Lesson: Pharmacologic Classes
INTRODUCTION

Several different classification systems have been developed to identify what kind of drug is used on a patient. These systems have been created for a number of reasons—from the need for a uniform way of classifying drugs to cost effectiveness. It’s vitally important that you familiarize yourself with these classification systems to succeed as a pharmacy technician.

OBJECTIVES

After completing this lesson, you’ll be able to

- Distinguish among systems of drug classification
- Explain the tier system used to classify drugs
- Identify several methods used to identify drugs
**HISTORY AND OVERVIEW OF CLASSIFICATION SYSTEMS**

The World Health Organization (WHO) is the international standard-setting organization that developed the Anatomical-Therapeutic-Chemical (ATC) system in 1976 to better calculate the consumption and utilization of drugs in all WHO-member countries. It’s widely used in Europe and some North American countries.

Other drug-information systems have also been developed. In the United States, the Veterans Administration has produced the VA Medication Classification System. Additionally, the Physicians’ Desk Reference (now PDR.net), the American Hospital Formulary System (AHFS) and Drugs.com all provide relevant drug-classification systems.

This lesson will focus on a synthesis of all of these systems but will especially concentrate on the following five classification systems:

1. Anatomical
2. Therapeutic
3. Pharmacologic
4. Chemical
5. The United States Adopted Name (USAN) Council stems for generic names

The great majority of drugs prescribed in the United States (greater than 80%) falls into four anatomical groups: 1) alimentary tract, 2) nervous system, 3) cardiovascular system, and 4) anti-infectives. These classification systems arose for the following reasons:

- To provide international standardization (Figure 30)
- To assist in drug utilization reviews
- To study cost effectiveness
- To populate drug catalogs
- To help organize the study of drugs
FIGURE 30—One of the reasons that international drug classification systems arose was to provide international standardization of drug categories.

WORLD HEALTH ORGANIZATION (WHO) ANATOMICAL-THERAPEUTIC-CHEMICAL (ATC) MAIN GROUPS

Each of the divisions that follow has several organs and therapeutic areas of treatment associated with it. Each division is also broken down into component physiologic areas with pharmacologic classes of treatment within each area.

A good flashcard series for therapeutic class may be found at https://quizlet.com/46105845/therapeutic-classification-flash-cards/. It will be helpful to learn the therapeutic areas listed:

- Alimentary tract and metabolism
- Blood and blood-forming organs
- Cardiovascular system
- Dermatologicals
- Genitourinary system and sex hormones
• Systemic hormonal preparations, excluding sex hormones and insulins
• Anti-infectives for systemic use
• Antineoplastic and immune-modulating agents
• Musculoskeletal system
• Nervous system
• Antiparasitic products, insecticides, and repellents
• Respiratory system
• Sensory organs
• Various

What follows is tier-system presentation for the alimentary and cardiovascular classes of drugs as an illustration of how drugs may be classified.

**Alimentary Tract and Metabolism**

The alimentary canal is also known as the gastrointestinal (GI) tract (Figure 31). It extends from the mouth to the anus and is made up of the following major anatomic divisions:
FIGURE 31—The alimentary canal, or gastrointestinal tract, extends from the mouth to the anus.

- Esophagus
- Stomach
- Gall bladder
- Pancreas
- Small intestines
- Large intestines
- Rectum
- Anus

Within each of these areas are common conditions that have become therapeutic areas of treatment. Pharmacologic classes of drugs have been developed to treat
the disease or condition. The anatomic area, pharmacologic class of drugs, and example drugs are given. USAN stems are also provided.

**Esophagus**

1. Acid reflux/heartburn/gastro-esophageal reflux disease (GERD)
   a. Proton pump inhibitors (USAN stem -prazole)
      • (Nexium®/esomeprazole)
      • (Dexilant®/dexlansoprazole)
      • (Prevacid®/lansoprazole)
      • (Prilosec®/omeprazole)
      • (Protonix®/pantoprazole)
      • (Aciphex®/rabeprazole)
   b. H2-blockers (USAN stem -tidine)
      • (Pepcid®/famotidine)
      • (Tagamet®/cimetidine)
      • (Zantac®/ranitidine)
      • (Axid®/nizatidine)

**Stomach**

1. Dyspepsia/indigestion/belching
   a. Acid reducers mentioned above
   b. Antacids (Tums®/Maalox®/Mylanta®)

2. Nausea and vomiting
   a. Pepto-Bismol®/bismuth subsalicylate
   b. Antivert®/meclizine
   c. Bonine®/meclizine
   d. Dramamine®/dimenhydrinate
   e. Compazine®/prochlorperazine
   f. Phenergan®/promethazine
   g. Tigan®/trimethobenzamide
   h. Transderm-Scop®/scopolamine
i. Vistaril®/hydroxyzine
j. Zofran®/odansetron (USAN stem -setron)

3. Peptic ulcer disease
   a. Acid reducers mentioned under GERD

**Gallbladder**

1. Gallstones
2. Bile enzyme disorders
   a. Urso®/Ursodeoxycholic acid

**Pancreas**

1. Exocrine/digestive functions
   a. Creon®/amylase-lipase-pancrelipase-protease

**Small Intestines**

1. Constipation
   a. Laxatives
      1) Osmotic laxative
         • Miralax®/PEG 3350 powder
         • Go-Lytely®/PEG electrolyte solution
         • Colyte®/PEG electrolyte solution
         • Milk of Magnesia®
      2) Bulk laxatives
         • Benefiber®
         • Citrucel®
         • FiberCon®
         • Metamucil®
      3) Stimulant laxatives
         • Dulcolax®/bisacodyl
         • Senokot®
         • ExLax®
4) Stool softeners
   - Colace®
   - Surfak®

2. Diarrhea
   - PeptoBismol® and Kaopectate®/bismuth subsalicylate
   - Imodium®/loperamide
   - Lomotil®/diphenoxylate and atropine
   - Linzess®/linaclotide (USAN stem -tide)

3. Crohn's disease
   a. Aminosalicylates
      - Sulfasalazine
      - Mesalamine
      - Olsalazine
      - Balsalazide
   b. Steroids
      - Prednisone
      - Medrol®/methylprednisolone
      - Entocort EC® and Uceris®/budesonide
   c. Immune suppressants
      - Imuran®/azathioprine
      - Purinethiol®/mecaptopurine
      - Rheumatrex®/methotrexate
   d. Biologics
      - Remicade®/infliximab
      - Humira®/adalimumab
      - Cimzia®/certolizumab
      - Tysabri®/natalizumab
      - Entyvio®/vedolizumab
      - Stelara®/ustekinumab (Figure 32)
**FIGURE 32**—Aminosalicylates, prednisone, immune suppressants, and biologics are used to treat Chron’s disease, which is a chronic inflammatory bowel disease that affects the lining of the digestive tract and causes abdominal cramping.

**Large Intestines**

1. Irritable bowel syndrome (IBS)
   - Lotronex®/alosetron (USAN stem -setron)
   - Amitiza®/ lubiprostone (USAN stem -prost-)
     a. Bulk laxatives (See under *Constipation.*)
     b. Anti-diarrheals (See under *Diarrhea.*)
     c. Antispasmodics
       - Levsin®/hyoscyamine
       - Bentyl®/dicyclomine
     d. Antidepressants
       - Tofranil®/imipramine
       - Pamelor®/nortriptyline
       - Prozac®/fluoxetine (USAN stem -oxetine)
       - Paxil®/paroxetine (USAN stem -oxetine)

2. Ulcerative colitis (See treatments for Crohn’s under *Small Intestines.*)

3. Crohn’s disease (Crohn’s affects both small and large intestines. See treatments for Crohn’s under *Small Intestines.*)
Cardiovascular System

The cardiovascular system is made up of the heart, veins, arteries, and capillaries—which circulate blood throughout the body. The following therapeutic classes of cardiovascular drugs is provided for each anatomical area (Figure 33).

Heart

1. Antianginal: Used to treat cardiac related chest pain (angina) resulting from ischemic heart disease—which is an inadequate supply of blood to the heart caused by partial or total blockage of an artery. Patients suffer a lack of oxygen and blood flow to the myocardium.

2. Beta-blockers: Slow heart rate, lowers blood pressure, and creates less oxygen demand by heart muscle
   - Atenolol (Tenormin®)
   - Bisoprolol (Zebeta®)

FIGURE 33—A variety of medications have been created, patented, and registered to treat disorders in the cardiovascular system—which is composed of the heart, veins, arteries, and capillaries.
3. **Vasodilators**: Relax venous smooth muscle and open diameter of blood vessels
   - Isosorbide dinitrate (Isordil®)
   - Nitroglycerin (Nitrostat®) (Figure 34)

   ![Figure 34](image)

   **FIGURE 34**—Nitroglycerin is a vasodilator used to treat chest pain.

4. **Calcium channel blockers**: Reduce the flow of calcium into cardiac cells, therefore, reducing strength of heart contraction. Reduces oxygen demand by heart.
   - Verapamil (Calan®, Verelan®)
   - Amlodipine (Norvasc®)
   - Diltiazem (Cardizem®)
   - Felodipine (Plendil®)
   - Nifedipine (Procardia®) (USAN stem -dipine)

5. **Antiarrhythmics**: Used to treat irregular heart rhythms. They regulate the conduction activity of the heart by inhibiting the abnormal pacemaker cells or recurring abnormal impulses and restoring a normal rhythm.
Veins, Arteries, and Capillaries

1. **Membrane-stabilizing agents**: Slow the movement of sodium ions along the heart cells. Dampen out potential abnormal rhythms and heartbeats.
   - Disopyramide (Norpace®)
   - Flecainide (Tambocor®)
   - Mexiletine (Mexitil®)
   - Procainamide (Pronestyl®)
   - Propafenone (Rythmol®)

2. **Beta-blockers** (See Beta-blockers under Heart.)

3. **Potassium channel blockers**
   - Amiodarone (Cordarone®)

4. **Digoxin**: Slows heart rate

5. **Calcium channel blockers** (See Beta-blockers under Heart.)

6. **Antihypertensives**: Used to reduce a sustained elevation in blood pressure. Factors affecting blood pressure include stress, blood volume, arterial narrowing, age, gender, and general condition of health.

7. **Antihyperlipidemics**: Used to lower high levels of cholesterol that can lead to blocked blood vessels. Cholesterol is a fat normally present in the body that’s essential for healthy cell function. Cholesterol levels are measured as total cholesterol, LDL (low-density lipoprotein), and HDL (high-density lipoprotein). Excessive amounts of LDL can lead to blocked blood vessels and cardiovascular problems. HMG-CoA reductase inhibitors (statins) are used to treat high LDL levels.

**CHEMICAL CLASSES**

A drug usually belongs to one or more drug classes. A *drug class* is a group of drugs that have something structural in common. They’re similar in some way, but they aren’t identical.

Drugs are placed in classes because drugs are related by their chemical structure. For example, aspirin is a salicylate. Its full chemical name is *acetylSalicylic acid*, or ASA. A *salicylate* is a chemical found in plants, for example, in willow tree bark and the meadowsweet plant. There have been many other drugs developed that have a chemical structure similar to aspirin, and they’re also called salicylates.
Some common chemical groupings of drugs include these:

- **Opiates**: Analgesic drugs that were derived from the opium poppy and based on morphine as the chemical template (Figure 35)
- **Benzodiazepines**: Tranquilizer/sedative drugs that were developed based on the 1,4-benzodiazepine chemical structure
- **Barbiturates**: Hypnotic drugs designed based on the barbituric acid chemical structure
- **Phenothiazines**: Tranquilizer drugs based on the dibenzo-1,4-thiazine chemical structure
- **Steroids**: Anti-inflammatory drugs based on the sterane chemical structure
- **Thiazides**: Diuretic drugs based on the 1,2,4-benzothiadiazine chemical structure
- **Bisphosphonates**: Osteoporosis drugs related to diphosphonic esters
- **Quinolones**: Antibiotic compounds using 4-keto-1-benzopiperidine (known chemically as quinolone) as the basic structure
- **Sulfonamides**: Antibiotic compounds that are based on amides of para-aminosulfonic acid
- **Thiazolidinediones**: Antidiabetic agents that are modeled after 1,3-thiazolidine-2,4-dione chemical structure
FIGURE 35—Opiates are analgesic drugs derived from the opium poppy and based on morphine as the chemical template.

This list of chemical classes isn’t exhaustive but is designed to illustrate how some types of drug classification arise. While you’re not expected to become a chemist, you should recognize that some types of drug classification are based on an original chemical structure that has had many modifications made to it so that pharmaceutical companies can compete with the originator.

UNITED STATES ADOPTED NAMES (USAN)

Drugs are classified by their United States Adopted Names (USAN).

USAN Council

The United States Adopted Names (USAN) Council serves health professions of the United States by selecting simple, informative, and unique nonproprietary (generic) names for drugs by establishing logical nomenclature (naming)
classifications based on pharmacological and/or chemical relationships. The USAN Council is comprised of five members, one from each of the sponsoring organizations: American Medical Association (AMA), American Pharmaceutical Association (APhA), and United States Pharmacopeia (USP). It also includes one member from the Food and Drug Administration (FDA) and one member-at-large. One member is nominated to the USAN Council annually by each sponsoring organization. The FDA nominates one liaison member annually, and the member-at-large is selected by the sponsoring organizations from a list of candidates proposed by the AMA, APhA, and the USP.

**USAN Stems**

A great deal of information may be obtained from the USAN stem syllables and the following is a partial list of USAN stems and their meanings.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Meaning</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>-afil</td>
<td>PDE5 inhibitors used to treat erectile dysfunction</td>
<td>Sildenafil (Viagra®), tadalafil (Cialis®)</td>
</tr>
<tr>
<td>-olol</td>
<td>beta-blockers for treating high blood pressure</td>
<td>Atenolol (Tenormin®)</td>
</tr>
<tr>
<td>-azepam</td>
<td>anti-anxiety agents</td>
<td>Lorazepam (Ativan®)</td>
</tr>
<tr>
<td>-caine</td>
<td>local anesthetic</td>
<td>Benzocaine (Americaine®)</td>
</tr>
<tr>
<td>-cef or -ceph</td>
<td>cephalosporin class of antibiotic</td>
<td>Cephalexin (Keflex®)</td>
</tr>
<tr>
<td>-pine</td>
<td>calcium channel blocker for heart and blood pressure</td>
<td>Nifedipine (Procardia®)</td>
</tr>
<tr>
<td>-pril</td>
<td>angiotensin-converting-enzyme (ACE) antihypertensive</td>
<td>Enalapril (Vasotec®)</td>
</tr>
<tr>
<td>-statin</td>
<td>cholesterol-lowering agent (Figure 36)</td>
<td>Rosuvastatin (Crestor®)</td>
</tr>
<tr>
<td>-prazole</td>
<td>anti-ulcer agent</td>
<td>Esomeprazole (Nexium®)</td>
</tr>
<tr>
<td>-glitazone</td>
<td>sugar-lowering agent</td>
<td>Pioglitazone (Actos®)</td>
</tr>
<tr>
<td>-mab</td>
<td>monoclonal antibodies</td>
<td>Adalimumab (Humira®)</td>
</tr>
<tr>
<td>-oxetine</td>
<td>Antidepressant</td>
<td>Paroxetine (Paxil®)</td>
</tr>
<tr>
<td>-tidine</td>
<td>H2 receptor antagonist for heartburn</td>
<td>Cimetidine (Tagamet®)</td>
</tr>
<tr>
<td>-vir</td>
<td>Antivirals</td>
<td>Acyclovir (Zovirax®)</td>
</tr>
</tbody>
</table>
FIGURE 36—A build-up of cholesterol can block veins and arteries. Statin drugs lower cholesterol.

There are a great many USAN stems, and it’s important to know that a generic name has special meaning. Trying to learn some stems will improve your ability to recall what class a drug is in.

WIN (What’s Important Now!)

The USAN Council has provided thousands of nonproprietary (generic) names over the past 50 years. In 2015, they provided 115 names, and the new drug pipeline continues to grow.
CHECK YOUR LEARNING 3

Go to http://www.drugs.com/drug-classes.html and click on the drug classes in the following list. From each of the drug classes, write down the trade name and generic name of each agent listed in the category. Don't send your answers to the school.

Angiotensin-converting-enzyme (ACE) inhibitors

Benzodiazepines

Bisphosphonates

Cardioselective beta-blockers

Group III anti-arrythmics

Proton pump inhibitors

Peripheral vasodilators

Sulfonylureas

Check your answers with those found at the end of this learning guide. If you are accessing this lesson online, click on Check Your Learning Answers in the left-hand menu of this lesson group.
Now that you’ve completed this part of your program, it’s time to take the Achievement Exam.

First, log on to the student portal. Once you log on,

• Click Courses
• Click on More Sites and select this course
• Select Exams and Quizzes from the left navigation bar
• Select the following exam from the list shown:
  ➢ Dosage Forms and Routes of Administration/Pharmacologic Classes

Good luck with your exam!