is divided into the pre-FDA phase and the FDA phase (Fig. 1-1). During the pre-FDA phase, a manufacturer discovers a drug that looks promising. In vitro testing (testing in an artificial environment, such as a test tube) using animal and human cells is done. This testing is followed by studies in live animals. The manufacturer then makes application to the FDA for Investigational New Drug (IND) status.

With IND status, clinical testing of the new drug begins. Clinical testing involves three phases, with each phase involving a larger number of people. All effects, both pharmacologic and biologic, are noted. Phase I lasts 4 to 6 weeks and involves 20 to 100 individuals who are either "normal" volunteers or individuals in the intended treatment population. If Phase I studies are successful, the testing moves to Phase II, and if those results are positive, to Phase III. Each successive phase has a larger subject population. Phase III studies offer additional information on dosing and safety. The three phases last anywhere from 2 to 10 years, with the average being 5 years.

A New Drug Application (NDA) is submitted after the investigation of the drug in Phases I, II, and III is

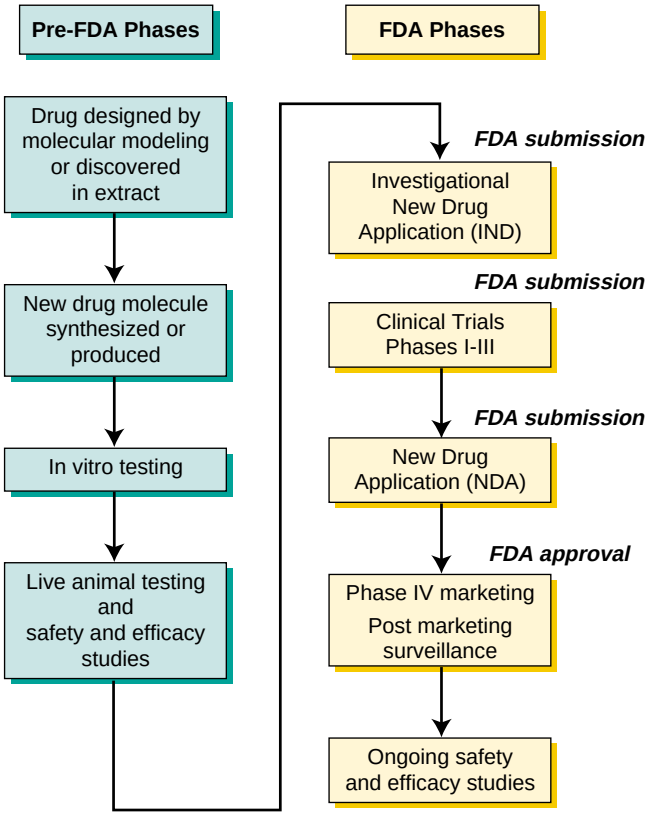


FIGURE 1-1 Phases of drug development. Adapted from (1997, Spring) *PharmPhax,* 3 (2), 2.

complete and the drug is found to be safe and effective. With the NDA, the manufacturer submits all data collected concerning the drug during the clinical trials. A panel of experts, including pharmacologists, chemists, physicians, and other professionals, reviews the application and makes a recommendation to the FDA. The FDA then either approves or disapproves the drug for use. This process of review takes approximately 2 years. After FDA approval, continued surveillance is done to ensure safety.

Postmarketing surveillance occurs after the manufacturer places the drug on the market. During this surveillance, an ongoing review of the drug occurs with particular attention given to adverse reactions. Health care professionals are encouraged to help with this surveillance by reporting adverse effects of drugs to the FDA by using MedWatch (see Display 1-1).

SPECIAL FDA PROGRAMS

Although it takes considerable time for most drugs to get FDA approval, the FDA has special programs to meet different needs. Examples of these special programs include the orphan drug program, accelerated programs for urgent needs, and compassionate use programs.

Orphan Drug Program

The Orphan Drug Act of 1983 was passed to encourage the development and marketing of products used to treat rare diseases. The act defines a "rare disease" as a condition affecting fewer than 200,000 individuals in the United States. The National Organization of Rare Disorders reports that there are more than 6000 rare disorders that affect approximately 25 million individuals. Examples of rare disorders include Tourette's syndrome, ovarian cancer, acquired immunodeficiency syndrome (AIDS), Huntington's disease, and certain forms of leukemia.

The act provides for incentives, such as research grants, protocol assistance by the FDA, and special tax credits, to encourage manufacturers to develop orphan drugs. If the drug is approved, the manufacturer has 7 years of exclusive marketing rights. More than 100 new drugs have received FDA approval since the law was passed. Examples of orphan drugs include thalidomide for leprosy, triptorelin pamoate for ovarian cancer, tetrabenazine for Huntington's disease, and zidovudine for AIDS.

Accelerated Programs

Accelerated approval of drugs is offered by the FDA as a means to make promising products for life-threatening diseases available on the market, based on preliminary evidence before formal demonstration of patient benefit.

DISPLAY 1-1 ● How to Report Adverse Reactions

A drug must be used and studied for many years before all of the adverse reactions are identified. To help in identifying adverse reactions the nurse must be aware of reporting mechanisms. The FDA established a reporting program called MedWatch by which nurses or other health care professionals can report observations of serious adverse drug effects by using a standard form (see Appendix A). The FDA protects the identity of those who voluntarily report adverse reactions. This form also is used to report an undesirable experience associated with the use of medical products (eg, latex gloves, pacemakers, infusion pumps, anaphylaxis, blood, blood components, etc.). It is important to submit reports, even if there is uncertainty about the cause-effect relationship.

Nurses play an important role in monitoring for adverse reactions. The FDA considers serious adverse reactions those that may result in death, life-threatening illness, hospitalization, or disability or those that may require medical or surgical intervention.

Adverse drug reactions may be reported to the FDA by completing the MedWatch form and sending it to:
MedWatch
5600 Fishers Lane
Rockville, MD 20852-9787

Reports may be faxed to the following number:
1-800-FDA-0178

Forms are available online and can be downloaded, completed, and returned via mail, fax, or electronic mail. See the following website:
www.fda.gov/medwatch/index.html

The approval that is granted is considered a "provisional approval," with a written commitment from the pharmaceutical company to complete clinical studies that formally demonstrate patient benefit. This program seeks to make life-saving investigational drugs available before granting final approval to treat diseases that pose a significant health threat to the public. One example of a disease that qualifies as posing a significant health threat is AIDS. Because AIDS is so devastating to the individuals affected and because of the danger the disease poses to public health, the FDA and pharmaceutical companies are working together to shorten the IND approval process for some drugs that show promise in treating AIDS. This accelerated process allows primary care providers to administer medications that indicate positive results in early Phase I and II clinical trials, rather than wait until final approval is granted. If the drug continues to prove beneficial, the process of approval is accelerated.

Compassionate Access to Unapproved Drugs

The compassionate access program allows patients to receive drugs that have not yet been approved by the FDA. This program provides experimental drugs for patients who could benefit from new treatments but whose conditions are such that they most probably would die before the drug is approved for use. These patients are often too sick to participate in the controlled studies. Drug manufacturers make a proposal to the FDA to target patients with the disease and, at the pharmaceutical company's expense, provide the drug free to patients. The pharmaceutical company analyzes and presents to the FDA data on the treatment. This program is not without problems. Because the drug is not in full production, quantities may be limited, so the number of patients may be limited, and patients may be selected at random. Because patients receiving compassionate access often are sicker, they are at increased risk for toxic reactions. This results in the newly developed drug running the risk of obtaining a "bad reputation," even before marketing begins.

DRUG NAMES

Throughout the process of development, drugs may have several names assigned to them: a chemical name, a generic (nonproprietary) name, an official name, and a trade or brand name. This is confusing unless the nurse has a clear understanding of the different names used. Table 1-1 identifies the different names and provides an explanation of each.

DRUG CATEGORIES

After approval of a drug, the FDA assigns the drug to one of the following categories: prescription, nonprescription, or controlled substance.

Prescription Drugs

Prescription drugs are drugs that the federal government has designated to be potentially harmful unless their use is supervised by a licensed health care provider, such as a nurse practitioner, physician, or dentist. Although these drugs have been tested for safety and therapeutic effect, prescription drugs may cause different reactions in some individuals.

In institutional settings the nurse administers the drug and monitors the patient for therapeutic effect and adverse reactions. Some drugs have the potential to be **toxic** (harmful). The nurse plays a critical role in evaluating the patient for toxic effects. When these drugs are prescribed to be taken at home, the nurse provides patient and family education about the drug.

TABLE 1-1 Drug Names

DRUG NAME AND EXAMPLE	EXPLANATION
Chemical name Example: ethyl 4-(8-chloro-5,6-dihydro-11*H*-benzo[5,6] cycloheptal[1,2-b]-pyridin-11-ylidene)-1-piperidinecardisplayylate	Gives the exact chemical makeup of the drug and placing of the atoms or molecular structure; it is not capitalized.
Generic name (nonproprietary) Example: loratadine	Name given to a drug before it becomes official; may be used in all countries, by all manufacturers; it is not capitalized.
Official name Example: loratadine	Name listed in *The United States Pharmacopeia-National Formulary;* may be the same as the generic name.
Trade name (brand name) Example: Claritin©	Name that is registered by the manufacturer and is followed by the trademark symbol; the name can be used only by the manufacturer; a drug may have several trade names, depending on the number of manufacturers; the first letter of the name is capitalized.

DEA # _____

CHARLES FULLER M.D.
SUSAN LUNGLEY R.N., A.N.
1629 TREASURE HILLS
HOUSTON, TX 79635

NAME _____

ADDRESS _____ DATE _____

R_x

☐ Label

Refill _____ times PRN NR

_____ M.D.

To ensure brand name dispensing, prescriber must write 'Dispense As Written' on the prescription.

FIGURE 1-2. Example of a prescription form.

Prescription drugs, also called legend drugs, are the largest category of drugs. Prescription drugs are prescribed by a licensed health care provider. The prescription (see Fig. 1-2) contains the name of the drug, the dosage, the method and times of administration, and the signature of the licensed health care provider prescribing the drug.

Nonprescription Drugs

Nonprescription drugs are drugs that are designated by the FDA to be safe (if taken as directed) and obtained without a prescription. These drugs are also referred to as over-the-counter (OTC) drugs and may be purchased in a variety of settings, such as a pharmacy, drugstore, or in the local supermarket. OTC drugs include those given for symptoms of the common cold, headaches, constipation, diarrhea, and upset stomach.

These drugs are not without risk and may produce adverse reactions. For example, acetylsalicylic acid, commonly known as aspirin, is potentially harmful and can cause gastrointestinal bleeding and salicylism (see Chap. 17). Labeling requirements give the consumer important information regarding the drug, dosage, contraindications, precautions, and adverse reactions. Consumers are urged to read the directions carefully before taking OTC drugs.

Controlled Substances

Controlled substances are the most carefully monitored of all drugs. These drugs have a high potential for abuse and may cause physical or psychological dependence. **Physical dependency** is a compulsive need to use a substance repeatedly to avoid mild to severe withdrawal symptoms; it is the body's dependence on repeated administration of a drug. **Psychological dependency** is a compulsion to use a substance to obtain a pleasurable experience; it is the mind's dependence on the repeated administration of a drug. One type of dependency may lead to the other type.

The Controlled Substances Act of 1970 regulates the manufacture, distribution, and dispensing of drugs that have abuse potential (see information under "Federal Drug Legislation and Enforcement" in this chapter). Drugs under the Controlled Substances Act are divided into five schedules, based on their potential for abuse and physical and psychological dependence. Display 1-2 describes the five schedules.

Prescriptions for controlled substances must be written in ink and include the name and address of the patient and the Drug Enforcement Agency number of the primary health care provider. Prescriptions for these drugs cannot be filled more than 6 months after the prescription

DISPLAY 1-2 ● Schedules of Controlled Substances

SCHEDULE I (C-I)
- High abuse potential
- No accepted medical use in the United States
- Examples: heroin, marijuana, LSD (lysergic acid diethylamide), peyote

SCHEDULE II (C-II)
- Potential for high abuse with severe physical or psychological dependence
- Examples: narcotics such as meperidine, methadone, morphine, oxycodone; amphetamines; and barbiturates

SCHEDULE III (C-III)
- Less abuse potential than schedule II drugs
- Potential for moderate physical or psychological dependence
- Examples: nonbarbiturate sedatives, nonamphetamine stimulants, limited amounts of certain narcotics

SCHEDULE IV (C-IV)
- Less abuse potential than schedule III drugs
- Limited dependence potential
- Examples: some sedatives and anxiety agents, nonnarcotic analgesics

SCHEDULE V (C-V)*
- Limited abuse potential
- Examples: small amounts of narcotics (codeine) used as antitussives or antidiarrheals

*Under federal law, limited quantities of certain schedule V drugs may be purchased without a prescription directly from a pharmacist if allowed under state law. The purchaser must be at least 18 years of age and must furnish identification. All such transactions must be recorded by the dispensing pharmacist.

was written or be refilled more than five times. Under federal law, limited quantities of certain schedule C-V drugs may be purchased without a prescription, with the purchase recorded by the dispensing pharmacist. In some cases state laws are more restrictive than federal laws and impose additional requirements for the sale and distribution of controlled substances. In hospitals or other agencies that dispense controlled substances, the scheduled drugs are counted every 8 to 12 hours to account for each ampule, tablet, or other form of the drug. Any discrepancy in the number of drugs must be investigated and explained immediately.

FEDERAL DRUG LEGISLATION AND ENFORCEMENT

Many laws have been enacted over the last century that affect drug distribution and administration. Those included here are the Pure Food and Drug Act; Harrison Narcotic Act; Pure Food, Drug, and Cosmetic Act; and the Comprehensive Drug Abuse Prevention and Control Act. These laws control the use of the three categories of drugs in the United States (prescription, nonprescription, and controlled substances).

Pure Food and Drug Act

This act, passed in 1906, was the first attempt by the government to regulate and control the manufacture, distribution, and sale of drugs. Before 1906, any substance could be called a drug, and no testing or research was required before placing the drug on the market. Before this time, drug potency and the purity of many drugs were questionable, and some were even dangerous for human use.

Harrison Narcotic Act

This law, passed in 1914, regulated the sale of narcotic drugs. Before the passage of this act, any narcotic could be purchased without a prescription. This law was amended many times. In 1970, the Harrison Narcotic Act was replaced with the passage of the Comprehensive Drug Abuse Prevention and Control Act.

Pure Food, Drug, and Cosmetic Act

In 1938, Congress passed this law that gave the FDA control over the manufacture and sale of drugs, food, and cosmetics. Before the passage of this act, some drugs, as well as foods and cosmetics, contained chemicals that were often harmful to humans. This law requires that these substances are safe for human use. It also requires pharmaceutical companies to perform toxicology tests before a new drug is submitted to the FDA for approval. Following FDA review of the tests performed on animals and other research data, approval may be given to market the drug (see sections on “Drug Development”).

Comprehensive Drug Abuse Prevention and Control Act

Congress passed this act in 1970 because of the growing problem of drug abuse. It regulates the manufacture, distribution, and dispensation of drugs that have the potential for abuse. Title II of this law, the Controlled Substances Act, deals with control and enforcement. The Drug Enforcement Agency within the US Department of Justice is the leading federal agency responsible for the enforcement of this act.

Drug Enforcement Administration

The Drug Enforcement Administration (DEA) within the US Department of Justice is the chief federal agency responsible for enforcing the Controlled Substances Act. Failure to comply with the Controlled Substances Act is punishable by fine and/or imprisonment. With drug abuse so prevalent, nurses must diligently adhere to the regulation imposed by the FDA and the Nurse Practice Act of their state. Any violation may result in the loss of the nurse’s license to practice. Nurses must also report any misuse or abuse of these substances by other nurses to their State Board of Nursing. Most states have provisions within their Nurse Practice Act to assist nurses who have problems with drug abuse.

DRUG USE AND PREGNANCY

The use of any medication—prescription or nonprescription—carries a risk of causing birth defects in the developing fetus. Drugs administered to pregnant women, particularly during the first trimester (3 months), may cause teratogenic effects. A **teratogen** is any substance that causes abnormal development of the fetus leading to a severely deformed fetus. Drugs are one type of teratogen.

In an effort to prevent teratogenic effects, the FDA has established five categories suggesting the potential of a drug for causing birth defects (Display 1-3). Information regarding the pregnancy category of a specific drug is found in reliable drug literature, such as the inserts accompanying drugs and approved drug references. In general, most drugs are contraindicated during pregnancy or lactation unless the potential benefits of taking the drug outweigh the risks to the fetus or the infant.

DISPLAY 1-3 ● Pregnancy Categories

PREGNANCY CATEGORY A
- Controlled studies show no risk to the fetus.
- Adequate well-controlled studies in pregnant women have not demonstrated risk to the fetus.

PREGNANCY CATEGORY B
- There is no evidence of risk in humans.
- Animal studies show risk, but human findings do not.
- If no adequate human studies have been done, animal studies are negative.

PREGNANCY CATEGORY C
- Risk cannot be ruled out.
- Human studies are lacking, and animal studies are either positive for fetal risk or lacking.
- The drug may be used during pregnancy if the potential benefits of the drug outweigh its possible risks.

PREGNANCY CATEGORY D
- There is positive evidence of risk to the human fetus.
- Investigational or postmarketing data show risk to the fetus.
- However, potential benefits may outweigh the risk to the fetus. If needed in a life-threatening situation or a serious disease, the drug may be acceptable if safer drugs cannot be used or are ineffective.

PREGNANCY CATEGORY X
- Use of the drug is contraindicated in pregnancy.
- Studies in animals or humans or investigational or postmarketing reports, have shown fetal risk that clearly outweighs any possible benefit to the patient.

Regardless of the pregnancy category or the presumed safety of the drug, no drug should be administered during pregnancy unless it is clearly needed and the potential benefits outweigh potential harm to the fetus.

During pregnancy, no woman should consider taking any drug, legal or illegal, prescription or nonprescription, unless the drug is prescribed or recommended by the primary health care provider. Smoking or drinking any type of alcoholic beverage also carries risks, such as low birth weight, premature birth, and fetal alcohol syndrome. Children born of mothers using addictive drugs, such as cocaine or heroin, often are born with an addiction to the drug abused by the mother.

DRUG ACTIVITY WITHIN THE BODY

Drugs act in various ways in the body. Oral drugs go through three phases: the pharmaceutic phase, pharmacokinetic phase, and pharmacodynamic phase. Liquid and parenteral drugs (drugs given by injection) go through the later two phases only.

Pharmaceutic Phase

The **pharmaceutic** phase of drug action is the dissolution of the drug. Drugs must be in solution to be absorbed. Drugs that are liquid or drugs given by injection (parenteral drugs) do not go through the pharmaceutic phase. A tablet or capsule (solid forms of a drug) goes through this phase as it disintegrates into small particles and dissolves into the body fluids within the gastrointestinal tract. Tablets that are enteric-coated do not disintegrate until reaching the alkaline environment of the small intestine.

Pharmacokinetic Phase

Pharmacokinetics refers to activities within the body after a drug is administered. These activities include absorption, distribution, metabolism, and excretion (ADME). Another pharmacokinetic component is the half-life of the drug. **Half-life** is a measure of the rate at which drugs are removed from the body.

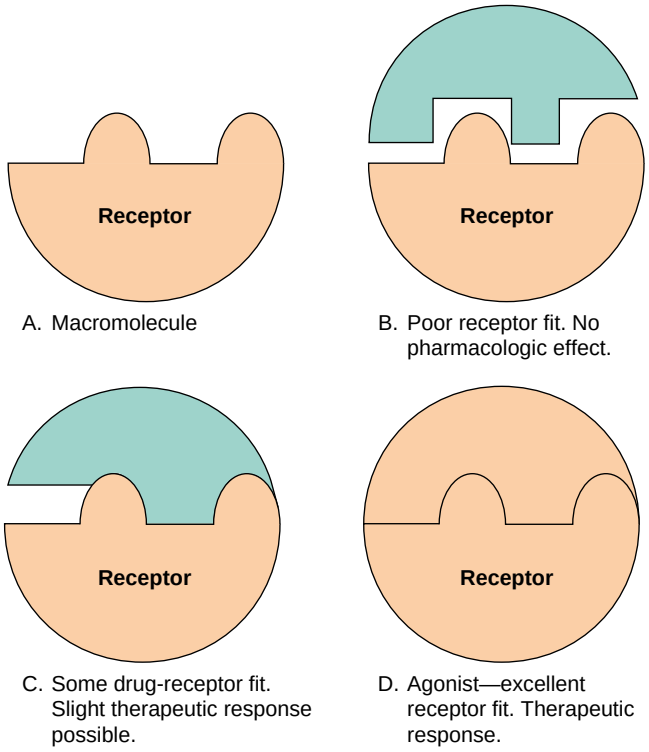
Absorption

Absorption follows administration and is the process by which a drug is made available for use in the body. It occurs after dissolution of a solid form of the drug or after the administration of a liquid or parenteral drug. In this process the drug particles within the gastrointestinal tract are moved into the body fluids. This movement can be accomplished in several ways: active absorption, passive absorption, and pinocytosis. In active absorption a carrier molecule such as a protein or enzyme actively moves the drug across the membrane. Passive absorption occurs by diffusion (movement from a higher concentration to a lower concentration). In pinocytosis cells engulf the drug particle causing movement across the cell.

As the body transfers the drug from the body fluids to the tissue sites, absorption into the body tissues occurs. Several factors influence the rate of absorption, including the route of administration, the solubility of the drug, and the presence of certain body conditions. Drugs are most rapidly absorbed when given by the intravenous route, followed by the intramuscular route, the subcutaneous route, and lastly, the oral route. Some drugs are more soluble and thus are absorbed more rapidly than others. For example, water-soluble drugs are readily absorbed into the systemic circulation. Bodily conditions, such as the development of lipodystrophy (atrophy of the subcutaneous tissue) from repeated subcutaneous injections, inhibit absorption of a drug given in the site of lipodystrophy.

Distribution

The systemic circulation distributes drugs to various body tissues or target sites. Drugs interact with specific receptors (see Fig. 1-3) during distribution. Some drugs travel by binding to protein (albumin) in the blood. Drugs bound to protein are pharmacologically inactive. Only when the protein molecules release the drug can the drug diffuse into the tissues, interact with receptors, and produce a therapeutic effect.



A. Macromolecule
B. Poor receptor fit. No pharmacologic effect.
C. Some drug-receptor fit. Slight therapeutic response possible.
D. Agonist—excellent receptor fit. Therapeutic response.

FIGURE 1-3. Drug-receptor interactions. (Adapted from Reiss & Evans, *Pharmacological Aspects of Nursing Care,* 3rd ed.)

As the drug circulates in the blood, a certain blood level must be maintained for the drugs to be effective. When the blood level decreases below the therapeutic level, the drug will not produce the desired effect. Should the blood level increase significantly over the therapeutic level, toxic symptoms develop. Specific therapeutic blood levels are discussed in the subsequent chapters when applicable.

Metabolism

Metabolism, also called **biotransformation,** is the process by which a drug is converted by the liver to inactive compounds through a series of chemical reactions. Patients with liver disease may require lower dosages of a drug detoxified by the liver, or the primary care provider may select a drug that does not undergo a biotransformation by the liver. Frequent liver function texts are necessary when liver disease is present. The kidneys, lungs, plasma, and intestinal mucosa also aid in the metabolism of drugs.

Excretion

The elimination of drugs from the body is called excretion. After the liver renders drugs inactive, the kidney excretes the inactive compounds from the body. Also, some drugs are excreted unchanged by the kidney without liver involvement. Patients with kidney disease may require a dosage reduction and careful monitoring of kidney function. Children have immature kidney function and may require dosage reduction and kidney function tests. Similarly, older adults have diminished kidney function and require careful monitoring and lower dosages. Other drugs are eliminated by sweat, breast milk, breath, or by the gastrointestinal tract in the feces.

Half-Life

Half-life refers to the time required for the body to eliminate 50% of the drug. Knowledge of the half-life of a drug is important in planning the frequency of dosing. For example, drugs with a short half-life (2–4 hours) need to be administered frequently, whereas a drug with a long half-life (21–24 hours) requires less frequent dosing. It takes five to six half-lives to eliminate approximately 98% of a drug from the body. Although half-life is fairly stable, patients with liver or kidney disease may have problems excreting a drug. Difficulty in excreting a drug increases the half-life and increases the risk of toxicity. For example, digoxin (Lanoxin) has a long half-life (36 hours) and requires once-daily dosing. However, aspirin has a short half-life and requires frequent dosing. Older patients or patients with impaired kidney or liver function require frequent diagnostic tests measuring renal or hepatic function.

PHARMACODYNAMIC PHASE

Pharmacodynamics deals with the drug's action and effect within the body. After administration, most drugs enter the systemic circulation and expose almost all body tissues to possible effects of the drug. All drugs produce more than one effect in the body. The primary effect of a drug is the desired or therapeutic effect. Secondary effects are all other effects, whether desirable or undesirable, produced by the drug.

Most drugs have an affinity for certain organs or tissues and exert their greatest action at the cellular level on those specific areas, which are called target sites. There are two main mechanisms of action:

1. Alteration in cellular environment
2. Alteration in cellular function

Alteration in Cellular Environment

Some drugs act on the body by changing the cellular environment, either physically or chemically. Physical changes in the cellular environment include changes in osmotic pressures, lubrication, absorption, or the conditions on the surface of the cell membrane. An example of a drug that changes osmotic pressure is mannitol, which produces a change in the osmotic pressure in brain cells, causing a reduction in cerebral edema. A

drug that acts by altering the cellular environment by lubrication is sunscreen. An example of a drug that acts by altering absorption is activated charcoal, which is administered orally to absorb a toxic chemical ingested into the gastrointestinal tract. The stool softener docusate is an example of a drug that acts by altering the surface of the cellular membrane. Docusate has emulsifying and lubricating activity that causes a lowering of the surface tension in the cells of the bowel, permitting water and fats to enter the stool. This softens the fecal mass, allowing easier passage of the stool.

Chemical changes in the cellular environment include inactivation of cellular functions or the alteration of the chemical components of body fluid, such as a change in the pH. For example, antacids neutralize gastric acidity in patients with peptic ulcers.

Alteration in Cellular Function

Most drugs act on the body by altering cellular function. A drug cannot completely change the function of a cell, but it can alter its function. A drug that alters cellular function can increase or decrease certain physiologic functions, such as increase heart rate, decrease blood pressure, or increase urine output.

Receptor-Mediated Drug Action

The function of a cell alters when a drug interacts with a receptor cell. A **receptor** is a specialized **macromolecule** (a large group of molecules linked together) that attaches or binds to the drug molecule. This alters the function of the cell and produces the therapeutic response of the drug. For a drug–receptor reaction to occur, a drug must be attracted to a particular receptor. Drugs bind to a receptor much like a piece of a puzzle. The closer the shape, the better the fit, and the better the therapeutic response. The intensity of a drug response is related to how good the "fit" of the drug molecule is and the number of receptor sites occupied.

Agonists are drugs that bind with a receptor to produce a therapeutic response. Drugs that bind only partially to the receptor will most probably have some, although slight, therapeutic response. Figure 1-3 identifies the different drug–receptor interactions. Partial agonists are drugs that have some drug receptor fit and produce a response but inhibit other responses.

Antagonists join with a receptor to prevent the action of an agonist. When the antagonist binds more tightly than the agonist to the receptor, the action of the antagonist is strong. Drugs that act as antagonists produce no pharmacologic effect. An example of an antagonist is Narcan, a narcotic antagonist that completely blocks the effects of morphine, including the respiratory depression. This drug is useful in reversing the effects of an overdose of narcotics.

Receptor-Mediated Drug Effects

The number of available receptor sites influences the effects of a drug. If only a few receptor sites are occupied, although many sites are available, the response will be small. If the drug dose is increased, more receptor sites are used and the response increases. If only a few receptor sites are available, the response does not increase if more of the drug is administered. However, not all receptors on a cell need to be occupied for a drug to be effective. Some extremely potent drugs are effective even when the drug occupies few receptor sites.

DRUG REACTIONS

Drugs produce many reactions in the body. The following sections discuss adverse drug reactions, allergic drug reactions, drug idiosyncrasy, drug tolerance, cumulative drug effect, and toxic reactions. Pharmacogenetic reactions can also occur. A pharmacogenetic reaction is a genetically determined adverse reaction to a drug.

Adverse Drug Reactions

Patients may experience one or more **adverse reactions** (side effects) when they are given a drug. Adverse reactions are undesirable drug effects. Adverse reactions may be common or may occur infrequently. They may be mild, severe, or life threatening. They may occur after the first dose, after several doses, or even after many doses. An adverse reaction often is unpredictable, although some drugs are known to cause certain adverse reactions in many patients. For example, drugs used in the treatment of cancer are very toxic and are known to produce adverse reactions in many patients receiving them. Other drugs produce adverse reactions in fewer patients. Some adverse reaction is predictable, but many adverse drug reactions occur without warning.

Some texts use both terms *side effect* and *adverse reactions.* These texts distinguish between the two terms by using *side effects* to explain mild, common, and nontoxic reactions; *adverse reaction* is used to describe more severe and life-threatening reactions. For the purposes of this text only the term *adverse reaction* is used, with the understanding that these reactions may be mild, severe, or life threatening.

Allergic Drug Reactions

An **allergic reaction** also is called a **hypersensitivity** reaction. Allergy to a drug usually begins to occur after more than one dose of the drug is given. On occasion, the nurse may observe an allergic reaction the first time a drug is given because the patient has received or taken the drug in the past.

A drug allergy occurs because the individual's immune system views the drug as a foreign substance or **antigen.** The presence of an antigen stimulates the antigen–antibody response that in turn prompts the body to produce **antibodies.** If the patient takes the drug after the antigen–antibody response has occurred, an allergic reaction results.

Even a mild allergic reaction produces serious effects if it goes unnoticed and the drug is given again. Any indication of an allergic reaction is reported to the primary health care provider before the next dose of the drug is given. Serious allergic reactions require contacting the primary health care provider immediately because emergency treatment may be necessary.

Some allergic reactions occur within minutes (even seconds) after the drug is given; others may be delayed for hours or days. Allergic reactions that occur immediately often are the most serious.

Allergic reactions are manifested by a variety of signs and symptoms observed by the nurse or reported by the patient. Examples of some allergic symptoms include itching, various types of skin rashes, and hives (urticaria). Other symptoms include difficulty breathing, wheezing, cyanosis, a sudden loss of consciousness, and swelling of the eyes, lips, or tongue.

Anaphylactic shock is an extremely serious allergic drug reaction that usually occurs shortly after the administration of a drug to which the individual is sensitive. This type of allergic reaction requires immediate medical attention. Symptoms of anaphylactic shock are listed in Table 1-2.

All or only some of these symptoms may be present. Anaphylactic shock can be fatal if the symptoms are not identified and treated immediately. Treatment is to raise the blood pressure, improve breathing, restore cardiac function, and treat other symptoms as they occur. Epinephrine (adrenalin) 0.1 to 0.5 mg may be given by subcutaneous or intramuscular injection. Hypotension and shock may be treated with fluids and vasopressors. Bronchodilators are given to relax the smooth muscles of the bronchial tubes. Antihistamines may be given to block the effects of histamine.

TABLE 1-2 Symptoms of Anaphylactic Shock

Respiratory	Bronchospasm Dyspnea (difficult breathing) Feeling of fullness in the throat Cough Wheezing
Cardiovascular	Extremely low blood pressure Tachycardia (heart rate > 100 bpm) Palpations Syncope (fainting) Cardiac arrest
Integumentary	Urticaria Angioedema Pruritus (itching) Sweating
Gastrointestinal	Nausea Vomiting Abdominal pain

Angioedema (angioneurotic edema) is another type of allergic drug reaction. It is manifested by the collection of fluid in subcutaneous tissues. Areas that are most commonly affected are the eyelids, lips, mouth, and throat, although other areas also may be affected. Angioedema can be dangerous when the mouth is affected because the swelling may block the airway and asphyxia may occur. Difficulty in breathing or swelling to any area of the body is reported immediately to the primary health care provider.

Drug Idiosyncrasy

Drug idiosyncrasy is a term used to describe any unusual or abnormal reaction to a drug. It is any reaction that is different from the one normally expected of a specific drug and dose. For example, a patient may be given a drug to help him or her sleep (eg, a hypnotic). Instead of falling asleep, the patient remains wide awake and shows signs of nervousness or excitement. This response is an idiosyncratic response because it is different from what the nurse expects from this type of drug. Another patient may receive the same drug and dose, fall asleep, and after 8 hours be difficult to awaken. This, too, is abnormal and describes an overresponse to the drug.

The cause of drug idiosyncrasy is not clear. It is believed to be due to a genetic deficiency that makes the patient unable to tolerate certain chemicals, including drugs.

Drug Tolerance

Drug tolerance is a term used to describe a decreased response to a drug, requiring an increase in dosage to achieve the desired effect. Drug tolerance may develop when a patient takes certain drugs, such as the narcotics and tranquilizers, for a long time. The individual who takes these drugs at home increases the dose when the expected drug effect does not occur. The development of drug tolerance is a sign of drug dependence. Drug tolerance may also occur in the hospitalized patient. When the patient receives a narcotic for more than 10 to 14 days, the nurse suspects drug tolerance (and possibly drug dependence). The patient may also begin to ask for the drug at more frequent intervals.

Cumulative Drug Effect

A **cumulative drug effect** may be seen in those with liver or kidney disease because these organs are the major sites for the breakdown and excretion of most

drugs. This drug effect occurs when the body is unable to metabolize and excrete one (normal) dose of a drug before the next dose is given. Thus, if a second dose of this drug is given, some drug from the first dose remains in the body. A cumulative drug effect can be serious because too much of the drug can accumulate in the body and lead to toxicity.

Patients with liver or kidney disease are usually given drugs with caution because a cumulative effect may occur. When the patient is unable to excrete the drug at a normal rate the drug accumulates in the body, causing a toxic reaction. Sometimes, the primary health care provider lowers the dose of the drug to prevent a toxic drug reaction.

Toxic Reactions

Most drugs can produce **toxic** or harmful reactions if administered in large dosages or when blood concentration levels exceed the therapeutic level. Toxic levels build up when a drug is administered in dosages that exceed the normal level or if the patient's kidneys are not functioning properly and cannot excrete the drug. Some toxic effects are immediately visible; others may not be seen for weeks or months. Some drugs, such as lithium or digoxin, have a narrow margin of safety, even when given in recommended dosages. It is important to monitor these drugs closely to avoid toxicity.

Drug toxicity can be reversible or irreversible, depending on the organs involved. Damage to the liver may be reversible because liver cells can regenerate. However, hearing loss due to damage to the eighth cranial nerve caused by toxic reaction to the anti-infective streptomycin may be permanent. Sometimes drug toxicity can be reversed by the administration of another drug that acts as an antidote. For example, in serious instances of digitalis toxicity, the drug Digibind may be given to counteract the effect of digoxin toxicity.

Nurses must carefully monitor the patient's blood levels of drugs to ensure that they remain within the therapeutic range. Any deviation should be reported to the primary health care provider. Because some drugs can cause toxic reactions even in recommended doses, the nurse should be aware of the signs and symptoms of toxicity of commonly prescribed drugs.

Pharmacogenetic Reactions

A **pharmacogenetic disorder** is a genetically determined abnormal response to normal doses of a drug. This abnormal response occurs because of inherited traits that cause abnormal metabolism of drugs. For example, individuals with glucose-6-phosphate dehydrogenase (G6PD) deficiency have abnormal reactions to a number of drugs. These patients exhibit varying degrees of hemolysis (destruction of red blood cells) if these drugs are administered. More than 100 million people are affected by this disorder. Examples of drugs that cause hemolysis in patients with a G6PD deficiency include aspirin, chloramphenicol, and the sulfonamides.

DRUG INTERACTIONS

It is important for the nurse administering medications to be aware of the various drug interactions that can occur, most importantly drug–drug interactions and drug–food interactions. The following section gives a brief overview of drug interactions. Specific drug–drug and drug–food interactions are discussed in subsequent chapters.

Drug—Drug Interactions

A drug–drug interaction occurs when one drug interacts with or interferes with the action of another drug. For example, taking an antacid with oral tetracycline causes a decrease in the effectiveness of the tetracycline. The antacid chemically interacts with the tetracycline and impairs its absorption into the bloodstream, thus reducing the effectiveness of the tetracycline. Drugs known to cause interactions include oral anticoagulants, oral hypoglycemics, anti-infectives, antiarrhythmics, cardiac glycosides, and alcohol. Drug–drug interactions can produce effects that are additive, synergistic, or antagonistic.

ADDITIVE DRUG REACTION. An **additive drug reaction** occurs when the combined effect of two drugs is equal to the sum of each drug given alone. For example, taking the drug heparin with alcohol will increase bleeding. The equation one + one = two is sometimes used to illustrate the additive effect of drugs.

SYNERGISTIC DRUG REACTION. Drug **synergism** occurs when drugs interact with each other and produce an effect that is greater than the sum of their separate actions. The equation one + one = four may be used to illustrate synergism. An example of drug synergism is when a person takes both a hypnotic and alcohol. When alcohol is taken simultaneously or shortly before or after the hypnotic is taken, the action of the hypnotic increases. The individual experiences a drug effect that is greater than if either drug was taken alone. On occasion, the occurrence of a synergistic drug effect is serious and even fatal.

ANTAGONISTIC DRUG REACTION. An antagonistic drug reaction occurs when one drug interferes with the action of another, causing neutralization or a decrease in

the effect of one drug. For example, protamine sulfate is a heparin antagonist. This means that the administration of protamine sulfate completely neutralizes the effects of heparin in the body.

Drug–Food Interactions

When a drug is given orally, food may impair or enhance its absorption. A drug taken on an empty stomach is absorbed into the bloodstream at a faster rate than when the drug is taken with food in the stomach. Some drugs (eg, captopril) must be taken on an empty stomach to achieve an optimal effect. Drugs that should be taken on an empty stomach are administered 1 hour before or 2 hours after meals. Other drugs, especially drugs that irritate the stomach, result in nausea or vomiting, or cause epigastric distress, are best given with food or meals. This minimizes gastric irritation. The nonsteroidal anti-inflammatory drugs and salicylates are examples of drugs that are given with food to decrease epigastric distress. Still other drugs combine with a drug forming an insoluble food–drug mixture. For example, when tetracycline is administered with dairy products, a drug–food mixture is formed that is unabsorbable by the body. When a drug is unabsorbable by the body, no pharmacologic effect occurs.

FACTORS INFLUENCING DRUG RESPONSE

Certain factors may influence drug response and are considered when the primary health care provider prescribes and the nurse administers a drug. These factors include age, weight, gender, disease, and route of administration.

Age

The age of the patient may influence the effects of a drug. Infants and children usually require smaller doses of a drug than adults do. Immature organ function, particularly the liver and kidneys, can affect the ability of infants and young children to metabolize drugs. An infant's immature kidneys impair the elimination of drugs in the urine. Liver function is poorly developed in infants and young children. Drugs metabolized by the liver may produce more intense effects for longer periods. Parents must be taught the potential problems associated with administering drugs to their children. For example, a safe dose of a nonprescription drug for a 4-year-old child may be dangerous for a 6-month-old infant.

Elderly patients may also require smaller doses, although this may depend on the type of drug administered. For example, the elderly patient may be given the same dose of an antibiotic as a younger adult. However, the same older adult may require a smaller dose of a drug that depresses the central nervous system, such as a narcotic. Changes that occur with aging affect the pharmacokinetics (absorption, distribution, metabolism, and excretion) of a drug. Any of these processes may be altered because of the physiologic changes that occur with aging. Table 1-3 summarizes the changes that occur with aging and the possible pharmacokinetic effect.

Polypharmacy is the taking of numerous drugs that can potentially react with one another. When practiced by the elderly, polypharmacy leads to an increase in the number of potential adverse reactions. Although multiple drug therapy is necessary to treat certain disease states, it always increases the possibility of adverse reactions. The nurse needs good assessment skills to detect any problems when monitoring the geriatric patient's response to drug therapy.

TABLE 1-3 Factors Altering Drug Response in the Elderly

AGE-RELATED CHANGES	EFFECT ON DRUG THERAPY
Decreased gastric acidity; decreased gastric motility	Possible decreased or delayed absorption
Dry mouth and decreased saliva	Difficulty swallowing oral drugs
Decreased liver blood flow; decreased liver mass	Delayed and decreased metabolism of certain drugs; possible increased effect, leading to toxicity
Decreased lipid content of the skin	Possible decrease in absorption of transdermal drugs
Increased body fat; decreased body water	Possible increase in toxicity of water-soluble drugs; more prolonged effects of fat-soluble drugs
Decreased serum proteins	Possible increased effect and toxicity of highly protein-bound drugs
Decreased renal mass, blood flow, and glomerular filtration rate	Possible increased serum levels, leading to toxicity of drugs excreted by the kidney
Changes in sensitivity of certain drug receptors	Increase or decrease in drug effect

Adapted from Eisenhauer, L., Nichols, L., Spencer, R., & Bergan, F. (1998). *Clinical pharmacology and nursing management* (5th ed., p. 189). Philadelphia: Lippincott-Raven. Used with permission.

Weight

In general, dosages are based on a weight of approximately 150 lb, which is calculated to be the "average" weight of men and women. A drug dose may sometimes be increased or decreased because the patient's weight is significantly higher or lower than this average. With narcotics, for example, higher or lower than average dosages may be necessary to produce relief of pain, depending on the patient's weight.

Gender

The gender of an individual may influence the action of some drugs. Women may require a smaller dose of some drugs than men. This is because many women are smaller than men and have a body fat-and-water ratio different from that of men.

Disease

The presence of disease may influence the action of some drugs. Sometimes disease is an indication for not prescribing a drug or for reducing the dose of a certain drug. Both hepatic (liver) and renal (kidney) disease can greatly affect drug response.

In liver disease, for example, the ability to metabolize or detoxify a specific type of drug may be impaired. If the average or normal dose of the drug is given, the liver may be unable to metabolize the drug at a normal rate. Consequently, the drug may be excreted from the body at a much slower rate than normal. The primary health care provider may then decide to prescribe a lower dose and lengthen the time between doses because liver function is abnormal.

Patients with kidney disease may exhibit drug toxicity and a longer duration of drug action. The dosage of drugs may be reduced to prevent the accumulation of toxic levels in the blood or further injury to the kidney.

Route of Administration

Intravenous administration of a drug produces the most rapid drug action. Next in order of time of action is the intramuscular route, followed by the subcutaneous route. Giving a drug orally usually produces the slowest drug action.

Some drugs can be given only by one route; for example, antacids are given only orally. Other drugs are available in oral and parenteral forms. The primary health care provider selects the route of administration based on many factors, including the desired rate of action. For example, the patient with a severe cardiac problem may require intravenous administration of a drug that affects the heart. Another patient with a mild cardiac problem may experience a good response to oral administration of the same drug.

NURSING IMPLICATIONS

Many factors can influence drug action. The nurse should consult appropriate references or the hospital pharmacist if there is any question about the dosage of a drug, whether other drugs the patient is receiving will interfere with the drug being given, or whether the oral drug should or should not be given with food.

Drug reactions are potentially serious. The nurse should observe all patients for adverse drug reactions, drug idiosyncrasy, and evidence of drug tolerance (when applicable). It is important to report all drug reactions or any unusual drug effect to the primary health care provider.

The nurse must use judgment about when adverse drug reactions are reported to the primary health care provider. Accurate observation and evaluation of the circumstances are essential; the nurse should record all observations in the patient's record. If there is any question regarding the events that are occurring, the nurse can withhold the drug but must contact the primary health care provider.

HERBAL THERAPY AND NUTRITIONAL SUPPLEMENTS

Botanical medicine or herbal therapy is a type of complementary/alternative therapy that uses plants or herbs to treat various disorders. Individuals worldwide use both herbal therapy and nutritional supplements extensively. According to the World Health Organization (WHO), 80% of the world's population relies on herbs for a substantial part of their health care. Herbs have been used by virtually every culture in the world throughout history, from the beginning of time until now. For example, Hippocrates prescribed St. Johns Wort, currently a popular herbal remedy for depression. Native Americans used plants such as coneflower, ginseng, and ginger for therapeutic purposes. Herbal therapy is part of a group of nontraditional therapies commonly known as complementary/alternative medicine (CAM). Unfortunately, CAM therapies are not widely taught in medical schools. A 1998 survey revealed that 75 of 117 US medical schools offered elective courses in CAM or included CAM topics in required courses. Complementary therapies are therapies such as relaxation techniques, massage, dietary supplements, healing touch, and herbal therapy that can be used to "complement" traditional health care. Alternative therapies, on the other hand, are therapies used in place of or instead of conventional or Western medicine. The term *complementary/alternative therapy* often is used as an umbrella term for many therapies from all over the world.

Although herbs have been used for thousands of years, most of what we know has been from observation. Most herbs have not been scientifically studied for safety and efficacy (effectiveness). Much of what we know about herbal therapy has come from Europe, particularly Germany. During the last several decades, European scientists have studied botanical plants in ways that seek to identify how they work at the cellular level, what chemicals are most effective, and adverse effects related to their use. Germany has compiled information on 300 herbs and made recommendations for their use.

Dietary Supplement Health and Education Act

Because herbs cannot be sold and promoted in the United States as drugs, they are regulated as nutritional or dietary substances. *Nutritional* or *dietary substances* are terms used by the federal government to identify substances not regulated as drugs by the FDA but that are purported to be effective for use to promote health. Herbs, as well as vitamins and minerals, are classified as dietary or nutritional supplements. Because natural products cannot be patented in the United States, it is not profitable for drug manufacturers to spend the millions of dollars and the 8 to 12 years to study and develop these products as drugs. In 1994, the US government passed the Dietary Supplement Health and Education Act (DSHEA). This act defines substances such as herbs, vitamins, minerals, amino acids, and other natural substances as "dietary supplements." The act permits general health claims such as "improves memory" or "promotes regularity" as long as the label also has a disclaimer stating that the supplements are not approved by the FDA and are not intended to diagnose, treat, cure, or prevent any disease. The claims must be truthful and not misleading and be supported by scientific evidence. Some have abused the law by making exaggerated claims, but the FDA has the power to enforce the law, which it has done, and these claims have decreased.

Center for Complementary and Alternative Health

In 1992, the National Institutes of Health established an Office of Alternative Medicine to facilitate the study of alternative medical treatments and to disseminate the information to the public. In 1998, the name was changed to National Center for Complementary and Alternative Medicine (NCCAM). This office was established partly because of the increased interest and use of these therapies in the United States. It has been estimated that approximately 40% of all individuals in the United States use some form of complementary/alternative therapy. In 1997, Americans spent more that $27 billion on these therapies. Among the various purposes of the NCCAM, one is to evaluate the safety and efficacy of widely used natural products, such as herbal remedies and nutritional and food supplements. Although the scientific study of CAM is relatively new, the Center is dedicated to developing programs and encouraging scientists to investigate CAM treatments that show promise. The NCCAM budget has steadily grown from $2 million in 1993 to more than $68.7 million in 2000. This funding increase reflects the public's interest and need for CAM information that is based on rigorous scientific research.

Educating the Client on the Use of Herbs and Nutritional Supplements

The use of herbs and nutritional supplements to treat various disorders is common. Herbs are used for various effects, such as to boost the immune system, treat depression, and for relaxation. Individuals are becoming more aware of the benefits of herbal therapies and nutritional supplements. Advertisements, books, magazines, and Internet sites abound concerning these topics. People, eager to cure or control various disorders, take herbs, teas, megadoses of vitamins, and various other natural products. Although much information is available on nutritional supplements and herbal therapy, obtaining the correct information sometimes is difficult. Medicinal herbs and nutritional substances are available at supermarkets, pharmacies, health food stores, specialty herb stores, and through the Internet. The potential for misinformation abounds. Because these substances are "natural products," many individuals may incorrectly assume that they are without adverse effects. When any herbal remedy or dietary supplement is used, it should be reported to the nurse and the primary health care provider. Many of these botanicals have strong pharmacological activity, and some may interact with prescription drugs or be toxic in the body. For example, comfrey, an herb that was once widely used to promote digestion, can cause liver damage. Although it may still be available in some areas, it is a dangerous herb and is not recommended for use as a supplement.

When obtaining the drug history, the nurse must always question the patient about the use of herbs, teas, vitamins, or other nutritional or dietary supplements. Many patients consider herbs as natural and therefore safe. It is also difficult for some to report the use of an herbal tea as a part of the health care regimen. Display 1-4 identifies teaching points to consider when discussing the use of herbs and nutritional supplements with patients. Although a complete discussion about the use of herbs is beyond the scope of this book, it is important to remember that the use of herbs and nutritional supplements is commonplace in many areas of the country. To help the student become more aware of herbal therapy and nutritional supplements, Appendix B gives

DISPLAY 1-4 ● Teaching Points When Discussing the Use of Herbal Therapy

- If you regularly use herbal therapies, invest in a good herbal reference book such as *Guide to Popular Natural Products,* edited by Ara DerMarderosian (Facts and Comparisons Publishing Group, 2001).
- Store clerks are not experts in herbal therapy. Your best choice is to select an herbal product manufactured by a reputable company.
- Check the label for the word "standardized." This means that the product has a specific percentage of a specific chemical.
- Some herbal tinctures are 50% alcohol, which could pose a problem to individuals with a history of alcohol abuse.
- Use products with more than six herbs cautiously. It is generally better to use the single herb than to use a diluted product with several herbs.
- Do not overmedicate with herbs. The adage "If one is good, two must be better" is definitely not true. Take only the recommended dosage.
- Herbs are generally safe when taken in recommended dosages. However, if you experience any different or unusual symptoms, such as heart palpitations, headaches, rashes, or difficulty breathing, stop taking the herb and contact your health care provider.
- Inform your primary health care provider of any natural products that you take (eg, herbs, vitamins, minerals, teas, etc.). Certain herbs can interact with the medications that you take, causing serious adverse reactions or toxic effects.
- Allow time for the herb to work. Generally, 30 days is sufficient. If your symptoms have not improved within 30 to 60 days, discontinue use of the herb.

Adapted from Fontaine, K. L. (2000). *Healing practices: Alternative therapies for nursing* (pp. 126–127). Upper Saddle River, NJ: Prentice Hall. Used with permission.

an overview of selected common herbs and nutritional supplements. In addition, Herbal Alerts are placed in various chapters throughout the book, giving the student valuable information or warnings about the use of herbs.

● *Critical Thinking Exercises*

1. *Judy Martin, a student nurse, has just administered an antibiotic to Mr. Green. When she returns to the room about 30 minutes later, she finds Mr. Green flushed, reporting a lump in his throat, and experiencing difficulty breathing. Determine what actions the student nurse should take.*
2. *Jenny Davis, age 25, is pregnant. Jenny's primary health care provider tells her that she may not take any medication without first checking with the health care provider during the pregnancy. Jenny is puzzled and questions you about this. Discuss how you would address Jenny's concerns.*
3. *Ms. James, an 80-year-old woman, is receiving a lower dose of Demerol, a narcotic analgesic, postoperatively for pain. Her family questions the use of a lower dose. Determine what information you would give her family when they voice concerns that the dosage will not adequately relieve their mother's pain. Analyze what patient assessment, if any, you would need to make before talking with the family.*

● *Review Questions*

1. Mr. Carter has a rash and pruritus. You suspect an allergic reaction and immediately assess him for other more serious symptoms of an allergic reaction. What question would be most important to ask Mr. Carter?
   - **A.** Are you having any difficulty breathing?
   - **B.** Have you noticed any blood in your stool?
   - **C.** Do you have a headache?
   - **D.** Are you having difficulty with your vision?
2. Mr. Jones, a newly admitted patient, has a history of liver disease. In planning Mr. Jones' care the nurse must consider that liver disease may result in a (an) _____.
   - **A.** increase in the excretion rate of a drug
   - **B.** impaired ability to metabolize or detoxify a drug
   - **C.** necessity to increase the dosage of a drug
   - **D.** decrease in the rate of drug absorption
3. Oxycodone is prescribed for a patient on the unit where you work. To safely administer oxycodone the nurse knows that this drug is regulated by the Controlled Substance Act, which classifies this drug as a Schedule _____.
   - **A.** drug with a high abuse potential
   - **B.** drug with the potential for high abuse with severe dependency
   - **C.** drug with moderate abuse potential
   - **D.** drug with limited abuse potential
4. A patient asks the nurse to define a hypersensitivity reaction. The nurse begins by telling the patient that a hypersensitivity reaction is also called a _____.
   - **A.** synergistic reaction
   - **B.** antagonistic reaction
   - **C.** drug idiosyncrasy
   - **D.** drug allergy
5. If a patient takes a drug on an empty stomach, the nurse is aware that the drug will be _____.
   - **A.** absorbed more slowly
   - **B.** neutralized by pancreatic enzymes
   - **C.** affected by enzymes in the colon
   - **D.** absorbed more rapidly
6. In monitoring drug therapy, the nurse is aware that a synergistic drug effect may be defined as _____.
   - **A.** an effect greater than the sum of the separate actions of two or more drugs
   - **B.** an increase in the action of one of the two drugs being given
   - **C.** a neutralizing drug effect
   - **D.** a comprehensive drug effect