GENERAL CONCEPTS OF PHARMACOLOGY

* No medication has a single action; all medications have the potential to alter more than one body function. For example, aspirin may be given for anti-inflammatory action for arthritis, or for antiplatelet action to prevent strokes.

**NURSING PRIORITY:** Many medications have several actions that are desirable. Carefully evaluate the question to determine the desired response of the medication for the specific client situation.

A. Desired action: the desired, predictable response for which the medication is administered.
B. Side effects (drug reaction): the undesirable or unwanted response; frequently predictable.
C. Unpredictable response: the unusual response to a medication.
   1. Idiosyncratic reaction: an individual, unexpected response to a medication.
   2. Allergic reaction: may or may not occur with the initial dose of medication; occurs with subsequent doses because it requires that the immune system respond with the production of antibodies in order to trigger the allergic reaction.
D. The Drug Amendments of 1962 made it mandatory that each medication have one official name.
   1. Generic name (nonproprietary): the official designated name that the medication is listed under in official publications.
   2. Chemical name: designates the specific chemical composition of the medication.
   3. Trade name (proprietary name, brand name): the name designated and registered by a specific manufacturer.

**TEST ALERT:** Typically, the medications on the NCLEX-PN examination will be identified with both the generic and trade name—for example: diazepam (Valium).

E. Pharmacokinetic process: Consists of four phases - absorption, distribution, metabolism, or excretion, acting together to determine the concentration of a drug at its site of action.

1. Absorption: The movement of the drug from the site of administration into the blood.
   a. Drug absorption can be altered by the increase or decrease in gastric emptying, by changing the gastric pH, or by forming drug complexes.
   b. Administration affects absorption, for example subcutaneous injection vs oral administration.
2. Distribution: The movement of the drug through the body. Drug metabolism and excretion as well as cardiac output will affect the distribution of a drug.
3. Metabolism: the alteration of the drug structure, the alterations occur in the liver with excretion by the kidney.
4. Excretion: Changes in liver and renal function as well as changes in cardiac output will affect the excretion of a drug.

**OLDER ADULT PRIORITY:** Creatinine clearance is a more effective indication of renal function than serum creatinine in older adults.

F. Potential for Abuse: Controlled Substances Act, 1970, defines rules for the manufacture and distribution of drugs that are considered to have a potential for abuse.
   1. 5 Categories of medications: Schedules I, II, III, IV, V—potential for abuse decreases with each category, medications in Schedule V have lowest potential for abuse.
   2. Schedule I drugs are highly addictive (e.g., heroin) and are not used in therapeutic administration of medications. Schedule V drugs (e.g., diphenoxylate hydrochloride [Lomotil]) have the lowest potential for abuse.

**Drug Actions**

A. Desired action: the desired, predictable response for which the medication is administered.
B. Adverse drug reactions (ADR): an undesirable drug effect, ranging from mild untoward effects to severe responses.
OLDEN ADULT PRIORITY: ADRs are 7 times more common in older adults than in young adults.

1. **Side effects:** undesirable drug effects, ranging from mild untoward effects to severe responses that occur at normal drug dosages.
2. **Toxicity:** drug reactions that primarily occur as a result of receiving an excessive dose (e.g., medication error, poisoning); can also include severe reactions (anaphylaxis) that occur regardless of the dose.
3. **Allergic reactions:** drug reaction that occurs as a result of prior sensitization and results in an immune response. Intensity can range from very mild to very severe (anaphylaxis).
4. **Idiosyncratic effect:** an uncommon drug response.
C. **Tolerance:** an increased dose is required to maintain expected drug response. For example, when a client with chronic pain may requires higher doses of an analgesic to achieve pain relief.
D. **Dependence:** an expected response to repeated use of a drug, resulting in physical signs and symptoms of withdrawal when the serum drug level decreases suddenly. For example, when a client abruptly stops taking a strong opioid agonist (methadone) and develops symptoms of withdrawal.
E. **Addiction:** the continued use of a psychoactive substance regardless of physical, psychologic, or social harm.

**Drug Interactions**

A. An altered or modified action or effect of a drug as a result of interaction with one or more drugs. It is not an adverse drug reaction or drug toxicity.
B. Drug incompatibility: a chemical or physical reaction that occurs between two or more drugs outside the body.
C. **Potentiation effect** (synergistic effect): if two or more drugs are given together and this increases the therapeutic effects, it is beneficial; if it increases adverse effects, it may be detrimental. For example, a diuretic and a beta blocker may be give together for hypertension.
D. **Antagonistic or inhibitory effect:** if two or more drugs are given together, one may inhibit the effect of the other; this may be beneficial or detrimental. For example, naloxone (Narcan) may be given to suppress the effects of morphine.

**TEST ALERT:** Assess client for actual or potential side effects and adverse effects of medications; identify symptoms/evidence of allergic reactions to medications; implement procedures to counteract adverse effects of medications; evaluate and document client response to actions taken to counteract side effects and adverse effects of medications.

**E. Drug incompatibility:** a chemical or physical reaction that occurs when two or more drugs are combined in vitro (outside the body).

**F. Breast-feeding:** advise women who are lactating to always advise their health care provider; medications may be excreted in breast milk.

**TEST ALERT:** Use critical thinking skills when considering the effects and/or outcomes of medications; identify any contraindications to administration of a prescribed or OTC medication.

G. **Food and Drug Administration pregnancy risk categories** (Table 4-1).

**Herbal Supplements**

A. Use of herbs to treat health problems is the most common form of alternative medicine, which can be defined as treatment practices that are not widely accepted or practiced by mainstream clinicians in a given culture.
B. The word **natural** is not synonymous with **safe**! Remember, poison ivy and tobacco are natural too.
C. Some commonly used medicinal herbs (Table 4-2).

**NURSING PRIORITY:** Unlike conventional drugs, herbal and other dietary supplements can be marketed without any proof of safety or efficacy. Dietary supplements are not regulated by the FDA.

**MEDICATION ADMINISTRATION**

**NURSING PRIORITY:** The nurse’s responsibility in administering medication is influenced by three primary factors: nursing guidelines for safe medication administration, pharmacological implications of the medication, and the legal aspects of medication administration.

**Nursing Responsibilities in Medication Administration**

A. **Follow the “7 Rights” of medication administration.**
   1. **Right medication.**
   2. **Right dosage.**
   3. **Right route of administration.**
   4. **Right time.**
   5. **Right client.**
   6. **Right charting (documentation).**
   7. **Right technique**

**TEST ALERT:** Administer medications according to the “7 Rights” of medication administration.
CHAPTER 4 Pharmacology

Remote Risk of Fetal Harm: Adequate and well-controlled studies in pregnant women have not shown an increased risk of fetal abnormalities.

Slightly More Risk Than A: Animal studies have revealed no evidence of harm to the fetus; however, there are no adequate and well-controlled studies in pregnant women.

Greater Risk Than B: Animal studies have shown an adverse effect, but adequate and well-controlled studies in pregnant women have failed to demonstrate a risk to the fetus.

Proven Risk of Fetal Harm: Studies—adequate well-controlled or observational—in pregnant women have demonstrated a risk to the fetus. However, the benefits of therapy may outweigh the potential risk.

Proven Risk of Fetal Harm: Studies—adequate well-controlled or observational—in animals or pregnant women have demonstrated positive evidence of fetal abnormalities. The use of the product is contraindicated in women who are or may become pregnant.


<table>
<thead>
<tr>
<th>Medicinal Herb</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black cohosh</td>
<td>A popular treatment for acute symptoms of menopause and premenstrual syndrome (PMS). Minor side effect of upset stomach may occur.</td>
</tr>
<tr>
<td>Feverfew</td>
<td>For treatment of migraine, fever; stimulates menstruation and suppresses inflammation.</td>
</tr>
<tr>
<td>Garlic</td>
<td>Reduces levels of triglycerides and cholesterol and decreases formation of atherosclerotic plaque.</td>
</tr>
<tr>
<td>Ginger root</td>
<td>Used for nausea and vomiting caused by motion sickness and perhaps nausea caused by chemotherapy.</td>
</tr>
<tr>
<td>Ginkgo biloba</td>
<td>Is used for increased circulation, memory, clear thinking, and impotence. May cause stomach upset and dose-related headache.</td>
</tr>
<tr>
<td>Goldenseal</td>
<td>Is used for bacterial, fungal, and protozoal infections of mucous membranes in the respiratory, gastrointestinal, and genitourinary tracts. Also used to treat inflammation of the gallbladder. Well tolerated but toxic in high doses.</td>
</tr>
<tr>
<td>Kava</td>
<td>Is used to relieve anxiety, promote sleep, and relax muscles. Long-term use and high doses cause CNS depression, skin problems, and liver damage.</td>
</tr>
<tr>
<td>Ma huang (ephedra)</td>
<td>Reduces appetite, increases energy, and relieves bronchospasms. Increases blood pressure and heart rate. Potentially dangerous to the cardiovascular system with long-term use or in high doses.</td>
</tr>
<tr>
<td>St John’s wort</td>
<td>Is used for depression. Potential interactions with other drugs.</td>
</tr>
<tr>
<td>Saw palmetto</td>
<td>Is used to relieve urinary symptoms related to benign prostatic hypertrophy (BPH) and is well tolerated. May cause a false-negative result on PSA test.</td>
</tr>
</tbody>
</table>

Drug Interactions

May potentiate hypotensive effects of antihypertensive drugs, as well as hypoglycemic action of insulin and oral hypoglycemics.

May suppress platelet aggregation and increase risk for bleeding in clients on anticoagulant medications (aspirin, warfarin, heparin).

Increases risk for bleeding in clients taking antiplatelet drugs (aspirin) or anticoagulants (warfarin, heparin).

Increases risk for bleeding in clients taking antiplatelet drugs (aspirin) or anticoagulants (warfarin, heparin).

Increases risk for bleeding in clients taking antiplatelet drugs (aspirin) or anticoagulants (warfarin, heparin).

Contraindicated in pregnancy.

Intensifies the effects of CNS depressants. Should not be taken with alcohol.

Potentiates the effects of CNS stimulants; can counteract the effects of antihypertensive drugs.

May cause hypertensive crisis if taken with MAO inhibitors.

May interfere with oral contraceptives; reduced anticoagulation in clients taking warfarin; decreased effectiveness of cyclosporine. Caution in use with antidepressants.

Avoid use in pregnancy. Should not use with finasteride (Proscar) in treatment of BPH.
B. A nurse should administer only those medications that he or she has prepared.

C. Be familiar with medication.
   1. General reason the client is receiving the medication.
   2. Common side effects.
   3. Average dose or range of safe doses.
   4. Any specific safety precautions before administration (e.g., check apical pulse rate for digitalis; check clotting time for heparin).

D. Document medication against physician’s or PCP’s orders according to institution policy

E. Evaluate client’s overall condition and assess for changes that may indicate the medication should not be given (e.g., morphine would be contraindicated in a client who has increased intracranial pressure).

F. Use appropriate aseptic technique in preparing and administering medication.

G. Do not leave medications at the client’s bedside without a doctor’s order to do so.

H. If client is to administer his or her own medication, review the correct method of administration (e.g., eye drops) with the client.

I. Nursing implications for administering medication to an older adult client (Box 4-1).

J. Factors affecting dose – response relationships (Box 4-2).

**TEST ALERT: Maintain current, accurate medication list.**

**Nurse’s Legal Responsibilities in Administration of Medication**

A. The nurse administers a medication only by order of a doctor or PCP and according to the provisions of the specific institution.

B. The nurse should not automatically carry out an order if the dosage is outside the normal range or if the route of administration is not appropriate; the nurse should consult the nursing supervisor or PCP.

C. The nurse is legally responsible for the medication he/she administers, even when the medication is administered according to a physician’s order.

D. The nurse is responsible for evaluating the client before and after the administration of a PRN medication.

E. The nurse must administer the medication according to the nursing responsibilities previously discussed.

F. The medication should be charted as soon as possible after administration.

G. When taking verbal orders over the phone, carefully repeat all the orders to verify they are correct (Box 3-7).

H. Medication errors:
   1. If an error is found in a physician’s or PCP’s medication order, it is the nurse’s responsibility to question the order.

**BOX 4-1 Medication Implications for Older Adult Clients**

**Avoiding adverse drug reactions.**
- Obtain a complete drug history that includes over-the-counter drugs and herbs.
- Monitor client responses and drug levels
- Keep dosing regime as simple as possible, use daily dosing when possible rather than twice a day.
- Emphasize to clients the importance of disposing of medications they are no longer taking.

**Promoting compliance**
- Intentional underdosing (by clients) is the most common reason for nonadherence to drug regimen.
- Provide written instructions to clients regarding medication administration, as well as why they are taking the medication.
- Ask the pharmacist to label drug containers with large type.
- Provide drug containers that can be opened easily.
- Encourage clients to use a system to record or track their drug doses (calendar, pill organizer).

2. Always report medication errors to the nursing supervisor or PCP immediately.

3. It is the nurse’s responsibility to carefully assess the client for effects of the erroneous medication.

4. Medication errors should be documented both in an incident report (see Chapter 3) and on the client’s chart.

**TEST ALERT: Identify situations in which the reporting of an incident/event/irregular occurrence/variance is appropriate; report the incident/error/event/occurrence per protocol.**

1. **High-Alert Medications.**
   1. The Joint Commission (TJC) and the Institute for Safe Medication Practices (ISMP) have identified specific medications for which errors could have devastating effects on clients.
   2. These medications are identified within the medication tables throughout this book.
   3. TJC requires:
      a. Institution or facility to develop processes to manage High-Alert Medications.
      b. A specific process of communication among health care workers to reconcile medications. This includes a process for reconciling the list of medications during transfer, at discharge, and after major procedures.
   4. Nursing Implications for High-Alert Medications (Box 4-3).
Methods of Medication Administration

Note: This section on medications should not be used as a procedure guideline. The purpose is to point out specific characteristics of each method. All medications should be administered according to previously discussed nursing responsibilities in medication administration.

TEST ALERT: Administer and document medications given by common routes (e.g. oral, topical), administer and document medications given by parenteral routes (intravenous, intramuscular, subcutaneous), and determine the need for administration of PRN medications.

A. Oral medication.
   1. Assess level of consciousness and ability to follow directions.
   2. Evaluate swallow reflex.

B. Topical medications.
   1. Skin application: evaluate condition of the skin in the area where medication is to be applied; rotate sites to prevent irritation.
   2. Sublingual: allow medication to dissolve under the tongue; client should not chew or swallow.
   3. Nasal: position client to allow nose drops or spray to enter nares directly without contaminating the eyes. Position should foster the movement of the medication to the affected area.
   4. Eyes: medication must be specifically indicated for ophthalmic use.
      a. Instill 1 or 2 drops in the middle of the lower conjunctival sac.
      b. Do not allow tip of applicator to come in contact with the eye.
      c. Do not drop medication directly on the cornea.
      d. Direct client to close his or her eyes gently to distribute the medication.

A. Suppositories.
   a. Rectal: absorption of medication from rectal mu cosa is slower and less predictable than that of medications administered systemically.
      (1) Frequently given for constipation or for nausea and vomiting.
      (2) May be preferred route for infant.
   b. Vaginal: absorption across vaginal mucous membranes.
      (1) Insert suppository about 3 to 4 inches into vagina; maintain supine position after insertion.
      (2) Should not douche unless advised to do so; maintain good perineal hygiene.

C. Transdermal medication: medication is stored in a patch or is measured on a dose-determined applicator placed on the skin; absorption occurs through the skin.
   1. Provides more consistent blood levels and avoids gastrointestinal problems.
   2. Patch sites should be rotated. Old patch should be removed and area should be cleansed after use.
   3. Do not apply a topical patch or apply medication over an inflamed area.
   4. Do not allow transdermal medications to come in contact with your skin, because medication could be absorbed.
   5. Patch must come in contact with client’s skin; excessive body hair may need to be removed. Do not shave the area; use scissors to clip hair from area.

D. Inhalation medication: medication is in an aerosol or powder form and is inhaled and absorbed throughout the respiratory tract (see Chapter 10).
   1. Place client in semi-Fowler’s position.
   2. Check instructions for use of an inhaler and make sure client understands.

E. Parenteral medications: administration of medications by some method of injection
   1. Injection routes (Figure 4-1)
   2. Selection of a syringe: select a syringe and type of needle that is appropriate for the type of parenteral medication to be administered.
   3. Intradermal injection: administered just below the skin surface.
      a. Use a syringe with appropriate calibrations because amount is very small in volume (0.01 to 0.1 mL).

BOX 4-2 Factors influencing dose-response relationships.

- Age: Infants and older adults are generally more sensitive to medications.
- Presence of disease process, specifically kidney and liver problems.
- Method of administration – IV is much more rapid than PO.
- Adequate cardiac output.
- Emotional factors: Clients are more likely to respond to a medication in a positive manner if they have confidence in their treatment and anticipate the therapeutic effects.

- Make sure you administer the correct medication in the correct eye.
- Ears: medication is instilled into the auditory canal.
   a. Position client with affected ear upward.
   b. Children under 3 years: pull pinna down and backward.
   c. Older children and adults: pull pinna up and backward.
   d. Administer solution at room temperature.
   e. Keep client in the same position for appropriate time to prevent medication from coming out.

- Suppositories.
   a. Rectal: absorption of medication from rectal mucosa is slower and less predictable than that of medications administered systemically.
      (1) Frequently given for constipation or for nausea and vomiting.
      (2) May be preferred route for infant.
   b. Vaginal: absorption across vaginal mucous membranes.
      (1) Insert suppository about 3 to 4 inches into vagina; maintain supine position after insertion.
      (2) Should not douche unless advised to do so; maintain good perineal hygiene.

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   1. Provides more consistent blood levels and avoids gastrointestinal problems.
   2. Patch sites should be rotated. Old patch should be removed and area should be cleansed after use.
   3. Do not apply a topical patch or apply medication over an inflamed area.
   4. Do not allow transdermal medications to come in contact with your skin, because medication could be absorbed.
   5. Patch must come in contact with client’s skin; excessive body hair may need to be removed. Do not shave the area; use scissors to clip hair from area.

- Inhalation medication: medication is in an aerosol or powder form and is inhaled and absorbed throughout the respiratory tract (see Chapter 10).
   1. Place client in semi-Fowler’s position.
   2. Check instructions for use of an inhaler and make sure client understands.

- Parenteral medications: administration of medications by some method of injection
   1. Injection routes (Figure 4-1)
   2. Selection of a syringe: select a syringe and type of needle that is appropriate for the type of parenteral medication to be administered.
   3. Intradermal injection: administered just below the skin surface.
      a. Use a syringe with appropriate calibrations because amount is very small in volume (0.01 to 0.1 mL).
CHAPTER 4 Pharmacology

b. Use a tuberculin or 1-mL syringe with a small-gauge (25-or 27-gauge) needle, 3/8 to 5/8 inch long.

c. Select area where skin is thin (e.g., inner surface of forearm, middle of back).

d. Insert needle bevel edge up at a 5- to 15-degree angle.

e. Frequently used for tuberculin testing, administration of local anesthetic, allergy testing.

4. Subcutaneous injection: medication is injected into fatty tissue, just below the dermis.

a. Medication should be small in volume (0.5 to 1 mL) and nonirritating.

b. Areas on outer surface of upper arm, anterior surface of the thigh, and the abdomen are frequent sites.

c. Use a 25-gauge needle that is 3/8 inches long and insert at a 45-degree angle; or a 25-gauge needle that is 1/2 inch long and insert at a 90-degree angle.

5. Intramuscular injection: injection of medication into the muscle.

a. The amount of medication is usually 0.5 to 3.0 mL.

b. Appropriate sites.

(1) Deltoid (Figure 4-2)

(2) Vastus lateralis muscles (Figure 4-4), ventrogluteal (Figure 4-3)

c. Use a 1-inch to 1 1/2-inch needle; gauge of needle depends on viscosity of medication; insert needle at 90-degree angle.

(1) For oil-based or viscous medications use an 18- to 22-gauge needle.

(2) For less viscous medications use a 20- to 22-gauge needle.

d. Aspirate when needle is in place; if no blood returns, administer medication at a rate of 1 mL every 10 seconds.

e. Z-track technique is used to prevent medication from leaking back through the needle track and irritating or staining subcutaneous tissue.

1. After medication is drawn up, change the needle.

2. Pull skin over to one side at the injection site.

3. Inject medication into taut skin at site selected.

4. Remove the needle and release the skin. As the stretched skin returns to its original position, the needle track is sealed.

5. The preferable site is the ventrogluteal area.

f. Intramuscular injections in children.

(1) Vastus lateralis (see Figure 4-4) muscle is common site in infants.

(2) Ventrogluteal (see Figure 4-3) site is the preferred site in children.

(3) A 22-gauge 1-inch needle is appropriate for an IM injection in most children.

6. IV administration medication administered into the blood.

a. Administration of large volumes of liquid by infusion.

b. Administration of irritating medications by piggy back method.

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**Box 4-3 NURSING IMPLICATIONS FOR HIGH-ALERT MEDICATIONS**

- Maintain good communication and locate easily found information regarding the administration of pain medications to prevent overdose, for example, use a visual pain scale. Store narcotics in individual client areas rather than as floor stock.

- Do not store together medications that have the same type of measurements. For example, heparin and insulin are both administered in units.

- Use only accepted abbreviations (See Appendices 4-2, 4-3, 4-4).

- Establish a check system for high alert medications or for calculations, one nurse would prepare the medication and another nurse check it.

- Infusion pump rates and concentrations must have an independent check system.

- Identify medications that have similar names and use caution in administering them. For example, hydromorphone (Dilaudid) and morphine; potassium phosphate and potassium chloride; methyldopa (Aldomet) with levodopa or L-dopa.

- Premixed solutions and standardized concentrations (potassium chloride, sodium chloride or normal saline) should be available on the nursing unit; decrease the premixing and calculation of medications on the nursing unit.

- Do not store vials or containers of saline in concentrations above 9% on the nursing unit.

- Use single-dose vials when possible.
(1) Dilute medication according to directions, usually 25 to 250 mL of a compatible intravenous fluid like normal saline (NS).

(2) Assess patency of primary infusion.

(3) Connect medication and adjust flow rate for the time designated, usually 30 to 45 minutes.

(4) Administration of medications through IV piggyback method enhances the action of the medication.

c. Retrograde IV administration: medication is mixed with diluent, the port closest to client is clamped and medication is injected into the port and allowed to fill (retrograde) into the IV tubing. The clamp closest to the client is opened and the medication is allowed to infuse at the prescribed flow rate.

d. Always follow facility guidelines regarding LPN administration of IV piggy back medications.

TEST ALERT: Administer IVPB medications, monitor site and flow rate.

Forms of Medication Preparations

A. Solids.
1. Capsule: medication is provided in cylindrical gelatin container.
2. Pills, tablets: medication is pressed into solid form in various shapes and colors.
   a. Enteric-coated: prevents medication from being released in stomach; dissolves in intestine. Do not crush enteric-coated, extended-release (ER), or sustained-release (SR) tablets.

b. Lozenge: flavored tablet is held in the mouth for slow release of medication.
3. Suppositories: keep in cool area; will melt at body temperature.
   a. Rectal.
   b. Vaginal.

4. Ointments: used for external application.
5. Powders: finely ground medications that are stable only in dry form; frequently mixed with solution before administration.

B. Solutions.
1. Syrups: medication prepared in an aqueous sugar solution.
2. Elixirs: solutions containing alcohol, sugar, and water.
3. Suspensions: finely ground particles of medication dispersed in a liquid; shake all suspensions well before preparing dose (antacids).
4. Emulsions: medication is dispersed in an oil or fat solution; shake all emulsions well before preparing dose.
5. Liniments, lotions: medication is combined in a mixture of oil, soap, alcohol, water; used for external application.

Calculation of Medication Dosages

Occasionally, medications are ordered by the physician in amounts not supplied by the pharmacy. In these situations, the nurse must calculate the correct dosage. Another important area of calculation is in the administration of IV solutions. Thus, it is essential that the nurse have a good working knowledge of the fundamental principles of mathematics to calculate medication dosages correctly.

Oral Medication Calculations

Dose desired ÷ Dose on hand = Amount to give

Example: Order reads to give Keflex 500 mg. Dose on hand is 250-mg capsules.

\[
\frac{500}{250} = 2 \text{ capsules}
\]

Dose desired ÷ Dose on hand × Quantity = Amount to give

Example: Order reads to give ampicillin 350 mg. Dose on hand is 250 mg in 5 mL.

\[
\frac{350}{250} \times 5 = x
\]

\[
350 \div 250 = 14
\]

\[
14 \times 5 \text{ mL} = 7 \text{ mL}
\]

The problem can also be set up in algebraic proportion:

\[
\frac{350}{x} = \frac{250}{5 \text{ mL}}
\]

\[
250x = 1750
\]

\[
x = 7 \text{ mL}
\]

Parenteral Medication Calculations

Dose desired ÷ Dose on hand × Quantity of solution = Amount to give

Example: Order reads Gentamycin 60 mg IM. On hand is 80 mg in 1 mL.

\[
\frac{60}{80} \times 1 \text{ mL} = x
\]

\[
60 \div 80 = 0.75
\]

\[
0.75 \times 1 \text{ mL} = \frac{3}{4} \text{ mL or 0.75 mL}
\]

Set up in algebraic proportion, the equation reads:

\[
\frac{60}{x} = \frac{80}{1 \text{ mL}}
\]

\[
60x = 75
\]

\[
x = 0.75 \text{ mL or } \frac{3}{4} \text{ mL}
\]

Intravenous Medication Flow Calculation

To determine how long an infusion will run, divide the total number of milliliters to infuse by the hourly infusion rate.

Amount to infuse ÷ Hourly rate = Number of hours

Example: Order reads 1000 mL at 125 mL per hour.

How long will it take the 1000 mL to infuse?

\[
1000 \div 125 = x
\]

\[
1000 \div 125 = 8 \text{ hours}
\]

To determine the rate in milliliters per hour at which an infusion will run, divide the total number of milliliters to infuse by the infusion time.

Amount to infuse ÷ Total infusion time = Rate (mL/hr)

Example: Order reads 1000 mL to run every 8 hours.

At what rate in milliliters per hour will the medication be infused?

\[
1000 \div 8 \text{ hours} = 125 \text{ mL/hr}
\]

Calculating drop factors: Check the IV equipment to determine how many drops are delivered in 1 mL. For example purposes, a drop factor of 10 gtt per 1 mL is used. The following are two formulas with which to calculate this factor.

\[
\frac{\text{Total mL}}{\text{Time in min}} = \text{mL per min} \times \text{Drop factor} = \text{gtt per min}
\]

Example: 1000 mL is ordered to infuse in 8 hours. Set drop factor is 10 gtt/mL.

\[
\frac{1000}{480\min} = 2.08 \text{ mL/min}
\]

\[
2.08 \times 10 = 20.8 \text{ or 21 gtt/min}
\]

Example: 500 mL is ordered to infuse in 2 hours. Set calibration is 10 gtt/mL.

\[
\frac{500}{120\min} = 4.16 \times 10 = 41.6 \text{ or 42 gtt/min}
\]

Determine the number of milliliters per hour and divide by 60 (60 minutes in 1 hour). This equals the number of milliliters per minute. Multiply by set calibration of number of drops per milliliter.

\[
\text{Number of milliliters per hour} \div 60 = \text{mL/min}
\]

\[
\text{Rate (mL/min)} \times \text{Set calibration} = \text{gtt/min}
\]

Example: 500 mL is ordered to infuse in 2 hours. Set calibration is 10 gtt/mL (250 mL/hr to infuse).

\[
\frac{250}{60} = 4.16 \text{ mL/min}
\]

\[
4.16 \times 10 = 41.6 \text{ or 42 gtt/min}
\]

NOTE: There may be a difference of 2 to 4 gtt when different formulas are used.
Study Questions: Pharmacology

1. What should the nurse take into consideration when giving medication to an older adult client?
   1. Multiple simultaneous drugs can be dangerous.
   2. The older client metabolizes and excretes medications differently from younger clients.
   3. Medications affect the older client during the early hours of the morning.
   4. Medications have an effect on the respiratory system of the older adult.

2. A client has an order for fluoxetine (Prozac) 20 mg in the am and at noon; 10-mg tablets are available. How many tablets will the client receive each day?
   1. 8 tablets.
   2. 6 tablets.
   3. 4 tablets.
   4. 3 tablets.

3. A client has been ordered thioridazine (Mellaril) elixir 300 mg daily at bedtime. You have Mellaril elixir on the floor at 500 mg/ml. How many milliliters will the client receive?
   1. 0.3 ml.
   2. 1.3 ml.
   3. 0.6 ml.
   4. 0.5 ml.

4. Gentamicin (Garamycin) 60 mg IM is ordered for a client. Available is a multidose vial with 40 mg/ml. What is the correct amount to give?
   1. 1.5 vials.
   2. 1.25 vials.
   3. 2.0 vials.
   4. 1.75 vials.

5. To ensure that the right medication was being given, the first step the nurse would take in preparing to administer the medication would be:
   1. Check the client’s ID band.
   2. Read the information insert for directions as to correct administration.
   3. Check the order with the medication administration sheet.
   4. Check the expiration date on the medication.

6. The nurse pours a dose of medication and then finds that the client no longer needs the dose. What action should the nurse take?
   1. Record the dose as taken to keep the count correct.
   2. Charge for the dose because the dose must be paid for.
   3. Record the medication as “not taken” and waste the poured dose.
   4. Pour the medication back into the container.

7. Different medication preparations of drugs are absorbed in the body at different rates of time. Which preparation of a drug absorbs more rapidly?
   1. Ointment applied to the skin.
   2. Liquid medicine given orally.
   4. Enteric-coated tablets.

8. Medications taken orally must undergo a change after contact with body fluids in order to be used by the body. This process is known as:
   1. Concentration.
   2. Elimination.
   3. Transference.
   4. Absorption.

9. The nurse is evaluating information to determine if the client needs a medication. The nurse should first check the:
   1. Client’s name.
   2. Expiration date of the drug.
   3. Route of delivery.
   4. Medication administration record.

10. The doctor has indicated that ampicillin and gentamicin are to be given piggyback in the same hour, every 6 hours (12-6-12-6). How would the nurse administer these drugs?
    1. Give both drugs together IV push.
    2. Give each drug separately, flushing between drugs.
    3. Retrograde both drugs into the tubing.
    4. Give one drug every 4 hours and one every 6 hours.

11. Which of the following is correct regarding the administration of an intradermal injection?
    1. It forms a bleb in the dermal area of the skin.
    2. The injection is given at a 40-degree angle.
    3. The injection site is pressed and rubbed in a circular motion.
    4. A 16-gauge needle is used.

12. What is the correct method for administering eye drops to an older adult client?
    1. Drop the medication directly on the cornea.
    2. Instruct the client to rapidly open and close their eye to distribute the medication.
    3. Place the applicator tip on the lower conjunctival sac and instil the drops.
    4. Instil the drops in the lower conjunctival sac.

Answers and rationales to these questions are in the section at the end of the book titled Chapter Study Questions: Answers and Rationales.
Appendix 4-1  CONVERSIONS

**Celsius and Fahrenheit**

Fahrenheit reading = \( \frac{9}{5} \times \) Celsius reading + 32

Example: Temperature is 50°C Celsius
Fahrenheit = \( \frac{9}{5} \times 50 + 32 \)
90 + 32 = 122°F Fahrenheit

**Pounds and Grams**

1 pound = 454 grams

To convert pounds to grams, multiply the number of pounds by 454.

\[ 7.5 \times 454 = 3405 \text{ g} \]

To convert grams to pounds, divide the number of grams by 454.

Example: An infant weighs 3405 g
\[ \frac{3405}{454} = 7.5 \text{ lb, or 7 lb 8 oz} \]

Appendix 4-2  ABBREVIATIONS AND SYMBOLS

<table>
<thead>
<tr>
<th>ac</th>
<th>ad lib</th>
<th>bid</th>
<th>C</th>
<th>Cl</th>
<th>cm</th>
<th>ft</th>
<th>gm</th>
<th>gt/gtt</th>
<th>H2O</th>
<th>H2O2</th>
<th>in</th>
<th>K</th>
<th>L</th>
<th>lb or #</th>
<th>liq</th>
<th>lytes</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td>before meals</td>
<td>as desired</td>
<td>twice daily</td>
<td>with</td>
<td>calcium</td>
<td>complete blood count</td>
<td>chloridene</td>
<td>and</td>
<td>extract</td>
<td>fluid</td>
<td>gram</td>
<td>drop/drops</td>
<td>water</td>
<td>hydrogen peroxide</td>
<td>inch</td>
<td>potassium</td>
<td>liter</td>
<td></td>
</tr>
</tbody>
</table>
| Mg | mcg | N | Na | NPO | OOB | os | pc | po | prn | q | qid | q2h | q3h | s | ss | \( \% \)at | \( \% \)ab | tid | WBC | milliliter | magnesium | micrograms | nitrogen | sodium | nothing by mouth | out of bed | mouth | after meals | by mouth | as needed | every | four times a day | every 2 hours | every 3 hours | without | one half | immediately | tablet | three times a day | white blood count/white blood cell
### Appendix 4-3

**LIST OF “DO NOT USE” ABBREVIATIONS, ACRONYMS, AND SYMBOLS APPROVED BY THE JOINT COMMISSION (TJC)**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Potential Problem</th>
<th>Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>U (for unit)</td>
<td>Mistaken as zero, four, or cc</td>
<td>Write “unit”</td>
</tr>
<tr>
<td>IU (for international unit)</td>
<td>Mistaken as IV (intravenous) or 10 (ten)</td>
<td>Write “international unit”</td>
</tr>
<tr>
<td>Q.D., QD, q.d., qd, (Latin abbreviation for once daily)</td>
<td>Mistaken for each other. The period after the Q can be mistaken for an “I” and the “O” can be mistaken for “I.”</td>
<td>Write “daily” and “every other day”</td>
</tr>
<tr>
<td>Q.O.D., QOD, q.o.d., qod, (Latin abbreviation for every other day)</td>
<td>Decimal point is missed</td>
<td>Write X mg</td>
</tr>
<tr>
<td>Trailing zero (X.0 mg)</td>
<td>Can mean morphine sulfate or magnesium sulfate</td>
<td>Write 0.X mg</td>
</tr>
<tr>
<td>Lack of leading zero (.X mg)</td>
<td>Confused for one another</td>
<td>Write “morphine sulfate” or “magnesium sulfate”</td>
</tr>
<tr>
<td>MS, MSO₄, MgSO₄</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


### Appendix 4-4

**ABBREVIATIONS AND SYMBOLS THAT ARE RECOMMENDED BUT NOT YET MANDATED BY THE JOINT COMMISSION (TJC) FOR INCLUSION IN THE OFFICIAL “DO NOT USE” LIST**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Potential Problem</th>
<th>Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; (Greater greater than)</td>
<td>Confused for one another and could be interpreted as the letter “L” or the number “7”</td>
<td>Write “greater than” or “less than”</td>
</tr>
<tr>
<td>&lt; (Less less than)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ (for the word at)</td>
<td>Mistaken for the number “2”</td>
<td>Write “at”</td>
</tr>
<tr>
<td>Drug name abbreviations</td>
<td>Misinterpreted for another drug due to similar abbreviations</td>
<td>Write drug names in full</td>
</tr>
<tr>
<td>μg (for microgram)</td>
<td>Mistaken for mg (milligrams) resulting in 1000-fold dosing overdose</td>
<td>Write “mcg” or “microgram”</td>
</tr>
</tbody>
</table>