Pharmacology Basics

Elizabeth Boldon RN, MSN

Elizabeth Boldon is a Nurse Education Specialist at Mayo Clinic in Rochester, Minnesota. She received a BSN from Allen College in Waterloo, Iowa in 2002 and an MSN with a focus in education from the University of Phoenix in 2008. She has bedside nursing experience in medical neurology and the neuroscience ICU.

Abstract:
Pharmacology basics is an important topic for nurses, as medications have a great power to both help and to harm patients. The basic principles of pharmacology, pharmacokinetic processes including absorption, distribution, metabolism and excretion, as well as several drug classes and some of the commonly seen drugs within those classes are discussed.
Continuing Nursing Education Course Director & Planners
William A. Cook, PhD, Director, Douglas Lawrence, MS, Webmaster,
Susan DePasquale, CGRN, MSN, FPMHNP-BC, Lead Nurse Planner

Accreditation Statement
This activity has been planned and implemented in accordance with the
policies of NurseCe4Less.com and the continuing nursing education
requirements of the American Nurses Credentialing Center's Commission on
Accreditation for registered nurses.

Credit Designation
This educational activity is credited for 4 hours. Pharmacology content
includes 4 hours. Nurses may only claim credit commensurate with the
credit awarded for completion of this course activity.

Course Author & Planner Disclosure Policy Statements
It is the policy of NurseCe4Less.com to ensure objectivity, transparency, and
best practice in clinical education for all CNE educational activities. All
authors and course planners participating in the planning or implementation
of a CNE activity are expected to disclose to course participants any relevant
conflict of interest that may arise.

Statement of Need
Pharmacology is a rapidly growing area of health research and medicine.
Nurses need to understand the basics of drug classifications and principles
underlying the use of certain medications. Nurses are important contributors
to pharmacology research and practice standards.
Course Purpose
To improve nursing knowledge of the basics of pharmacology and to prepare them for more advanced learning of drug categories and treatments.

Learning Objectives
1. Describe the role of receptors related to medications.
2. Discuss the four components of pharmacokinetics.
3. Describe how medications are classified.
4. Identify some medications from some commonly seen classifications, as well as their actions, uses, adverse reactions and side effects, contraindications, and implications.

Target Audience
Advanced Practice Registered Nurses, Registered Nurses, Licensed Practical Nurses, and Associates

Course Author & Director Disclosures
Elizabeth Boldon, RN, MSN, William S. Cook, PhD, Douglas Lawrence, MS, Susan DePasquale, CGRN, MSN, FPMHNP-BC – all have no disclosures

Acknowledgement of Commercial Support:
There is no commercial support for this course.

Activity Review Information:
Reviewed by Susan DePasquale, CGRN, MSN, FPMHNP-BC

Release Date: 1/1/2015 Termination Date: 8/1/2016

Please take time to complete the self-assessment Knowledge Questions before reading the article. Opportunity to complete a self-assessment of knowledge learned will be provided at the end of the course.
1. Pharmacokinetics is the branch of pharmacology that:
   a. deals with determining the movement (kinetics) of drugs into and out of the body
   b. explains how drugs are manufactured
   c. addresses only the risks and benefits of medication
   d. answers b and c above

2. Controlled medications are divided into ______ schedules based on their potential for abuse and physical and psychological dependence.
   a. 3
   b. 4
   c. 5
   d. 7

3. A medication will have a generic name and one or more trade names. The generic name:
   a. usually signifies the medication’s chemical derivation
   b. may either be determined by the company that first developed the drug, or by the U.S. Adopted Name Council
   c. are written beginning with a lower case (small) letter
   d. all of the above

4. True or False. Anticoagulants are a class of drugs commonly used to prevent the blood from forming dangerous clots.
   a. True
   b. False

5. True or False. Neostigmine and bethanechol are examples of cholinergic blockers.
   a. True
   b. False
Introduction

Did you ever wonder how Tylenol knows to go to your head when you have a headache and to your elbow when you have "Tennis Elbow"? Or how one or two small tablets containing only 500-1000 mg of active drug can relieve a headache or ease the inflammation of a strained muscle or tendon in a 185 lb. athlete?

This course will describe the basic principles of pharmacology, pharmacokinetic processes including absorption, distribution, metabolism and excretion, as well as several drug classes and some of the commonly seen drugs within those classes.

This is an important topic as medications have a great power to both help patients (in terms of curing disease or infection, relieving symptoms such as pain or nausea) and to harm patients (in terms of allergic reactions, overdoses, adverse reactions, or administering the wrong medication to the wrong patient.) All members of the healthcare team who deal, in any way with medications, should respect the power of medications and act accordingly.

Receptors

The answer to the question in the introduction is that drugs are distributed throughout the body by the blood and other fluids of distribution. Once they arrive at the proper site of action, they act by binding to receptors, usually located on the outer membrane of cells, or on enzymes located within the cell.

Receptors are like biological "light switches" which turn on and off when stimulated by a drug, which binds to the receptor and activates it. For example, narcotic pain relievers like morphine bind to receptors in the brain that sense pain and decrease the intensity of that perception. Non-narcotic
pain relievers like aspirin, Motrin (ibuprofen) or Tylenol (acetaminophen) bind to an enzyme located in cells outside of the brain close to where the pain is localized (i.e., hand, foot, low back, but not in the brain) and decrease the formation of biologically-active substances known as prostaglandins, which cause pain and inflammation. These "peripherally-acting" (act outside of the central nervous system (CNS)) analgesics may also decrease the sensitivity of the local pain nerves causing fewer pain impulses to be sensed and transmitted to the brain for appreciation.

In some instances, a drug's site of action or "receptor" may actually be something that resides within the body, but is not anatomically a part of the body. For example, when you take an antacid like Tums or Rolaids, the site of action is the acid in the stomach that is chemically neutralized. However, if you take an over-the-counter (OTC) medication that inhibits stomach acid production instead of just neutralizing it (i.e., Tagamet (cimetidine) or Pepsid-AC (famotidine)), these compounds bind to and inhibit receptors in the stomach wall responsible for producing acid.

Another example of drugs, which bind to a receptor that is not part of your body, is antibiotics. Antibiotics bind to portions of a bacterium that is living in your body and making you sick. Most antibiotics inhibit an enzyme inside the bacteria that causes the bacteria to either stop reproducing or to die from inhibition of a vital biochemical process.

In many instances, the enzyme in the bacteria does not exist in humans, or the human form of the enzyme does not bind the inhibiting drug to the same extent that the bacterial enzyme does, thus providing what pharmacologists call "Selective Toxicity". Selective toxicity means that the drug is far more toxic to the sensitive bacteria than it is to humans thus providing sick patients with a benefit that far outweighs any risks of direct toxicity. Of
course, this does not mean that certain patients won't be allergic to certain drugs.

Penicillin is a good example of this. Although penicillin inhibits an enzyme found in sensitive bacteria which helps to "build" part of the cell wall around the outside of the bacteria, and this enzymatic process does not occur in human cells, some patients develop an allergy to penicillin (and related cephalosporin) antibiotics. This allergy is different from a direct toxicity and demonstrates that certain people's immune system become "sensitized" to some foreign drug molecules (xenobiotics), which are not generally found in the body.

As medical science has learned more about how drugs act, pharmacologists have discovered that the body is full of different types of receptors that respond to many different types of drugs. Some receptors are very selective and specific, while others lack such specificity and respond to several different types of drug molecules.

To date, receptors have been identified for the following common drugs, or neurotransmitters found in the body: narcotics (morphine), benzodiazepines (Valium, Xanax), acetylcholine* (nicotinic and muscarinic cholinergic receptors), dopamine*, serotonin* (5-hydroxytryptamine; 5-HT), epinephrine (adrenalin) and norepinephrine* (a and b adrenergic receptors), and many others.

Neurotransmitters* are chemicals released from the end of one neuron (nerve cell) which diffuse across the space between neurons called the synaptic cleft and stimulate an adjacent neuron to signal the transmission of information.
Pharmacokinetics

The next part of this course is designed to explain the complicated journey of a drug through the body, which pharmacologists call pharmacokinetics.

Pharmacokinetics is the branch of pharmacology, which deals with determining the movement (kinetics) of drugs into and out of the body. Experimentally, this is done by administering the drug to a group of volunteer subjects or patients and obtaining blood and urine specimens for subsequent quantitative (how much) analysis. When the results of these analyses are plotted on graph paper with blood levels or urinary excretion on the vertical axis and time on the horizontal axis, a blood level-time or urinary excretion pattern is obtained.

These graphs can be used to calculate the rates of appearance and elimination of the drug in the bloodstream, the rates of formation of the compounds into which the drugs are transformed in the liver (metabolized), and finally the rates of elimination or excretion of the metabolites.

There are four scientific or pharmacokinetic processes to which every drug is subject in the body:

1. Absorption
2. Distribution
3. Metabolism
4. Excretion

These four processes occur contemporaneously until, firstly, the entire drug is absorbed from the GI tract, the muscle or subcutaneous tissue site into which it was injected, and there is no more absorption phase; and, secondly,
all of the drug has been metabolized, and there is no more "parent" drug and it is no longer detectable in the blood.

**Absorption**

Absorption is the process by which a drug is made available to the fluids of distribution of the body (*i.e.*, blood, plasma, serum, aqueous humor, lymph, etc.).

In the fasting state, most orally-administered drugs reach a maximum or "peak" blood concentration within one to two hours. Intravenous (IV) administration is the most rapid route of administration, with intra-nasal, smoking (inhalation), sublingual (under the tongue), intra-muscular (IM), subcutaneous (*i.e.*, under the skin, SC or SQ), and percutaneous (through the skin) being the next most rapid.

The *rate* of absorption of orally-administered drugs and the subsequent appearance of the drug in the blood is dependent on the following factors:

1. The rates of disintegration and dissolution of the pill or capsule in the stomach or gastrointestinal (GI) tract;

2. The solubility of the drug in stomach or intestinal fluids (the more soluble, the faster);

3. The molecular charge on the drug molecule (charged substances are soluble, but don't pass through lipid (fat) soluble biologic membranes well);

4. Aqueous (water) solubility vs. lipid (fat) solubility. Water-soluble drugs are soluble but don't pass through lipid-soluble biologic membranes well;
5. The presence or absence of food in the stomach (food delays the absorption of some drugs and enhances the absorption of others);

6. The presence of any concomitant medication(s) that can interfere with gastrointestinal (GI) motility, *i.e.*, Reglan increases GI motility, Aluminum antacids slow, drugs like atropine or scopolamine used for ulcers or "queasy stomachs" slow GI motility keeping some drugs in the stomach slowing absorption, while drugs like Tagamet, Zantac and Prilosec (Pepcid-AC) decrease gastric acid production increasing the rate of gastric emptying and increasing the rate of absorption of some drugs.

**Distribution**

Once a drug has been absorbed from the stomach and/or intestines (GI Tract) into the blood, it is circulated to some degree to all areas of the body to which there is blood flow. This is the process of distribution. Organs with high blood flow, *i.e.*, brain, heart, liver, etc. are the first to accumulate drugs, while connective tissue and lesser-perfused organs are the last.

The pattern of distribution of drug molecules by different tissues after the chemical enters the circulatory system varies. Because of differences in pH, lipid content, cell membrane functions, and other individual tissue factors, most drugs are not distributed equally in all parts of the body. For example, the acidity of aspirin influences a distribution pattern that is different from that of an alkaline product such as amphetamine.

Many drugs are bound to plasma proteins such as albumin. Since only drugs that are not bound are free to exert a pharmacologic effect, the ratio of "free" to "bound" drug is important in determining the onset and duration of action of drugs. Highly bound drugs are distributed less extensively throughout the body and are slower to act. By virtue of their high binding to
plasma proteins, they also stay in the body for longer periods of time because the binding sites act as a sort of "reservoir" for the drug, releasing drug molecules slowly. One example of commonly used extended release mediation is Effexor XR (an antidepressant medication.) Most extended release mediations will have XR, ER or XL in their name.

**Metabolism**

Drugs in the blood and tissues must be inactivated and excreted from the body. This process is initiated by altering the chemical structure of the drug in such a way as to promote its excretion. The transformation of the drug molecule into a chemically related substance that is more easily excreted from the body is called metabolism, biotransformation or detoxification.

Drug metabolism is the process by which the body breaks down and converts medication into active chemical substances. Drugs can interact with other drugs, foods, and beverages. Interactions can lessen or magnify the desired therapeutic effect of a drug, or may cause unwanted or unexpected side effects. There are thousands of possible drug-to-drug and drug-to-food interactions, and many medications and supplements are contraindicated (not recommended) under certain conditions or in patients with specific diseases and disorders. This is why it is imperative that patients always keep their physician fully informed about all drugs and dietary supplements (including herbal remedies) they are taking.

The primary site of drug metabolism is the liver, the organ that plays a major role in metabolism, digestion, detoxification, and elimination of substances from the body. Enzymes in the liver are responsible for chemically changing drug components into substances known as metabolites. Metabolites are then bound to other substances for excretion through the lungs, or bodily fluids such as saliva, sweat, breast milk, and urine, or through reabsorption by the intestines. The primary mode of
excretion is through the kidneys and will be described further in the next section.

The family of liver isoenzymes known as cytochrome P-450 are crucial to drug metabolism. These enzymes (labeled CYP1A2, CYP2C9, CYP2C19, CYP2D6, and CYP3A4) have a catabolic action on substances, breaking them down into metabolites. Consequently, they also act to lower the concentration of medication in the bloodstream.

Drug interactions can occur when one drug inhibits or induces a P-450 that acts on another drug. An example is nicotine, a drug contained in tobacco, and known to induce P-450s. Individuals with liver disease (i.e., cirrhosis) may also have insufficient levels of P-450 enzymes. As a result, the concentration of drugs metabolized by these enzymes (i.e., amprenavir and other protease inhibitors) remains high and can build up to toxic levels in the bloodstream. In addition, certain medications and foods, such as grapefruit juice, can inactivate or lessen the metabolic activity of P-450s. Changing the drug dosage can alleviate the problem in some cases.

The metabolic rate can vary significantly from person to person, and drug dosages that work quickly and effectively in one individual may not work well for another. Factors such as genetics, environment, nutrition, and age also influence drug metabolism; infants and elderly patients may have a reduced capacity to metabolize certain drugs, and may require adjustments in dosage.

In the case of ethanol, the alcohol molecule is metabolized in the liver by the enzyme alcohol dehydrogenase, to acetaldehyde that causes dilatation of the blood vessels and, after accumulation, is responsible for the subsequent hangover that ensues. The acetaldehyde is subsequently metabolized by the enzyme aldehyde dehydrogenase to acetate, a substance very similar to acetic acid or vinegar.
Therapeutic agents like antibiotics and drugs used for the treatment of high blood pressure, epilepsy (i.e., phenobarbital, Dilantin), pain (i.e., morphine, codeine), anxiety (i.e., Valium, Xanax) are also metabolized to chemically-related compounds called metabolites, which are then excreted in the urine.

Drugs that commonly interact with other medications include:

- **Diuretics.** Diuretics such as hydrochlorothiazide can reduce serum potassium and sodium electrolyte levels when taken with digoxin and lithium, respectively.
- **Monoamine oxidase inhibitors (MAOIs).** MAOI antidepressants can cause convulsions and other serious side effects when used with tricyclic antidepressants (i.e., Imipramine, Nortriptyline), selective serotonin reuptake inhibitors (SSRIs), or sympathomimetic drugs (i.e., amphetamines).
- **Antibiotics.** Antibiotics may reduce the efficiency of oral contraceptives.
- **Metals.** Medications containing metals, such as antacids with aluminum additives and iron supplements, can reduce the absorption of tetracyclines and fluoroquinolones.
- **Drugs that inhibit liver enzyme function.** Drugs that slow drug metabolism include ciprofloxacin, erythromycin, fluoxetine, nefazodone, paroxetine, and ritonavir. The therapeutic effect of other medications taken with these drugs may be amplified.

Warfarin, a blood thinner, should be used with great caution in individuals taking these drugs.

Foods and beverages that may interact with drugs include:
• **Grapefruit juice:**

Grapefruit juice inhibits the metabolism of many medications, including cyclosporine, felodipine, nifedipine, nitrendipine, nisoldipine, carbamazepine, triazolam, and midazolam.

• **Foods and beverages with tyramines:**

Red wine, malted beers, smoked foods (*i.e.*, fish and meats), dried fruits, and aged cheeses may contain tyramines, and can cause a severe and dangerous elevation in blood pressure when taken with MAOI inhibitors (a class of antidepressants).

• **Dairy products:**

Milk, cream, and other dairy products containing calcium can prevent the absorption of antibiotics such as tetracycline, doxycycline, and ciprofloxacin when they are taken with the drug. In addition, whole milk with vitamin D can cause milk-alkali syndrome in patients taking aluminum hydroxide antacids.

• **Caffeinated beverages:**

The caffeine contained in coffee and colas can influence drug metabolism.

• **Alcohol:**

Alcohol is a central nervous system depressant, and should not be taken with other CNS depressants (*i.e.*, antipsychotics, antihistamines). In addition, certain fermented beverages may contain tyramines.
This list is not all-inclusive and individuals should always let their doctor and pharmacist know when they are taking other medications, herbal remedies, or dietary supplements. Anyone who experiences a serious reaction to a drug that is not consistent with its product labeling should report the event to their doctor and/or the MedWatch adverse event reporting system of the United States Food and Drug Administration (FDA).

**Excretion**

Excretion is the process by which a drug is eliminated from the body. Drugs can be excreted by various organs including the kidney and lungs, and found in many biological fluids like: bile, sweat, hair, breast milk, or tears. However, the most common fluid in which to look for drugs is the urine.

In order to determine the rate of excretion of any drug from blood, one must first be certain that the entire drug in the subject's GI tract has been absorbed. If not, calculation of a rate of excretion would be confounded by the ongoing absorption of more drug. Once the entire drug has been absorbed, this is called the post-absorbtive, or distributive stage. At this time, serial (multiple) blood level determinations should show a decline with time. The amount of time required to eliminate half of the drug from the body is called the *half-life*.

Generally, it takes six half-lives to rid the body of 98% of a drug and 10 half-lives to completely eliminate the drug from the body. Using these mathematical relationships allows pharmacologists to determine how often a therapeutic drug should be administered to a patient or toxicologists to determine a time interval within which one would test positive for drugs of abuse.
Drug Nomenclature

A medication will have a generic name and one or more trade names. The generic name usually signifies the medication’s chemical derivation. However, this may not always be the case, at times generic names are either determined by the company that first developed the drug, or a by the U.S. Adopted Name Council. Generic names are written beginning with a lower case (small) letter.

The trade name is a name chosen by a pharmaceutical company for purposes of marketing or to identify the company responsible for manufacturing the drug. The trade name may also represent some property of the drug. Trade Names usually begin with a capital letter and may be followed by a Trademark. A single drug may have many different trade names.

Examples of generic and trade names follow:

<table>
<thead>
<tr>
<th>Generic</th>
<th>Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>ibuprofen</td>
<td>Motrin®</td>
</tr>
<tr>
<td>acetaminophen</td>
<td>Tylenol®</td>
</tr>
<tr>
<td>benzoyl peroxide</td>
<td>Oxy10®</td>
</tr>
</tbody>
</table>

Drug Classifications

Drugs are classified into different groups according to their chemical characteristics, structure and how they are used to treat specific diseases.

One way to classify medications is as *controlled* versus *non-controlled*. Non-controlled medication is medication that is not considered to be a depressant or a stimulant and is not considered addictive or with a potential for abuse. Non-controlled medication may include over-the-counter medication or prescription medication.
Controlled medications are divided into five schedules based on their potential for abuse and physical and psychological dependence.

1. **Schedule I**: drugs that currently do not have accepted medical use, have a high potential for abuse, and lack accepted safety measures for use (i.e., LSD, peyote, heroin).

2. **Schedule II**: drugs that have medical use and a high potential for abuse; those that tend to cause severe dependence (i.e., morphine, secobarbital, amphetamines (Ritalin), methadone).

3. **Schedule III**: drugs used in medical practice with less potential for abuse than schedule II drugs; those that tend to cause moderate or low physical dependence or high psychological dependence (i.e., nalorphine, drug combinations containing small amounts of narcotics such as codeine).

4. **Schedule IV**: drugs that have medical use and lower potential for abuse than schedule III drugs; those that tend to cause limited physical or psychological dependence (i.e., meprobamate, chlordiazepoxide, diazepam).

5. **Schedule V**: drugs that have medical use and lower potential for abuse than schedule IV drugs; those that tend to cause less physical or psychological dependence (i.e., mixtures of limited quantities of narcotics such as cough syrups containing codeine).

Medications may be classified or categorized in a number of other ways. Medications may be classified by function or use. For example, an anti-anxiety medication is used to treat anxiety, tension and nervousness. An antidepressant treats depression by elevating the mood. Medication may also be classified by the body system that it affects. Cardiovascular drugs work on the heart and blood systems. Gastrointestinal medicines work on the stomach and intestinal tract.
Most of the medications within a classification group, like alpha-adrenergic blockers, are quite similar although they are not identical. Classification systems enable us to readily identify the similarities and differences among a large number of medications within and outside of a particular classification. One of the best and most efficient ways to master pharmacology is to become familiar with the classifications of medications and then to focus on the similarities and differences of medications within the same classification. Below are some of the commonly seen classes of medications, their actions, uses, adverse reactions and side effects, contraindications, implications, and examples of medications within that class.

**Alpha-Adrenergic Blockers**

Alpha-blockers relax certain muscles and help small blood vessels remain open. They work by keeping the hormone norepinephrine (noradrenaline) from tightening the muscles in the walls of smaller arteries and veins. Blocking that effect causes the vessels to remain open and relaxed. This improves blood flow and lowers blood pressure. Because alpha-blockers also relax other muscles throughout the body, these medications can help improve urine flow in older men with prostate problems.

| **Actions** | They bind to α-adrenergic receptors thus leading to the dilation of peripheral blood vessels, lowering of peripheral resistance and the lowering of blood pressure. |
| **Uses** | Hypertension and prevention of necrosis secondary to extravasation. |
| **Adverse Reactions & Side Effects** | Hypotension, stuffed nasal passages, tachycardia, diarrhea, nausea, and vomiting. |
| **Contraindications** | Myocardial infarction and coronary artery disease, including angina. |
| **Implications** | Potassium, Sodium, Carbon dioxide, daily weights, intake and output data as well as standing and lying blood pressures. |
| **Examples** | • dihydroergotamine mesylate  
• phentolamine mesylate |
Antacids

Antacids are taken by mouth to relieve heartburn, sour stomach, or acid indigestion. They work by neutralizing excess stomach acid. Some antacid combinations also contain simethicone, which may relieve the symptoms of excess gas. Antacids alone or in combination with simethicone may also be used to treat the symptoms of stomach or duodenal ulcers.

<table>
<thead>
<tr>
<th>Actions</th>
<th>They contain magnesium, aluminum, calcium and a combination of these compounds. They slow down the rate of gastric emptying and neutralize gastric acidity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Gastritis, peptic ulcer, hiatal hernia and reflux esophagitis.</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Constipation, diarrhea, flatus, abdominal distention, alkaluria.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Allergy and sensitivity</td>
</tr>
<tr>
<td>Implications</td>
<td>Assess epigastric pain, gastrointestinal symptoms and renal problems and electrolytes.</td>
</tr>
</tbody>
</table>
| Examples | • aluminum carbonate  
|          | • calcium carbonate |

Antianginals

An antianginal is a medication which is used to treat angina, a form of chest pain which develops when the supply of blood to the heart becomes restricted. There are a number of drugs which fit into the antianginal drug class, and they can be used in a variety of different ways. In an episode of angina, the patient experiences chest pain because the heart is not getting enough blood, and it goes into distress as a result of not receiving the supply
of oxygen it needs. Angina can take a number of different forms, and is often linked with cardiovascular disease such as coronary artery disease. The purpose of an antianginal is to either increase the supply of blood to the heart, or to decrease the heart's demand for oxygen. This classification is further divided into nitrates, calcium channel blockers and beta-adrenergic blockers.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Nitrates - dilate coronary arteries, decrease preload and afterload.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calcium channel blockers- also dilate coronary arteries, but they also decrease SA/AV node conduction</td>
</tr>
<tr>
<td></td>
<td>β-Adrenergic blockers- slow the heart rate, thus decreasing oxygen use.</td>
</tr>
<tr>
<td>Uses</td>
<td>Angina. Calcium channel blockers and β-blockers can also be used for hypertension and dysrhythmias.</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Postural hypotension, fatigue, dysrhythmias, headache, edema, dizziness.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Increased intracranial pressure, cerebral hemorrhage and sensitivity.</td>
</tr>
<tr>
<td>Implications</td>
<td>Monitor for side effects and orthostatic blood pressure. Continue to assess angina pain.</td>
</tr>
<tr>
<td>Examples</td>
<td>• propranolol</td>
</tr>
<tr>
<td></td>
<td>• verapamil hydrochloride</td>
</tr>
<tr>
<td></td>
<td>• nitroglycerine</td>
</tr>
</tbody>
</table>

**Anticholinergics**

There are two types of anticholinergics: short-acting and long-acting. The short-acting type relieves symptoms and the long-acting type helps prevent breathing problems. Short-acting anticholinergics are used for treating stable Chronic Obstructive Pulmonary Disease (COPD) in a person whose
symptoms come and go (intermittent symptoms). Long-acting anticholinergics are effective and convenient for preventing and treating COPD in a person whose symptoms do not go away. Anticholinergics relax and enlarge (dilate) the airways in the lungs, making breathing easier (bronchodilators). They may protect the airways from spasms that can suddenly cause the airway to become narrower (bronchospasm). They also may reduce the amount of mucus produced by the airways.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Inhibit acetylcholine (autonomic nervous system)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Many uses- some decrease gastrointestinal, urinary and biliary motility; others decrease gastrointestinal secretions, decrease involuntary movement, and relieve nausea, and vomiting.</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Dryness of the mouth, paralytic ileus, constipation, urinary problems (retention and hesitancy) dizziness and headache.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Gastrointestinal or urinary obstruction, narrow-angle glaucoma, and myasthenia gravis.</td>
</tr>
<tr>
<td>Implications</td>
<td>Monitor urinary and bowel function as well as vital signs. Keep the patient in bed for one hour after parenteral dose.</td>
</tr>
</tbody>
</table>
| Examples                 | • atropine sulfate  
                                 • scopolamine |

**Anticoagulants**

Anticoagulants are a class of drugs commonly used to prevent the blood from forming dangerous clots that could result in a stroke. Often called “blood thinners,” anticoagulants are often the first medication prescribed by doctors following a stroke or myocardial infarction (MI). By reducing the ability of the blood to clot — and thereby reducing the likelihood of coronary
or vascular emboli—anticoagulants are frequently used in patients who are already at high-risk for stroke or MI.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Prevent clot formation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Myocardial infarction (MI), pulmonary embolus, deep vein thrombosis, disseminated intravascular clotting syndrome (DIC), and atrial fibrillation. It is also used with dialysis.</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Hemorrhage, diarrhea, fever, rash and blood disorders (leukopenia, thrombocytopenia, etc.) depending on the specific drug.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Bleeding disorders, such as hemophilia and leukemia, ulcers, blood dyscrasias, nephritis, endocarditis and thrombocytopenia purpura.</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Observe for bleeding (oral, black stools, stool occult blood, ecchymosis, etc.). Monitor labs such as hemoglobin, hematocrit, prothrombin time (PT), international normalized ratio (INR) and partial thromboplastin time (PTT), vital signs and blood pressure as hypotension may occur).</td>
</tr>
</tbody>
</table>
| **Examples** | • warfarin sodium  
• heparin |

**Anticonvulsants**

Anticonvulsants are drugs that prevent or reduce the severity and frequency of seizures. The different types of anticonvulsants may act on different receptors in the brain and have different modes of action. This classification is further divided into barbituates, hydantoins, succinimides, benzodiazepines and others.
## Antiepileptic Drugs

### Actions
*To prevent seizures.*

### Uses
Depending on the specific drug, they prevent tonic-clonic seizures, psychomotor seizures, status epilepticus, petit mal seizures and cortical focal seizures.

### Adverse Reactions & Side Effects
Bone marrow depression, which can be life-threatening, gastrointestinal problems, Central Nervous System effects like confusion, ataxia and slurring of speech.

### Contraindications
Allergy or sensitivity

### Implications
Monitor hepatic and renal function, blood, mental status, blood dyscrasias, and toxicity (ataxia, bone marrow depression, nausea, vomiting, cardiovascular problems, Stevens-Johnson syndrome)

### Examples
- phenytoin
- diazepam

---

## Antidepressants

Antidepressants are a class of drugs that reduce symptoms of depressive disorders by correcting chemical imbalances of neurotransmitters in the brain. Chemical imbalances may be responsible for changes in mood and behavior. Antidepressants are further divided into MAOIs, tricyclics, and others.

### Actions

- **MAOIs** - inhibit MAO and thus they increase epinephrine, norepinephrine, serotonin, and dopamine.
- **Tricyclics** - block the reuptake of serotonin and norepinephrine in the nerve endings, thus increasing the actions of both in the nerve cells.

### Uses
Depression. Nocturnal enuresis in children.

### Adverse Reactions & Side Effects
Orthostatic hypotension, mouth dryness, dizziness, drowsiness, urinary retention, hypertension, renal failure and paralytic ileus.

### Contraindications
Hypertrophy of the prostate, seizure disorders, renal, hepatic and cardiac disease.
**Implications**

Monitor standing and lying blood pressure, blood, mental status, hepatic function. Observe for extrapyramidal symptoms and urinary retention. Withdrawal symptoms occur with abrupt cessation.

**Examples**

- sertraline
- amitriptyline
- bupropion
- phenelzine
- Lithium

---

**Antidiabetic Medications**

Antidiabetic drugs are developed to stabilize and control blood glucose levels amongst people with diabetes. Antidiabetic drugs are commonly used to manage diabetes. There are a number of different types of antidiabetic drug including insulins of varying kinds and oral hypoglycemic agents.

**Actions**

- Insulin- lowers blood sugar, potassium and phosphate
- Oral hypoglycemic agents- stimulate the \( \beta \) -cells of the pancreas to release insulin.

**Uses**

- Diabetes and ketoacidosis

**Adverse Reactions & Side Effects**

- Hypoglycemia, hepatotoxicity, allergic responses

**Contraindications**

- Oral agents are contraindicated for juvenile diabetes and ketoacidosis.

**Implications**

- Monitor blood glucose, assess for hypoglycemia, rotate insulin injection sites, and use human insulin with pork or beef sensitivity.

**Examples**

- insulin
- glyburide
Antidiarrheal medications

Antidiarrheal medications are used to treat sudden diarrhea (including traveler's diarrhea). They work by slowing down the movement of the gut. This decreases the number of bowel movements and makes the stool less watery. Loperamide is also used to reduce the amount of discharge in patients who have undergone an ileostomy. It is also used to treat on-going diarrhea in people with inflammatory bowel disease.

<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th>Varying. Some decrease water content of stool, some slow down gastrointestinal peristalsis.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Diarrhea</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Constipation, paralytic ileus, abdominal pain.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Colitis</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Used for short-term therapy (48 hours or less). Monitor electrolytes and bowel response.</td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>• bismuth subgallate</td>
</tr>
<tr>
<td></td>
<td>• kaolin and pectin mixtures</td>
</tr>
<tr>
<td></td>
<td>• loperamide</td>
</tr>
</tbody>
</table>

Antidysrhythmics

Antidysrhythmics are used for the treatment of cardiac dysrhythmia, which is any change from the normal heartbeat rhythm. Cardiac dysrhythmia includes not only bradycardia but also tachycardia. There are four classes of antidysrhythmic medications. Many of these medications act on the sinoatrial (SA) and atrioventricular (AV) nodes as described below.
| **Actions** | **Class I** - decreases any disparity in the refractory period, increases the duration of action potential and effective refractory period  
**Class II** - slows down the rate of SA node discharge and conduction through the AV node. Increases recovery time and decreases the heart rate, thus lowering oxygen consumption in the myocardium  
**Class III** - increases effective refractory period as well as the duration of action potential  
**Class IV** - decreases SA node discharge and slows the conduction velocity through the AV node. They also inhibit calcium movement across the cell.  
**Others** - slows conduction through the AV node (adenosine) and increases the refractory period in the AV node and decreases conduction velocity (digoxin) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Atrial and ventricular arrhythmias (atrial fibrillation, PVCs, and tachycardia), hypertension, and angina</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Hypotension, bradycardia, other arrhythmias and various other wide ranging side effects.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Various. Check each medication.</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor rate and rhythm, blood pressure, potassium, dependent edema and intake and output</td>
</tr>
</tbody>
</table>
| **Examples** | • digoxin  
• procainamide  
• quinidine  
• acebutolol |
Antifungals

Antifungal medications are used to treat fungal infections. Antifungal medicines work by either killing the fungal cells – for example, by affecting a substance in the cell wall, causing the contents of the cell to leak out and the cell to die or preventing the fungal cells from growing and reproducing.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Decreases sodium, potassium and nutrients in the cell and increases cell permeability.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Fungal infections such as cryptococcosis, aspergillosis, histoplasmosis, blastomycosis, coccidiomycosis, phycomycosis, and candidiasis</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Renal, liver damage and failure, gastroenteritis, hypokalemia, anorexia, nausea and vomiting.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Sensitivity and bone marrow depression.</td>
</tr>
<tr>
<td>Implications</td>
<td>For IV administration, use a filter, check for extravasation and protect from light (cover with foil). Monitor vital signs, intake and output, blood, weight, renal and hepatic function, hypokalemia and ototoxicity.</td>
</tr>
</tbody>
</table>
| Examples | • nystatin  
• amphotericin B |

Antihistamines

Antihistamines work well to relieve symptoms of different types of allergies, including seasonal (hay fever), indoor, and food allergies. Antihistamines come in different forms, including tablets, capsules, liquids, nasal sprays, and eye drops. Some are only available by prescription. Others can be bought over the counter (OTC).
<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th>Antagonists of histamine.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Allergies, pruritus and rhinitis.</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Most cause drowsiness, headache, urinary retention, blood dyscrasias, thickened bronchial secretions and gastrointestinal effects</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Sensitivity, asthma, peptic ulcer, narrow angle glaucoma.</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor urinary, respiratory and cardiac status. Also monitor for blood dyscrasias.</td>
</tr>
</tbody>
</table>
| **Examples** | • diphenhydramine hydrochloride  
• chlorpheniramine maleate  
• Allegra (fexofenadine)  
• Benadryl (diphenhydramine)  
• Dimetane (brompheniramine)  
• Claritin, Alavert (loratadine)  
• Tavist (clemastine)  
• Chlor-Trimeton (chlorpheniramine)  
• Zyrtec (certirizine) |

**Antihypertensives**

Medications used to treat high blood pressure are further divided into:

- angiotensin-converting enzyme (ACE) inhibitors
- b-adrenergic blockers
- calcium channel blockers
- centrally acting adrenergics
- diuretics
- peripherally acting antiadrenergics
- vasodilators
| **Actions** | Angiotensin-converting enzyme inhibitors- dilatation of the arterial and venous systems occur through the suppression of renin-angiotensin I to angiotensin II conversion  
Centrally acting adrenergics- inhibit impulses in the central nervous system and the sympathetic nervous system, decreases cardiac output, blood pressure and pulse rate  
Peripherally acting antiadrenergics- inhibit the release of norepinephrine thus decreasing sympathetic vasoconstriction  
Vasodilators- reduce blood pressure, cardiac rate and cardiac output because these medications relax and dilate the smooth muscle of the arteries  
b-Blockers, calcium channel blockers, and diuretics are discussed in another section below. |
| **Uses** | Hypertension, heart failure, angina and some dysrhythmias |
| **Adverse Reactions & Side Effects** | Hypotension, tachycardia, bradycardia, nausea, vomiting and headache. |
| **Contraindications** | Heart block, hypersensitivity |
| **Implications** | Check for edema, monitor renal function, blood and for symptoms of congestive heart failure. |
| **Examples** | - captopril  
- propranolol hydrochloride  
- reserpine  
- nitroprusside sodium |
Anti-infectives

Anti-infective medications are used to treat a wide variety of bacterial infections. They inhibit the growth of bacteria by interfering with the production of certain biochemicals necessary to sustain the bacteria's life or by interfering with the bacteria's ability to use nutrients. The body's defenses then have a much easier time eliminating the infection. When used properly, anti-infectives are usually effective. To treat an infection adequately, however, anti-infectives must be taken regularly for a specified time. If they are not taken for the prescribed period, microorganisms resistant to the medication may continue growing, and the infection could recur.

Anti-infectives are divided further into the following groups:

- penicillins
- cephalosporins
- aminoglycosides
- sulfonamides
- tetracyclines
- monobactam
- erythromycins
- quinolones
<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th>Inhibit the growth and/or replication of susceptible bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Infection</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Diarrhea, nausea, vomiting, bone marrow depression and anaphylaxis (life threatening)</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Hypersensitivity. Most people allergic to penicillins are also allergic to the cephalosporins.</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Observe bowel pattern and urinary output. Monitor renal function, blood cultures and for signs of a superinfection and bleeding.</td>
</tr>
</tbody>
</table>
| **Examples** | • penicillin  
• tetracycline |

**Antineoplastics**

Antineoplastics or Anticancer drugs are the drugs that prevent or inhibit the maturation and proliferation of neoplasms. Antineoplastic agents travel the body and destroy cancer cells. Many of the side effects associated with antineoplastic agents occur because treatment destroys the body's normal cells in addition to cancerous cells.

This classification is further divided into:

- alkylating agents
- antimetabolites
- antibiotic agents
- hormonal agents
- others
**Actions**

Alkylating agents - interfere with DNA

Antimetabolites - inhibit DNA synthesis

Antibiotic agents - inhibit RNA synthesis by delaying or inhibiting mitosis

Hormones - change the effects of androgens, estrogen, luteinizing hormone, and follicle-stimulating hormone

**Uses**

Tumors, lymphoma, leukemia and Hodgkin's disease

**Adverse Reactions & Side Effects**

Anemia, thrombocytopenia, leukopenia, nausea, vomiting, hair loss, hepatotoxicity, cardiotoxicity and hepatotoxicity

**Contraindications**

Sensitivity, liver and renal damage.

**Implications**

Monitor blood studies (complete blood count (CBC), platelet count and differential (the drug may have to be held), renal and liver function, intake and output. Observe for bleeding, jaundice, dependent edema, breaks in the skin and mucosal inflammation. Check for irritation and phlebitis with IV administration.

**Examples**

- fluorouracil
- cisplatin

**Antiparkinson Agents**

Antiparkinson drugs are medicines that relieve the symptoms of Parkinson's disease and other forms of parkinsonism. Parkinsonism is a group of disorders that share four main symptoms: tremor or trembling in the hands, arms, legs, jaw, and face; stiffness or rigidity of the arms, legs, and trunk; slowness of movement (bradykinesia); and poor balance and coordination. Parkinson's disease is the most common form of parkinsonism.
All types of parkinsonism occur when nerve cells in a particular part of the brain die or lose the ability to function. These cells normally produce a chemical called dopamine, which helps relay signals to different parts of the brain. This process is important in producing smooth, coordinated movement throughout the body. When dopamine-producing cells are lost, normal movement becomes impossible. This classification is further divided into:

- cholinergics and
- dopamine antagonists

<table>
<thead>
<tr>
<th>Actions</th>
<th>Cholinergics - block acetylcholine receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dopamine antagonists - activate dopamine receptors</td>
</tr>
<tr>
<td><strong>Uses</strong></td>
<td>Parkinson’s Disease</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Involuntary movement, insomnia, nausea, vomiting, orthostatic hypotension, dry mouth, numbness and headache</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Sensitivity and narrow angle glaucoma</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor respirations, blood pressure and changes in mental and behavioral status</td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>• levodopa</td>
</tr>
<tr>
<td></td>
<td>• entacapone</td>
</tr>
</tbody>
</table>

**Antipsychotic and Neuroleptic Agents**

The antipsychotics have the capacity to sedate, tranquilize, blunt emotional expression, attenuate aggressive and impulsive behavior, and cause disinterest in the environment and lack of initiative. Unique features of the drugs are that higher intellectual functions are left relatively intact and yet
they act to specifically ameliorate the agitation and bizarre behavior and thinking of psychotic patients. Unfortunately no antipsychotic medication currently available even approaches what an ideal drug in this group should be.

Virtually all have prominent anticholinergic side effects and produce a wide variety of dystonias and extrapyramidal symptoms. Of greater concern is the fact that these agents cause tardive dyskinesia, a seriously disabling movement disorder that is often irreversible. Nonetheless, the antipsychotics, primarily used in schizophrenia, have reduced enormously the patient populations in mental hospitals and have allowed for maintenance in the community of chronic mentally ill patients who before the advent of neuroleptics would have been lifelong residents of hospitals.

Again, this classification is subdivided. The groups are:

- phenothiazines
- thioxanthenes
- butyrophenones
- dibenzoxazepines
- dibenzodiazepines
- indolones
- other heterocyclic compounds
<table>
<thead>
<tr>
<th>Actions</th>
<th>All of these pharmacological agents block the dopamine receptors in the brain, the area that involves psychotic behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Schizophrenia, mania, paranoia, and anxiety. They are also sometimes used for unrelieved hiccups, nausea, vomiting, and pediatric behavioral problems as well as pre-operative relaxation.</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Some symptoms (extrapyramidal symptoms (EPS, dystonia, akathisia and tardive dyskinesia) can be controlled with antiparkinsonian medications. Others side effects include dry mouth, photosensitivity, agranulocytosis, hypotension, and life threatening cardiac problems and laryngospasm.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Coronary disease, severe hypertension, severe depression, bone marrow depression, blood dyscrasias, parkinsonism, cerebral arteriosclerosis, narrow angle glaucoma and children less than 12 years of age. Cautiously used with the elderly.</td>
</tr>
<tr>
<td>Implications</td>
<td>Monitor complete blood count (CBC), liver function, intake and output, blood pressure lying and standing (orthostatic hypotension), extrapyramidal symptoms (EPS) (antiparkinsonian agents should be used for this). Observe for dizziness, palpations, tachycardia, changes in affect, level of consciousness, gait and sleep patterns.</td>
</tr>
</tbody>
</table>
| Examples | • haloperidol  
• chlorpromazine  
• Lithium |

**Antituberculars**

These medications are used in the treatment and prevention of tuberculosis. Combinations are used in the treatment of active disease tuberculosis to rapidly decrease the infectious state and delay or prevent the emergence of resistant strains.
### Anti-tubercular Drugs

<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th>Decreases the replication of the offending bacillus through the inhibition of RNA or DNA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Pulmonary tuberculosis</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Anorexia, nausea, vomiting, rash, renal, hepatic and ototoxic effects, which could be severe.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Sensitivity, renal disease. Caution with hepatic disease, pregnancy and lactation</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Check renal and hepatic status and for signs of anemia.</td>
</tr>
</tbody>
</table>
| **Examples** | - isoniazid  

### Antitussives and Expectorants

These medications are used to treat cough and congestion such as with the common cold.

| **Actions** | **Antitussives** - suppression of the cough reflex  
**Expectorants** - decrease the viscosity of thick, tenacious secretions |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>The expectorants are used with a cough associated with bronchitis, tuberculosis (TB), pneumonia, cystic fibrosis and chronic obstructive pulmonary disease (COPD). Antitussives are used for nonproductive coughs.</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Dizziness, drowsiness and nausea</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Iodine sensitivity, pregnancy, lactation and hypothyroidism. Caution with the elderly and those with asthma</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor the cough and the sputum. Increase fluid intake and humidification to thin secretions.</td>
</tr>
</tbody>
</table>
| **Examples** | - guaifenesin  

- codeine |
**Antivirals**

Antivirals are used to treat infections caused by viruses. Unlike antibacterial drugs, which may cover a wide range of pathogens, antiviral agents tend to be narrow in spectrum, and have limited efficacy.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Interferes with the DNA needed for viral replication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>HIV infections, herpes (herpes simplex virus and herpes genitalis), encephalitis (herpes simplex) and varicella zoster encephomyelitis, influenza</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Nausea, vomiting, diarrhea, headache, anorexia, vaginitis, moniliasis, blood dyscrasias, renal failure and metabolic encephalopathy which could be fatal</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Immunosuppressed patients with herpes zoster and hypersensitivity. Caution with pregnancy, lactation, renal and liver disease and dehydration</td>
</tr>
<tr>
<td>Implications</td>
<td>Assess for renal and liver problems. Observe for signs of infection and allergic reactions (itching, rash, urticaria). Monitor the blood for dyscrasias.</td>
</tr>
</tbody>
</table>
| Examples | • acyclovir sodium  
• cidofovir  
• Tamiflu |

**Barbiturates**

Barbiturates are a class of drugs derived from barbituric acid that act as depressants to the central nervous system. These drugs are frequently used for medical reasons as sedatives or anesthetics.
<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th>Decreases impulse transmission to the cerebral cortex</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Epilepsy, sedation, insomnia, anesthesia, cholestasis with some medications in this classification.</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Drowsiness, nausea, blood dyscrasias and Stevens-Johnson syndrome</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Allergy, poor liver function, porphyria, pregnancy (category D). Caution with the elderly renal or hepatic disease (slowed metabolism)</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor seizure control, blood, hepatic and renal function. Observe for toxicity (insomnia, hallucinations, hypotension, pulmonary constriction; cold, clammy skin; cyanosis of lips, nausea, vomiting, delirium, weakness)</td>
</tr>
</tbody>
</table>
| **Examples**     | • phenobarbital  
                    • secobarbital |

**Benzodiazepines**

Benzodiazepines are a class of drugs primarily used for treating anxiety, but they also are effective in treating several other conditions. The exact mechanism of action of benzodiazepines is not known. All benzodiazepines affect gamma-aminobutyric acid (GABA), a neurotransmitter chemical that nerves use to communicate with one another. Since scientists believe that excessive activity of nerves in the brain may be the cause of anxiety and other psychological disorders, and GABA reduces the activity of nerves in the brain, benzodiazepines may be working by increasing the effects of GABA in the brain and spinal cord.
### Actions

Decreases anxiety by potentiating g-aminobutyric acid and other central nervous system inhibitory transmitters.

### Uses

Anxiety secondary to phobic disorders and other conditions, acute alcohol withdrawal and pre-operative relaxation.

### Adverse Reactions & Side Effects

Physical dependence and abuse, dizziness, drowsiness, orthostatic hypotension, and blurred vision.

### Contraindications

Narrow angle glaucoma, infants less than 6 months old, hypersensitivity, lactation (diazepam) and liver disease (clonazepam). Caution with the elderly as well as those with renal and/or hepatic disease.

### Implications

Monitor lying and standing blood pressure (notify MD if blood pressure drops 20 mm Hg or more), pulse, hepatic and renal function and signs of dependency. Administer with milk or food to prevent gastrointestinal symptoms.

### Examples

- Diazepam
- Clonazepam

---

**Beta-adrenergic Blockers**

Beta-blockers, also known as beta-adrenergic blocking agents, are medications that reduce blood pressure. Beta-blockers block the effects of the hormone epinephrine, also known as adrenaline. When one takes beta-blockers, the heart beats more slowly and with less force, thereby reducing blood pressure. Beta-blockers also help blood vessels open up to improve blood flow.

β-Blockers are divided into two categories:

- Selective blockers and
- Nonselective blockers.
### Actions

<table>
<thead>
<tr>
<th></th>
<th>Selective blockers- block the stimulation of b1-receptors in the cardiac smooth muscle with chronotropic and inotropic effects.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nonselective blockers- lowers blood pressure (plasma renins are reduced) without a reduction in heart rate or reflex tachycardia.</td>
</tr>
</tbody>
</table>

### Uses

|                | Hypertension, angina prophylaxis and ventricular dysrhythmias |

### Adverse Reactions & Side Effects

|                | Orthostatic hypotension, diarrhea, nausea, vomiting, bradycardia, blood dyscrasias, congestive heart failure (CHF) and bronchospasm |

### Contraindications

|                | Heart block, cardiogenic shock and congestive heart failure (CHF). Cautious use with the elderly and those patients with chronic obstructive pulmonary disease (COPD), coronary artery disease, asthma, renal disease, thyroid disease, pregnancy. |

### Implications

|                | Monitor blood pressure, intake and output, daily weights, pulse and renal function. Observe for edema and take the apical and radial pulse before administration in order to determine if significant changes have occurred. |

### Examples

- Acebutolol (Sectral)
- Atenolol (Tenormin)
- Bisoprolol (Zebeta)
- Metoprolol
- Nadolol (Corgard)
- Nebivolol (Bystolic)
- Propranolol (Inderal LA)

### Bronchodilators

Bronchodilators are medications that relax the bronchial muscles. Relaxing these muscles makes the airways larger, allowing air to pass through the lungs easier. This helps people with Chronic Obstructive Pulmonary Disease (COPD) breathe better. Many different kinds of bronchodilators are available. They can be grouped according to how long they work (called short- and
long-acting drugs) or the way in which they widen or dilate the airways (beta-agonists, anticholinergics or theophyllines). While all bronchodilators widen the airways, they work in different ways to do so. It is therefore possible to combine bronchodilators in order to achieve maximal benefit.

Many people with COPD experience constant breathing difficulty. Bronchodilators, therefore, need to be taken regularly to keep breathing under control, which is also known as \textit{maintenance medication}. Conversely, \textit{reliever medications} are used for temporary breathlessness. This classification is further subdivided into:

- anticholinergics
- α/β -adrenergic agonists
- β -adrenergic agonists
- phosphodiesterase inhibitors

<table>
<thead>
<tr>
<th>Actions</th>
<th>Anticholinergics- inhibit the interaction of acetylcholine at receptor sites on bronchial smooth muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>α/β -adrenergic agonists- increase the diameter of nasal passages and relax bronchial smooth muscle</td>
</tr>
<tr>
<td></td>
<td>β-adrenergic agonists- relax the smooth muscle of the bronchi</td>
</tr>
<tr>
<td></td>
<td>Phosphodiesterase inhibitors- increased smooth muscle relaxation in the respiratory system</td>
</tr>
<tr>
<td>Uses</td>
<td>Asthma, bronchospasm, chronic obstructive pulmonary disease (COPD), emphysema, Cheyne-Stokes respirations</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Dyspnea, bronchospasm, anxiety, tremors, throat irritation, nausea and vomiting.</td>
</tr>
</tbody>
</table>
### Contraindications

Narrow angle glaucoma, severe cardiac disease, tachydysrhythmias and sensitivity. Cautious use with hypertension, seizure disorders, pregnancy and lactation, hyperthyroidism and prostatic hypertrophy.

### Implications

Assess for a therapeutic response (absence of dyspnea and/or wheezing) and patient/family education about the use of the inhaler.

### Examples

- albuterol
- aminophylline

---

### Calcium Channel Blockers

#### Actions

Inhibits the flow of calcium ions across the cell membrane of cardiac and vascular smooth muscle, thus relaxing the coronary vascular smooth muscle, dilating the coronary arteries, slowing SA/AV node conduction, and dilating peripheral arteries.

#### Uses

Angina, hypertension, and dysrhythmias.

#### Adverse Reactions & Side Effects

Dysrhythmias, edema, fatigue, headache, and drowsiness.

#### Contraindications

Systolic blood pressure of less than 90 mm HG, Wolff-Parkinson-White syndrome, 2nd or 3rd degree heart block, sick sinus syndrome, and cardiogenic shock. Congestive heart failure (CHF) may get worse in the presence of edema. Cautious use with hepatic and renal disease.

#### Implications

Monitor blood pressure, pulse and respirations. Administer at bedtime and before meals.

#### Examples

- verapamil
- felodipine
Cardiac Glycosides

Cardiac glycosides represent a family of compounds that are derived from the foxglove plant (*Digitalis purpurea*). William Withering first described the therapeutic benefits of digitalis in 1785. Initially, digitalis was used to treat dropsy, which is an old term for edema. Subsequent investigations found that digitalis was most useful for edema that was caused by a weakened heart (*i.e.*, heart failure).

<table>
<thead>
<tr>
<th>Actions</th>
<th>Cardiac output and cardiac contractility are enhanced by making more calcium available.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Congestive heart failure (CHF) and tachycardia</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Cardiac changes, hypotension, gastrointestinal symptoms, blurred vision, yellowish-green halos and headache.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Hypersensitivity, ventricular fibrillation, ventricular tachycardia and carotid sinus syndrome. Caution among patients with imbalances of potassium, magnesium and/or calcium, acute myocardial infarction, severe respiratory disease, AV block, renal or liver disease, hypothyroid and the elderly.</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Assess vital signs, check apical rate for one full minute prior to administration (if less than 60, hold the dose and notify the physician), electrolytes (sodium, potassium, chloride and magnesium), renal and hepatic function. Monitor intake and output. For potassium level less than 3mg/dl, supplements may be ordered.</td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>• digitoxin</td>
</tr>
<tr>
<td></td>
<td>• digoxin</td>
</tr>
</tbody>
</table>

**Cholinergics**

Cholinergic drugs are any of various drugs that inhibit, enhance, or mimic the action of the neurotransmitter acetylcholine, the primary transmitter of...
nerve impulses within the parasympathetic nervous system — *i.e.*, that part of the autonomic nervous system that contracts smooth muscles, dilates blood vessels, increases bodily secretions, and slows the heart rate. Some cholinergic drugs, such as muscarine, pilocarpine, and arecoline, mimic the activity of acetylcholine in stimulating the parasympathetic nervous system. These drugs have few therapeutic uses, though one of them, nicotine, is the principal addictive ingredient in the tobacco used in cigarettes and cigars. Other cholinergic drugs, such as atropine and scopolamine, inhibit the action of acetylcholine and thus suppress all the actions of the parasympathetic nervous system. They are used therapeutically to diminish salivation and bronchial secretions during anesthesia and to dilate the pupil during ophthalmological procedures. Scopolamine is also used to treat motion sickness, an effect that depends on its ability to depress the activity of the central nervous system.

<table>
<thead>
<tr>
<th>Actions</th>
<th>These medications prevent the destruction of acetylcholine, thus increasing its concentration, which enhances impulse transmission.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Myasthenia gravis, bladder distention, urinary distention, and postoperative paralytic ileus</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Bronchospasm, laryngospasm, respiratory depression, convulsion, paralysis, respiratory arrest, nausea, vomiting and diarrhea</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Renal or intestinal obstruction. Cautious use with children, lactation, bradycardia, hypotension, seizure disorders, bronchial asthma, coronary occlusion, and hyperthyroidism</td>
</tr>
<tr>
<td>Implications</td>
<td>Monitor vital signs, intake and output. Assess for urinary retention, bradycardia, bronchospasm, hypotension, respiratory depression.</td>
</tr>
<tr>
<td>Examples</td>
<td>• neostigmine</td>
</tr>
<tr>
<td></td>
<td>• bethanechol</td>
</tr>
</tbody>
</table>
**Cholinergic Blockers**

Cholinergic blocking drugs interrupt parasympathetic nerve impulses in the central and autonomic nervous systems. These drugs are also referred to as anticholinergic drugs because they prevent acetylcholine from stimulating cholinergic receptors.

<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th>Blocks the autonomic nervous system's acetylcholine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Prevention of surgical secretions, to decrease the motility of the urinary, biliary and gastrointestinal tracts, reverses neuromuscular blockade. Some are used for parkinsonian symptoms secondary to the use of neuroleptic medications</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Constipation and dryness of the mouth.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Genitourinary or gastrointestinal obstruction, angle closure glaucoma, myasthenia gravis, and hypersensitivity. Cautious use among the elderly and with patients who have prostatic hypertrophy or tachycardia</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor urinary status and intake and output with particular attention to any dysuria, frequency or retention. The medication may be discontinued with these signs. Observe mental status and for constipation. Administer oral doses with milk or food and administer parenteral doses slowly with the person in a recumbent position to prevent postural hypotension</td>
</tr>
</tbody>
</table>
| **Examples**         | • atropine  
                        | • scopolamine |

**Corticosteroids**

Corticosteroids mimic the effects of hormones the body produces naturally in the adrenal glands, which sit on top of the kidneys. When prescribed in
doses that exceed the body's usual levels, corticosteroids suppress inflammation. This can reduce the signs and symptoms of inflammatory conditions, such as arthritis and asthma. Corticosteroids also suppress the immune system, which can help control conditions in which the immune system mistakenly attacks its own tissues. This classification is also subdivided. These groups are: glucocorticoids and mineralcorticoids.

| Actions | **Glucocorticoids** - increase capillary permeability and suppress the movement of fibroblasts and leukocytes, thereby decreasing inflammation.  

**Mineralcorticoids** - increase potassium and hydrogen excretion in the distal tubule by increasing the resorption of sodium |
|---|---|
| Uses | **Glucocorticoids** - decrease inflammation. Some are used for adrenal insufficiency, allergies and cerebral edema.  

**Mineralcorticoids** - adrenal insufficiency |
| Adverse Reactions & Side Effects | Insomnia, euphoria, behavioral changes, peptic ulcer (gastrointestinal irritation), sodium and fluid retention, hypokalemia, hyperglycemia, and carbohydrate intolerance (metabolic reactions) |
| Contraindications | Fungal infections, amebiasis, hypersensitivity, and lactation. Caution with the elderly, children and pregnant women, diabetes, seizures, peptic ulcers, glaucoma, congestive heart failure (CHF), hypertension, impaired renal function, myasthenia gravis and ulcerative colitis |
| Implications | Gastrointestinal symptoms can be prevented when the dose is given with food or milk. Monitor blood sugar, potassium, weight, intake and output, plasma cortisol levels, adrenal insufficiency and for any signs of infection. Observe for mood changes, particularly depression |
| Examples | • cortisone  

• dexamethasone  

• hydrocortisone  

• prednisone |
**Diuretics**

Diuretics help rid the body of sodium and water. They work by making the kidneys put more sodium into the urine. The sodium, in turn, takes water with it from the blood. That decreases the amount of fluid flowing through the blood vessels, which reduces pressure on the walls of the arteries.

This classification of medications is subdivided into:

- thiazides and thiazide-like diuretics
- loop diuretics
- carbonic anhydrase inhibitors
- osmotic diuretics
- potassium-sparing diuretics

<table>
<thead>
<tr>
<th>Actions</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thiazides and thiazide-like diuretics</strong>- slow resorption in the distal tubule, thus increasing the excretion of sodium and water</td>
<td>Hypertension and edema with congestive heart failure (CHF)</td>
</tr>
<tr>
<td><strong>Loop diuretics</strong>- inhibit the resorption of sodium and chloride in the loop of Henle.</td>
<td></td>
</tr>
<tr>
<td><strong>Carbonic anhydrase inhibitors</strong>- decrease the sodium-hydrogen ion exchange in the tubule, thus increasing sodium excretion</td>
<td></td>
</tr>
<tr>
<td><strong>Osmotic diuretics</strong>- decrease the absorption of sodium by increasing the osmotic pressure of glomerular filtrate</td>
<td></td>
</tr>
<tr>
<td><strong>Potassium-sparing diuretics</strong>- decrease potassium excretion by interfering with sodium resorption at the distal tubule</td>
<td></td>
</tr>
</tbody>
</table>

**Adverse Reactions & Side Effects**

Hypokalemia, hyperglycemia and hyperuricemia (mostly with thiazides), blood dyscrasias, aplastic anemia, volume depletion, and dehydration (thiazides, loop diuretics, and carbonic anhydrase inhibitors)
<table>
<thead>
<tr>
<th><strong>Contraindications</strong></th>
<th>Electrolyte imbalances (Potassium, Chloride, Sodium), anuria, dehydration. Caution among the elderly as well as in the presence of renal or hepatic disease</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implications</strong></td>
<td>A potassium supplement may be needed. Monitor electrolytes, blood sugar, and lying and standing blood pressures. Observe for signs of hypokalemia and metabolic alkalosis. The medication should be given in the morning to prevent the need for frequent nocturnal voiding.</td>
</tr>
</tbody>
</table>
| **Examples**          | • furosemide  
• hydrochlorothiazide |

**Histamine H2 Antagonists**

H2-blockers work by decreasing the amount of acid produced by the stomach and are available both over-the-counter (OTC) and with a medical provider's prescription.

<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th>Inhibits histamine in the parietal cells, thereby inhibiting the secretion of gastric acid secretion.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Gastric and duodenal ulcers, gastroesophageal reflux disease</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Thrombocytopenia, neutropenia agranulocytosis, aplastic anemia, confusion (not ranitidine), diarrhea and headache.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Hypersensitivity. Cautious use with children less than 16 years of age, hepatic or renal disease, organic brain syndrome, lactation and pregnancy.</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor intake and output, creatinine, blood urea nitrogen (BUN) and gastric pH. The pH should be maintained above 5. Give slowly IV over 30 minutes to avoid bradycardia and administer oral doses with meals to prolong the effect of the medication</td>
</tr>
</tbody>
</table>
| **Examples** | • cimetidine  
• ranitidine |
**Immunosuppressants**

Immunosuppressant drugs, also called anti-rejection drugs, are used to prevent the body from rejecting a transplanted organ.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Inhibits lymphocytes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Prevention of organ transplant rejection</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Proteinuria, renal failure, albuminuria, hematuria, hepatotoxicity, oral Candida, gum hyperplasia, headache and tremors</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Hypersensitivity. Caution with severe hepatic or renal disease and pregnancy</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor liver and kidney function, and drug blood levels. Observe for signs of hepatotoxicity, which can include itching, light colored stools, jaundice and dark urine. Administer with meals to avoid gastrointestinal symptoms</td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>• cyclosporine</td>
</tr>
<tr>
<td></td>
<td>• azathioprine</td>
</tr>
</tbody>
</table>

**Laxatives**

Laxatives are used to treat and prevent constipation.

This group is also subdivided as below:

- bulk products
- lubricants
- osmotics
- saline laxative stimulants
- stool softeners
| Actions            | Bulk laxatives - absorb water thus adding bulk to the stool  
|                   | Lubricants- increase water retention in the stool  
|                   | Stimulants- speed up peristalsis  
|                   | Saline laxatives- pull water into the intestines  
|                   | Osmotics- enhance peristalsis and increase distention  
|                   | Stool softeners- reduce the surface tension of liquids within the bowel.  
| Uses              | Constipation, as a bowel prep and a stool softener  
| Adverse Reactions & Side Effects | Cramping, diarrhea, and nausea  
| Contraindications | Megacolon, abdominal pain, nausea, vomiting, impaction, gastrointestinal obstruction or perforation, gastric retention and colitis. Caution with large hemorrhoids and rectal bleeding  
| Implications      | Monitor blood, intake and output, and urine electrolytes. Administer only with water to enhance absorption. Do not administer within one hour of taking an antacid, cimetidine or drinking milk.  
| Examples          | • psyllium  
|                   | • docusate sodium  
|                   | • magnesium hydroxide  
|                   | • mineral oil  
|                   | • bisacodyl  

**Neuromuscular Blocking Agents**

Neuromuscular blocking agents bind to acetylcholine receptors post-synaptically and inhibit the action of acetylcholine. This blocks neuromuscular transmission and causes paralysis of the muscle. Neuromuscular blocking agents are used as an adjunct to anesthesia, only
when artificial ventilation is available, to produce muscle relaxation in order to prevent movement of muscle during surgery or for certain critically ill patients.

This classification is divided into:

- depolarizing blockers and
- nondepolarizing blockers

<table>
<thead>
<tr>
<th>Actions</th>
<th>Inhibition of nerve impulse transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>The facilitation of endotracheal intubation and skeletal muscle relaxation (surgery, general anesthesia and mechanical ventilation)</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Apnea, respiratory depression, bronchospasm, and bradycardia</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Hypersensitivity. Cautious use with collagen, thyroid and cardiac disease, lactation, pregnancy, children less than two years of age, dehydration, electrolyte imbalances, and myasthenia gravis</td>
</tr>
<tr>
<td>Implications</td>
<td>Monitor potassium and magnesium (imbalance may increase the action of this medication), vital signs every 15 minutes until recovery, and intake and output. IV doses must be given over 1 to 2 minutes by a person qualified and competent to do so (usually an anesthesiologist)</td>
</tr>
</tbody>
</table>
| Examples         | • gallamine  
                      • pancuronium |
**Nonsteroidal Anti-inflammatories**

Nonsteroidal anti-inflammatory drugs (NSAIDs) work by reducing the production of prostaglandins. Prostaglandins are chemicals that promote inflammation, pain, and fever. They also protect the lining of the stomach and intestines from the damaging effects of acid, and promote blood clotting by activating blood platelets. Prostaglandins also affect kidney function.

The enzymes that produce prostaglandins are called cyclooxygenase (COX). There are two types of COX enzymes, COX-1 and COX-2. Both enzymes produce prostaglandins that promote inflammation, pain, and fever; however, only COX-1 produces prostaglandins that activate platelets and protect the stomach and intestinal lining. NSAIDs block COX enzymes and reduce production of prostaglandins. Therefore, inflammation, pain, and fever are reduced. Since the prostaglandins that protect the stomach and promote blood clotting also are reduced, NSAIDs can cause ulcers in the stomach and intestines, and increase the risk of bleeding.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Decreases prostaglandin synthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Mild to moderate pain, arthritis and dysmenorrhea</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Blood dyscrasias, nephrotoxicity (oliguria, azotemia, hematuria and dysuria), abdominal pain, cholestatic hepatitis, anorexia, dizziness and drowsiness.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Asthma, severe liver and/or renal disease, hypersensitivity. Cautious use with the elderly, children, lactation, pregnancy and for patients with GI, cardiac and/or bleeding disorders.</td>
</tr>
<tr>
<td>Implications</td>
<td>Monitor blood, renal and hepatic function. Baseline hearing and eye exams are recommended so that changes can be identified. Toxicity may be signaled with tinnitus and/or blurred vision.</td>
</tr>
</tbody>
</table>
| Examples              | • ibuprofen  
                         • naproxen |
Opioid Analgesics

Opioid drugs bind with the opioid receptors in the central nervous system to block the perception of pain or affect the emotional response to pain, including opium and its derivatives.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Depression of the pain impulse transmission at the level of the spinal cord</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Moderate to severe pain</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Gastrointestinal (constipation, nausea, vomiting, anorexia, cramps), sedation, respiratory depression, circulatory depression and increased intracranial pressure</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Upper airway obstruction, bronchial asthma, hypersensitivity, addiction. Cautious use with renal, hepatic, respiratory and heart disease.</td>
</tr>
<tr>
<td>Implications</td>
<td>Monitor respiratory, urinary and mental status, level of consciousness. An antiemetic can be used for nausea and vomiting. Continue to assess level of pain</td>
</tr>
<tr>
<td>Examples</td>
<td>• codeine</td>
</tr>
<tr>
<td></td>
<td>• fentanyl</td>
</tr>
<tr>
<td></td>
<td>• morphine</td>
</tr>
<tr>
<td></td>
<td>• oxycodone</td>
</tr>
</tbody>
</table>

Salicylates

Salicylates may be used to lessen the chance of heart attack, stroke, or other problems that may occur when a blood vessel is blocked by blood clots. These medications help prevent dangerous blood clots from forming. However, this effect may increase the chance of serious bleeding in some people. Therefore, these drugs should be used for this purpose only when a
doctor decides, after studying the patient’s medical condition and history, that the danger of blood clots is greater than the risk of bleeding.

<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th>Antipyretic (inhibits the heat regulation center in the hypothalamus), anti-inflammatory (inhibits prostaglandin), analgesic (inhibits prostaglandin)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
<td>Mild to moderate pain, inflammation (arthritis), fever, and thromboembolic disorders</td>
</tr>
<tr>
<td><strong>Adverse Reactions &amp; Side Effects</strong></td>
<td>Rash, gastrointestinal symptoms, hepatotoxicity, blood dyscrasias, hearing problems and tinnitus (a sign of possible toxicity)</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Frequently occurring hypersensitivity. Contraindicated with a vitamin K deficiency, gastrointestinal bleeding, a bleeding disorder, children with Reye's syndrome. Caution with Hodgkin's disease, hepatic and renal failure, anemia</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Monitor renal and hepatic function, blood. Observe for signs of hepatotoxicity (clay colored stool, dark urine, diarrhea, yellow sclera and skin, itching, fever, abdominal pain) and ototoxicity (ringing or roaring in the ears, tinnitus)</td>
</tr>
</tbody>
</table>
| **Examples** | • aspirin  
• salsalate |

**Thrombolytics**

Thrombolytics are used to treat some people who are having a heart attack or stroke. They are typically given in a vein (intravenously, or IV). These drugs dissolve or break up blood clots that are blocking blood flow through an artery.
| **Actions** | These medications convert plasminogen into plasmin which is able to break down the fibrin of clots |
| **Uses** | Pulmonary emboli, deep vein and arterial thrombosis, with or after myocardial infarction (MI), arteriovenous cannula occlusion |
| **Adverse Reactions & Side Effects** | Anaphylaxis, gastrointestinal, genitourinary, intracranial retroperitoneal bleeding, and anaphylaxis. The most common side effects are decreased Hematocrit, urticaria, headache, and nausea. |
| **Contraindications** | Hypersensitivity, people with central nervous system neoplasms, bleeding, renal or hepatic disease, hypertension, chronic obstructive pulmonary disease (COPD), subacute bacterial endocarditis, rheumatic valvular disease, cerebral embolism or thrombosis or hemorrhage, and recent surgery |
| **Implications** | Monitor vital signs and neurological signs every 4 hours, be alert for internal bleeding (temperature of more than 104 degrees), arrhythmias, retroperitoneal bleeding (leg weakness, back pain, and poor pulses), allergic responses (rash, fever, itching, chill), ecchymosis, hematuria, hematemesis, epistaxis. Monitor blood before and during therapy. Thrombolytics are not effective if the thrombi are more than one week old. Use 0.8 mm filter with IV administration |
| **Examples** | • streptokinase  
• urokinase |

**Thyroid Medications**

Thyroid drugs are thyroid hormones used to treat hypothyroidism. They are used to supplement the natural thyroid hormones in the body. Thyroid drugs are used in treatment of low thyroid activity, treating or suppressing different types of goiters and for diagnosing certain thyroid conditions.
### Actions
Increase metabolism cardiac output, blood volume, oxygen consumption, and respiratory rate

### Uses
Thyroid replacement

### Adverse Reactions & Side Effects
Palpitations, tachycardia, insomnia, tremors, angina, weight loss, dysrhythmias, thyroid storm.

### Contraindications
Myocardial infarction (MI), adrenal insufficiency and thyrotoxicosis. Cautious use with the elderly, pregnant and lactating women, and for patients with diabetes, hypertension, angina, and cardiac disease.

### Implications
Administer at the same time of day. Check the blood pressure before each dose. Monitor intake and output, weight, cardiac status and for irritability, excitability and nervousness.

### Examples
- thyroid
- levothyroxin

## Vasodilators

Vasodilators are agents that widen the blood vessels therefore cause a decrease in vascular resistance and an increase in blood flow. They may act by activation of the vasomotor center in the brain, which brings about relaxation of the smooth muscle in the blood vessel walls or they can act locally on blood vessel smooth muscle cells.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Various modes for each. Check a drug reference book for specifics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Hypertension, angina, intermittent claudication, vasospasm, arteriosclerosis</td>
</tr>
<tr>
<td>Adverse Reactions &amp; Side Effects</td>
<td>Both hypotension and hypertension, changes in EKG, nausea, headache</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Tachycardia, acute myocardial infarction and thyrotoxicosis. Cautious use with peptic ulcer and uncompensated heart disease</td>
</tr>
</tbody>
</table>
### Summary

The topic of pharmacology is an important one for all involved in the field of healthcare. Medications have great power both to help and to harm patients. Having an understanding of the basics of pharmacology will allow clinicians to better serve their patients.

This course has described the basic principles of pharmacology, pharmacokinetic processes including absorption, distribution, metabolism and excretion, as well as several drug classes and some of the commonly seen drugs within those classes.

---

**Implications**

Administer with meals to reduce any gastrointestinal symptoms. Check bleeding times and cardiac status.

**Examples**

- amyl nitrate
- hydralazine

---

Please take time to help the NURSECE4LESS.COM course planners evaluate nursing knowledge needs met following completion of this course by completing the self-assessment Knowledge Questions after reading the article. Correct Answers, page 59.
1. **Pharmacokinetics is the branch of pharmacology that:**
   a. deals with determining the movement (kinetics) of drugs into and out of the body
   b. explains how drugs are manufactured
   c. addresses only the risks and benefits of medication
   d. answers b and c above

2. **Controlled medications are divided into _______ schedules based on their potential for abuse and physical and psychological dependence.**
   a. 3
   b. 4
   c. 5
   d. 7

3. **A medication will have a generic name and one or more trade names. The generic name:**
   a. usually signifies the medication’s chemical derivation
   b. may either be determined by the company that first developed the drug, or a by the U.S. Adopted Name Council
   c. are written beginning with a lower case (small) letter
   d. all of the above

4. **True or False. Anticoagulants are a class of drugs commonly used to prevent the blood from forming dangerous clots.**
   a. True
   b. False

5. **True or False. Neostigmine and bethanechol are examples of cholinergic blockers.**
   a. True
   b. False
Correct Answers:

1. a
2. c
3. d
4. a
5. b

References:

   *MEDICINE*, 36(7), 339-343.


   Pleasantville, N.Y: Reader's Digest Association.


The information presented in this course is intended solely for the use of healthcare professionals taking this course, for credit, from NurseCe4Less.com. The information is designed to assist healthcare professionals, including nurses, in addressing issues associated with healthcare.

The information provided in this course is general in nature, and is not designed to address any specific situation. This publication in no way absolves facilities of their responsibility for the appropriate orientation of healthcare professionals.

Hospitals or other organizations using this publication as a part of their own orientation processes should review the contents of this publication to ensure accuracy and compliance before using this publication. Hospitals and facilities that use this publication agree to defend and indemnify, and shall hold NurseCe4Less.com, including its parent(s), subsidiaries, affiliates, officers/directors, and employees from liability resulting from the use of this publication.

The contents of this publication may not be reproduced without written permission from NurseCe4Less.com.