Basic Pharmacology
Unit 2
Chapter 4
Routes of Administration and the Drug Cycle
Learning Objectives

- Name 11 routes of drug administration
- Describe the advantages and disadvantages of oral administration of a drug.
- Describe the differences between an intradermal, subcutaneous, and intramuscular injection.
- Recognize and define Latin abbreviations for topical administration.
- Define the role of plasma proteins and the blood-brain barrier in distribution of a drug.
- Describe how the liver metabolizes drugs.
Learning Objectives

- Describe how the kidney’s excrete drugs.
- Describe how drug dosages are adjusted for patients with liver or kidney disease or elderly patients or premature infants.
- Define these words and phrases: *buccal route*, *parenteral*, *pharmacokinetics*, *receptor*, and *sublingual route*. 
Routes of Administration

Enteral or gastrointestinal (GI) tract
- Oral (PO)
- Nasogastric tube (NG)
- Rectal (R)

Parenteral route by which a drug is administered (by means other than through the digestive tract)
- Sublingual (SL)
- Intravenous (IV)
- Intramuscular (IM)
- Subcutaneous (SC)
- Intradermal (ID)
- Topical
- Dermal and mucosal
- Inhalation
Routes of Administration

- Disadvantages of oral route
  - difficult for some patients to swallow
  - cannot be used in unconscious patients
  - cannot be used in patients who are vomiting
  - some drugs are inactivated by stomach acid
  - some drugs are metabolized to quickly by the liver
  - some drugs cannot be taken with certain foods or beverages
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Latin Meaning</th>
<th>Medical Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.D.</td>
<td>auris dextra</td>
<td>right ear</td>
</tr>
<tr>
<td>A.S.</td>
<td>auris sinistra</td>
<td>left ear</td>
</tr>
<tr>
<td>A.U.</td>
<td>auris unitas</td>
<td>both ears</td>
</tr>
<tr>
<td></td>
<td>auris uterque</td>
<td>each ear</td>
</tr>
<tr>
<td>O.D.</td>
<td>oculus dexter</td>
<td>right eye</td>
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<td></td>
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*Table 4-1* Abbreviations for topical administration
Drug forms

- Tuberculin skin testing is done by which injection route?
  - Intramuscular
  - Intradermal
  - Subcutaneous
The Drug Cycle

- After administration, most drugs go through a well-defined sequence of four steps before being excreted from the body
  - absorption from the site of administration
  - distribution via the circulatory system
  - metabolism
  - excretion from the body

Do you remember?

- the study of how drugs move through the body in the processes of absorption, distribution, metabolism, and excretion is called?

  Pharmacokinetics
Absorption

Absorption involves the movement of drugs from the site of administration through tissues and into the bloodstream.

For most drugs, absorption involves three steps:
- **disintegrate**
  - must disintegrate before they are absorbed
  - this step is omitted when already in a liquid form or effervescent tablets
- **dissolve**
  - once in liquid form, dissolves into the surrounding fluids
- **absorb**
  - from the body fluid, the drug passes through the walls of nearby capillaries
Distribution

- Distribution
  - once a drug has been absorbed into the blood it is distributed via the circulatory system
    - some of the drug binds to circulating plasma proteins
    - other portions that do not bind moves through system and into tissues
Metabolism/biotransformation

- the process of metabolism
  - drug gradually transformed or metabolized from its original active form to less active or inactive form
- accomplished in the liver
  - principal organ of metabolism
  - by action of liver enzymes

What is the potential impact of first pass effect on drugs given orally?
Excretion

- Necessary step in ridding the body of waste products & removing active drugs that are not metabolized by the liver
- Principle organ is the drug excretion is the kidney
Chapter 5

Using Drugs therapeutically
Learning Objectives

- Describe the physiologic basis of all drug effects.
- Differentiate between a local and systemic drug effect.
- Define these terms *therapeutic effect, side effect, adverse effect, and target organ*.
- Describe two actions the physician might take to reverse drug toxicity.
- Describe the physiologic response of an allergic drug reaction.
- Describe the physiologic basis of drug-drug and drug-food interactions.
Learning Objectives

- Define the words receptor, antagonist, synergism, and antagonism.
- Describe the metric system of drug measurement.
- Describe these drug measurement systems: units, inches, drops, milliequivalents, percentages, and ratios.
- Recognize and define Latin abbreviations indicating frequency of dosing.
- Name the five rights of drug administration.
The effect a drug exerts is directed toward prevention, diagnosis, and treatment. It can also exert other undesirable effects. Drug effects can be altered by interaction with drugs and food.
Local and Systemic Effects of Drugs

- Drugs have one of two effects
  - local effect
    - limited to site of administration
    - tissues immediately surrounding it
  - systemic effect
    - felt throughout the body

Can you provide an example of each?
Therapeutic Effect

- Therapeutic effect
  - drug’s main action for which it was prescribed
  - selected to
    - prevent a disease
    - diagnose a disease
    - treat a disease by controlling, improving, or curing the symptoms
Other drug effects

- Side effects: drug effects other than the therapeutic effect can be mild and temporary to severe enough that the pt. must stop taking the drug.

- Adverse effects: Severe side effects become apparent only after a drug is on the market.
Toxic Effects

- when a drug’s serum levels rises above therapeutic level
- Therapeutic index
  - narrow margin of safety between therapeutic dose and toxic dose
  - when a drug with a low therapeutic index is administered it is not uncommon to see toxic symptoms

What happens if a patient begins to complain of signs and symptoms of drug toxicity?
Allergic Reactions

- Type of side effect but differs from other side effects
  - has specific underlying cause
  - release of histamine occurs when body’s immune system identifies a foreign substance (antigen)
  - initiates an antibody response against it
  - antigen does not provoke an allergic reaction in everyone, only in certain hypersensitive people
Allergic Reactions

- Histamine
  - produces mild-to-severe allergic symptoms—depends on amount released
  - Mild-to-severe to life-threatening reactions
  - most severe symptoms of an allergic reaction are collectively known as anaphylaxis or anaphylactic shock

**What are signs and symptoms of allergic reactions?**
- itching
- swelling
- redness
- sneezing
- bronchospasm
- edema
- shock
- death
Idiosyncratic Reactions

- Drug idiosyncrasy
  - Drug reaction not a side effect - not based on an allergic reaction
  - Individual’s unique reaction
  - Has basis in the genetic makeup of the individual causing changes in:
    - Metabolism of drug
    - Action of drug
Drug-Drug & Drug-Food Interactions

- **Synergism**
  - occurs when the two drugs combine to produce an effect
  - effect is greater than the independent effect of each drug

- **Antagonism**
  - occurs when two drugs combine to produce an effect
  - effect is less than the intended effect of either drug
Apothecary System

- Some apothecary measurements are still used today
  - liquid measurements of
    - pint
    - quart
    - gallon
- Apothecary drug doses measurement has been discontinued
- Variation of roman numerals often used with measurements

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\end{array}} \]
Metric System of Drug Measurement

- Invented by the French in 1790
- Officially known as the International System of Units (SI)
- Adopted as the exclusive unit of measurement by the AMA
- Based on
  - meter (for length measurements)
  - kilogram (for weight measurements)
  - liter (for volume measurements)
Metric System of Drug Measurements

- Metric length measurements include the meter and centimeter
  - a centimeter is equivalent to 1/100 of a meter
  - when a cube is formed, 1 cm long on each side
    - measurement of volume known as cubic centimeter (cm³ or cc)
    - equivalent to the volume in a milliliter (mL and cc)
    - often used to express volume of liquid drug doses
Metric System of Drug Measurements

- Drug weight measurements are not expressed in terms of kilograms
- Kilograms are used to measure a person’s weight
  - can be important in calculating correct drug doses
    - 50-kilograms equals 110 pounds
- Most drugs are measured in milligrams, occasionally micrograms
Metric System of Drug Measurements

- Metric volume measurements include the liter and milliliter
- 1 liter equals 1000 milliliters
- Drugs are not prescribed by the liter, by the milliliter (mL)
- Drug measurements in the metric system are never expressed in fractions.
- Drug doses with number less than 1 is written with a decimal and always has a zero added to the left of the decimal point
Other Drug Measurements

- **Unit**
  - some drugs are never measured by the metric system, but instead by a special designation called a unit
    - some penicillins (1 unit is 0.6 mcg of penicillin G)
    - all types of insulin (defined on weight basis of pure insulin)
      - manufactured with 100 units per milliliter
      - abbreviated as U-100
Other Drug Measurements

- **Inches**
  - Nitroglycerin ointment (Nitro-Bid)-only common medication measured in inches
    - Ointment squeezed onto specially marked paper
    - Prescribed dose may range from $\frac{1}{2}$ inch to 4 inches

- **Drops**
  - Abbreviated *gtt*
  - Eye and ear liquid drugs prescribed as drops to be given
Other Drug Measurements

- **Milliequivalents**
  - an equivalent is the molecular weight of an ion divided by the number of hydrogen ions it reacts with
  - a milliequivalent is 1/1000 of an equivalent
  - abbreviated *mEq*

- **Percentage**
  - one part in relationship to the whole
  - based on a total of 100
  - a 10% solution would be composed of 10 mL of drug in 100 mL of liquid
Other Drug Measurements

- **Ratio**
  - relationship between the concentrations of two substances together in a solution
  - expressed as two numbers with a colon mark between them

- **Household**
  - unofficial system
  - used by people at home measuring drugs
  - includes measuring spoons and silverware
  - inaccurate measurement system because of no standardized size
Medication orders

- Medication orders contain six parts:
  1. Date **(Right time)**
  2. Patient name **(Right patient)**
  3. Medication name **(Right medication)**
  4. Dosage or amount of medication **(Right amount)**
  5. Route or manner of administration **(Right route)**
  6. Time to be administered and frequency **(Right time)**

Always document any medication you give! **(Right documentation)**
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<td>a.c.</td>
<td><em>ante cibum</em></td>
<td>before meals</td>
</tr>
<tr>
<td>ad lib.</td>
<td><em>ad libitum</em></td>
<td>as needed</td>
</tr>
<tr>
<td>b.i.d.</td>
<td><em>bis in die</em></td>
<td>twice a day</td>
</tr>
<tr>
<td>č</td>
<td><em>cum</em></td>
<td>with</td>
</tr>
<tr>
<td>h.s.</td>
<td><em>hora somni</em></td>
<td>at bedtime (hour of sleep)</td>
</tr>
<tr>
<td>n.p.o., NPO</td>
<td><em>nil per os</em></td>
<td>nothing by mouth</td>
</tr>
<tr>
<td>p.c.</td>
<td><em>post cibum</em></td>
<td>after meals</td>
</tr>
<tr>
<td>p.r.n.</td>
<td><em>pro re nata</em></td>
<td>as needed</td>
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<tr>
<td>q.d.</td>
<td><em>quaque die</em></td>
<td>every day</td>
</tr>
<tr>
<td>q.h.</td>
<td><em>quaque hora</em></td>
<td>every hour</td>
</tr>
<tr>
<td>q.h.s.</td>
<td><em>quaque hora somni</em></td>
<td>at bedtime (hour of sleep)</td>
</tr>
<tr>
<td>q.i.d.</td>
<td><em>quater in die</em></td>
<td>four times a day</td>
</tr>
<tr>
<td>q.o.d.</td>
<td>(informal usage)</td>
<td>every other day</td>
</tr>
<tr>
<td>s</td>
<td><em>sine</em></td>
<td>without</td>
</tr>
<tr>
<td>t.i.d.</td>
<td><em>ter in die</em></td>
<td>three times a day</td>
</tr>
</tbody>
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Table 5-1  Common abbreviations for frequency of drug administration
Chapter 6
The prescription
Learning Objectives

- Give the definition of a prescription
- Name the types of prescriptions
- Describe medication orders and other types of orders
- Describe the difference between the components of a prescription and a medication order
- Describe the role of the pharmacist in filling a prescription
Definition of a Prescription

- Origin comes from Latin *praescriptio*, meaning *a written order*
- Prescription: the action of writing [that takes place] before [a drug is dispensed]
  - *pre-* (before) *script/o-* (write) *-ion* (action)
  - a written, computerized, electronic, or verbal order from a physician (or other qualified healthcare provider) to a pharmacist, giving instructions as to how to dispense a drug to a specific patient
  - a medicolegal document-can be used in court
Definition of a Prescription

- A prescription is:
  - a written, computerized, electronic, or verbal order from a physician (or other qualified healthcare provider) to a pharmacist, giving instructions as to how to dispense a drug to a specific patient
  - a medicolegal document
  - conveys precise information
  - legal document that can be used in court
The Prescription

- Check for completeness and accuracy
- Question any discrepancy, omission, or unusual order
- Specify number of refills
- Verify DEA registration number (if controlled substance)
- Telephone orders (TO)
- Verbal orders (VO)
Types of Prescriptions

- Computerized prescription
  - typed into the medical office’s software system
  - copy of prescription is printed out
  - signed by the physician and given to the patient
  - may be faxed directly to the pharmacist
Types of Prescriptions

- Electronic prescription
  - generated by a computer
  - not signed by the physician
  - digital electronic signature is automatically imprinted
  - may also be faxed directly to the pharmacist
Medication Orders and Other Types of Orders

- **Medication Order**
  - written record of a physician’s orders
  - handwritten on large preprinted order sheet known as the *physician’s order sheet*
  - located in the front of the patient’s medical record

- for facilities with electronic records
  - typed into the computer on a designated screen
  - screen serves as the physician’s order sheet
Medication Orders and Other Types of Orders

- **Verbal Order (Telephone Orders)**
  - when a patient is in the hospital
  - physician may give a verbal order over the phone to a licensed nurse
  - the nurse writes the order on the physician’s order sheet
  - it is marked as a verbal order (V.O.)
  - the nurse signs her name
  - physician must personally sign the order within a specific amount of time
Medication Orders and Other Types of Orders

- **Standing Orders**
  - group of specific orders
  - preprinted on the facility’s physician’s order sheet
  - often pertain to protocol of treatment to a specific disease or surgical procedure
  - in addition, a physician would also write more specific medication orders to address a particular patient’s medical needs