RECONSTITUTION OF SOLUTIONS
Reconstitution of Solutions: Objectives

After reviewing this chapter, you should be able to:

1. Prepare solutions from powdered medications according to directions
2. Identify essential information to be placed on a vial of medication
3. Determine the best concentration strength for medications when several are available
4. Identify varying directions for reconstitution and select correct directions for reconstitution
Reconstitution of Solutions: Objectives (Cont.)

5. Calculate dosages for reconstituted medications
6. Determine the rate in mL/hr for enteral feedings
7. Calculate the amount of solute and solvent needed to prepare a desired strength for enteral feedings
Background: Reconstitution of Medications

- Some medications are stable for only short periods in the liquid state.
- Once mixed, a medication is good for only 1 to 14 days.
- The mixing process is called “reconstitution.”
- Many facilities reconstitute medications in the pharmacy.
- Nurses may have to mix medications just before administration or in the home setting.
Background: Reconstitution of Medications (Cont.)

- **Solute**: powdered or concentrated liquid medication

- **Solvent** or **diluent**: liquid added to the solute, type depends on the medication

- **Solution**: liquid mixture that results when the solvent dissolves the solute
  - Example: making instant tea—tea powder = solute, water = diluent, tea = solution

- Medications may be oral, injectable, or for irrigation

- STERILE diluents are always used for injectables
Basic Principles for Reconstitution

1. Manufacturer provides directions
   - Including solvent amount in mL, diluent, storage instructions, concentration after admixture

2. Diluents—Check expiration dates before use!
   - Most common—sterile water or normal saline
   - Others: D₅W, special solution (provided)

3. Must identify the following information:
   - Type of diluent, amount of diluent
   - Expiration period after admixture
4. If components in item #3 are unavailable, consult PDR (Physician’s Desk Reference) or other reliable source.

5. After reconstitution a multi-dose vial LABEL:
   - Date and time, mixture strength, expiration date, and time
   - Storage instructions (e.g., “refrigerate”)
   - Nurse’s initials
   - Apply label so that med information is visible
   - Discard if labeled inappropriately
Basic Principles for Reconstitution (Cont.)

6. The concentration of new mixture MUST be on the label (e.g., 500 mg per mL)

7. Powder often adds significant substance to the total volume of the solution (e.g., volume of diluent is 2.5 mL and total volume of solution is 3 mL). The label should indicate the total volume and concentration after admixture.
Figure 19-1 Ceftriaxone 1-g vial reconstitution.
Calculation When Final Concentration Is Not Stated

- Directions may not state final concentration in unit of measure per mL
- Example: Available 1 g of powder, add 2.5 mL diluent to yield 3 mL of solution containing 1 g
- Concentration is calculated as follows:

\[
\frac{1 \text{ g}}{3 \text{ mL}} = \frac{x \text{ mg}}{1 \text{ mL}} \text{ (needs conversion)}
\]

\[
\frac{1,000 \text{ mg}}{3 \text{ mL}} = \frac{x \text{ mg}}{1 \text{ mL}}
\]

\[
x = 333 \text{ mg per mL}
\]
Reconstitution of Multiple-Strength Medications

- Some solutions can be mixed to varying concentrations.
- Refer to package insert if directions are not on the vial.
- Nurse must choose the appropriate concentration.
Guidelines for Choosing Appropriate Concentrations

1. Route of administration
   - IM—amount cannot exceed the capacity of the target muscle but should not be irritating
   - IV—may be further diluted after reconstitution (e.g., added to 50 or 100 mL of another diluent such as NS). Volumes are smaller in pediatrics

2. Choose concentration that is closest to the order from prescriber
   - If order is for 300,000 units IM and medication can be mixed as 200,000 units per mL, 250,000 units per mL, or 500,000 units per mL, choose 250,000 units per mL
Guidelines for Choosing Appropriate Concentrations

3. “Respectively” means “in the order given”

Example: Reconstitute with 23 mL, 18 mL, and 8 mL to provide concentrations of
200,000 units per mL, 250,000 units per mL, and 500,000 units per mL, respectively

• 23 mL yields 200,000 units per mL
• 18 mL yields 250,000 units per mL
• 8 mL yields 500,000 units per mL

SAFETY ALERT!

WRITE THE DOSAGE STRENGTH ON THE VIAL AFTER ADMIXTURE
Reconstitution from Package Insert

► If directions are not on the label, read the insert.
► Look closely at amount in vial and route.
► Insert may give directions for different sized vials—read closely

SAFETY ALERT!

Directions may vary according to route. DO NOT interchange dilution instructions for IM or IV, you could cause client harm.
Calculating Reconstituted Dosages

- Performed same as other calculations
  - Ratio/proportion method
  - Formula method
  - Dimensional analysis

- The “have” dosage is based on the final concentration per volume that you mixed during reconstitution
Examples

The following examples are based on this scenario:

Mixture produced contains 1,000,000 units per mL of penicillin
Give: Penicillin 2,000,000 units IM q6h
Ratio and Proportion Method

\[\frac{1,000,000 \text{ units}}{1 \text{ mL}} = \frac{2,000,000 \text{ units}}{x \text{ mL}}\]

\[1,000,000(x) = 2,000,000(1)\]

\[\frac{1,000,000x}{1,000,000} = \frac{2,000,000}{1,000,000}\]

\[x = 2 \text{ mL}\]
Formula Method

Desired 200,000 units
Have is 1,000,000 units
Quantity is 1 mL

\[
\frac{(D)}{200,000 \text{ units}} \times (Q) \frac{1 \text{ mL}}{100,000 \text{ units}} = x \text{ mL}
\]

\[x = 2 \text{ mL}\]
Fractional Equation Method

\[
\frac{1,000,000 \text{ units}}{1 \text{ mL}} = \frac{2,000,000 \text{ units}}{x \text{ mL}}
\]

\[
1,000,000(x) = 2,000,000 \quad (1)
\]

\[
\frac{1,000,000x}{1,000,000} = \frac{2,000,000}{1,000,000}
\]

\[
x = 2 \text{ mL}
\]
Case Study 4

Mrs. Garcia has diuresed 1,200 mL and her SOB has resolved. She is on 1.5 L per day fluid restrictions and strict I and O is ordered. It is now time to administer her antibiotic:

Tazicef 1,000 mg IV q12h
You reconstitute per manufacturer instruction in a 50 mL bag of 0.9% NaCl sterile solution. What is the dosage strength?
Case Study 4 (Cont.)

Answer:

Tazicef 20 mg per mL
Case Study 4 (Cont.)

Along with the antibiotic, Mrs. Garcia also gets:

Protinix 20 mg IV daily

You reconstitute with 10 mL NS. How much will you administer?
Case Study 4 (Cont.)

Answer:

Administer 5 mL slow IV push before running the antibiotic.
Reconstitution of Noninjectable Solutions (Enteral Feedings)

Nutrition via gastrointestinal tract to clients who are unable to ingest food

- Blended foods or feeding formulas
- Administered in different ways:
  - Bolus—several times a day
  - Continuous—throughout the day or for a limited time period, delivered by electronic pump
- Sample: Jevity® at 65 mL per hr via gastrostomy tube
Figure 19-4 Kangaroo pump. (From Potter PA, Perry AG, Stockert P, Hall A: Fundamentals of nursing, ed 8, St Louis, 2013, Mosby.)
Enteral Feeding Rate Calculation

Order: Pulmo Care 400 mL q8h followed by 100 mL of water after each feeding

\[
\frac{400 \text{ mL}}{8 \text{ hr}} = 50 \text{ mL/hr}
\]
Dilution of Enteral Feedings

- Nutritional liquids may be administered orally or through feeding tubes
- May require dilution before they are used
  - Dilute strengths to prevent intolerance
- Can be supplied as
  - Ready-to-use form
  - Powder for reconstitution
  - Liquid concentrate
- Review: solute, solvent, solution
1. \[ \text{Desired solution strength} \times \text{Amount of Desired Solution} = \text{Solute (solution to be dissolved)} \]

Note: Strength of desired solution is written as fraction.

Amount of desired solution is written in mL or oz.

2. \[ \text{Amount of desired solution} - |\text{Solute}| = \text{Amount of liquid needed to dissolve substance (solvent)} \]
Order: 1/3 strength Ensure® 900 mL via NG over 8 hr

Step 1

\[
\frac{1}{3} \times 900 \text{ mL} = x \text{ (solute)}
\]

\[
\text{desired strength} \times \text{ ordered amount of solution} = \text{amount of solute (Ensure)}
\]

\[
x = \frac{900}{3} = 300 \text{ mL of Ensure}
\]
Step 2

900 mL - 300 mL = 600 mL

ordered amount of solution

- solute needed

= amount of solvent needed to dissolve
Irrigating Solutions and Soaks

- Nurses may need to dilute solutions such as hydrogen peroxide for topical solution.

Example: Prepare 180 mL of \( \frac{1}{4} \) strength hydrogen peroxide solution diluted with NS.

\[
\frac{1}{4} \times 180 \text{ mL} = x \text{ mL}
\]

(Desired Strength) \( \times \) (Amount of Solution) = (Solute)

\[
x = \frac{180}{4} = 45 \text{ mL Hydrogen Peroxide}
\]
Mrs. Garcia receives 2/3 Strength Jevity® 240 mL q8h. You clear the pump from the earlier administration and prepare to administer a new bag. How much solute is necessary and what is the hourly rate?
Case Study 4 (Cont.)

Answer:

Mix 160 mL Jevity® with 80 mL water. Rate is 30 mL per hour.