Chapter 14

Reconstitution of Medications

Learning Objectives

1. Prepare a solution from a powdered medication according to directions on the vial or other resources.
2. Identify essential information to be placed on the vial of a medication after it is reconstituted.
3. Determine the best concentration strength for medications ordered when there are several directions for mixing.
4. Identify the varying directions for reconstitution and select the correct directions to prepare the dosage ordered.

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 to be dissolved or diluted
- ***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: D_5W, special solution (provided)
3. Must identify the following information:
   - Type of diluent, amount of diluent
   - Expiration period after reconstitution
   - Directions for storing after reconstitution
   - Strength of medication after reconstitution

Basic Principles for Reconstitution (Cont.)

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**.

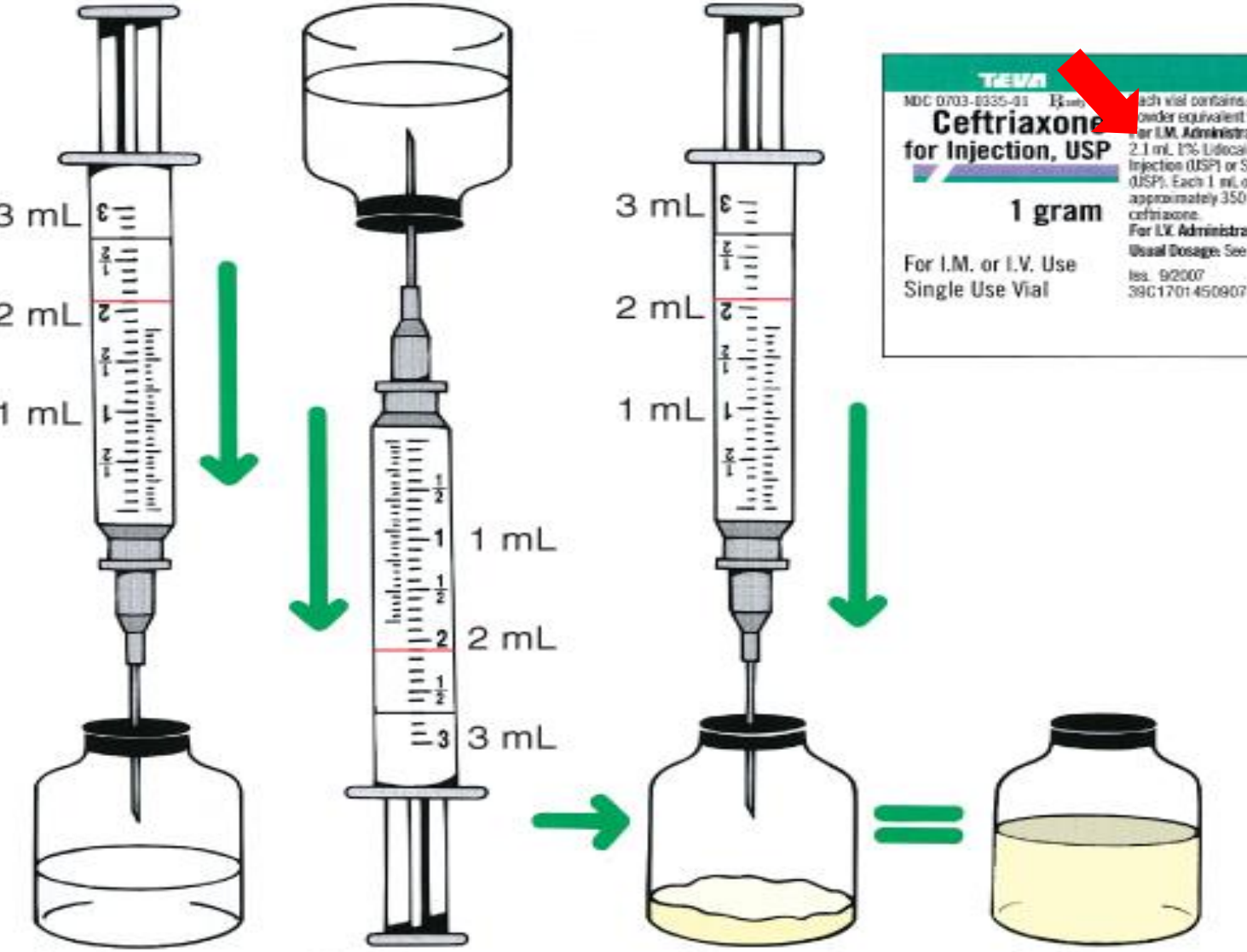
Multi Dose Vials

Proper Labeling & Disposal

- Write **date 28 days** from initial opening
- Discard on **28th day** or if sterility compromised
- **Examine** vial for visible signs of contamination or deterioration
  - **Withdrawals from vial MUST**
    - Use **sterile technique**
    - **DO NOT** leave needle or needle sheath in the vial top for ease of access!

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.



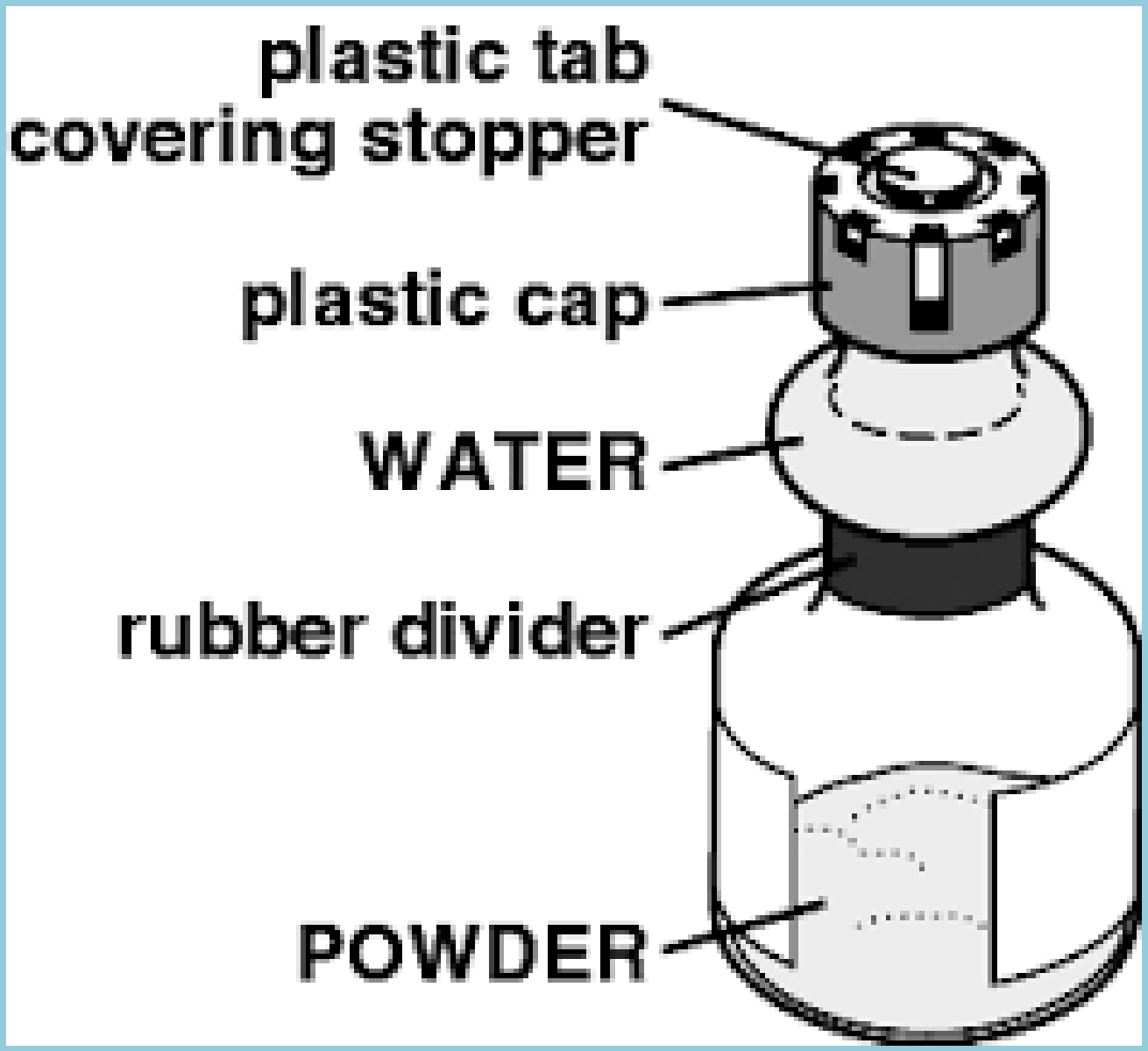
Sterile water for injection. Add 2.1 mL of air into sterile water diluent vial.

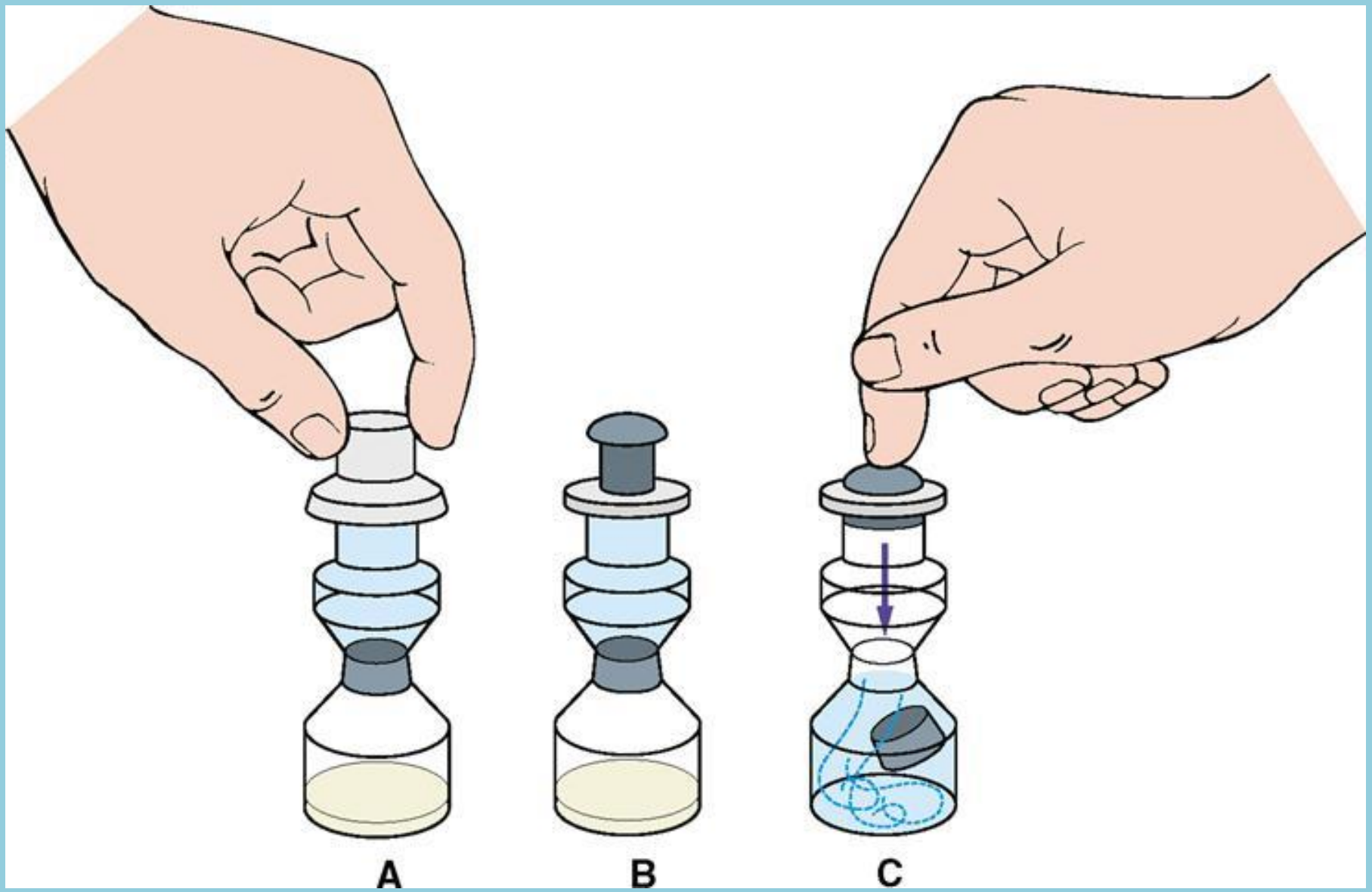
Sterile water for injection. Withdraw 2.1 mL of sterile water.

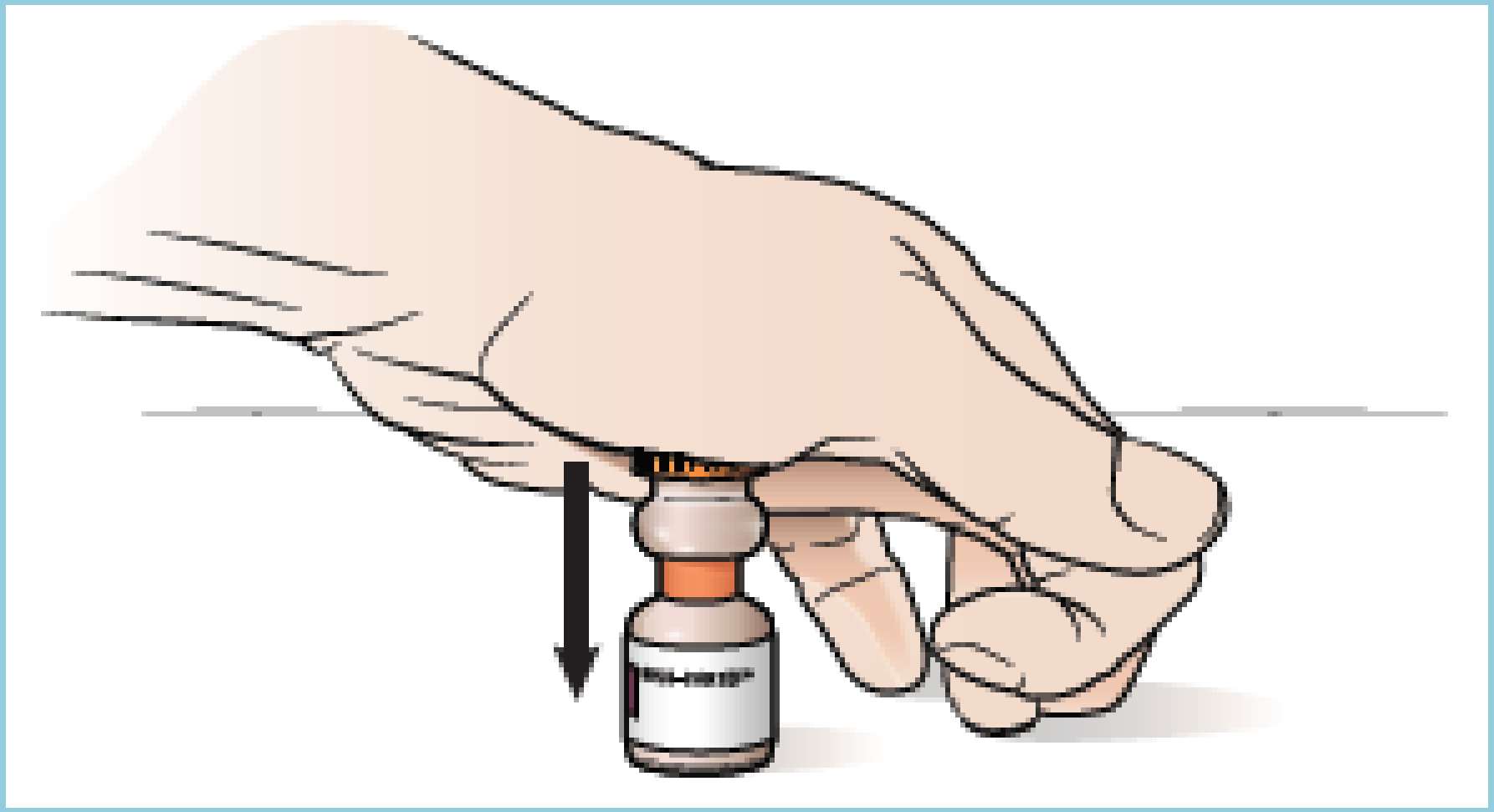
Add 2.1 mL sterile water for injection to ceftriaxone powder.

Ceftriaxone reconstituted solution 350 mg per mL.

In the Mix-O-Vial system, the vials are joined at the neck. Confirm the labels.


plastic tab
covering stopper
plastic cap
WATER
rubber divider
POWDER


A
B
C



Act-o-vial

- https://www.youtube.com/watch?v=xcGoYGW4NcU

  (3:20)

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 or dosage strength appropriate for the dosage ordered.

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 (Cont.)

SAFETY ALERT! 

When multiple directions are given for reconstituting medications, the smaller the amount of diluent used to reconstitute the medication, the more concentrated the resulting solution will be. Consider the route of administration when reconstituting medications. Always check the route and the directions related to reconstitution.

Guidelines for Choosing Appropriate Concentrations (Cont.)

3. "Respectively" means "in the order given"

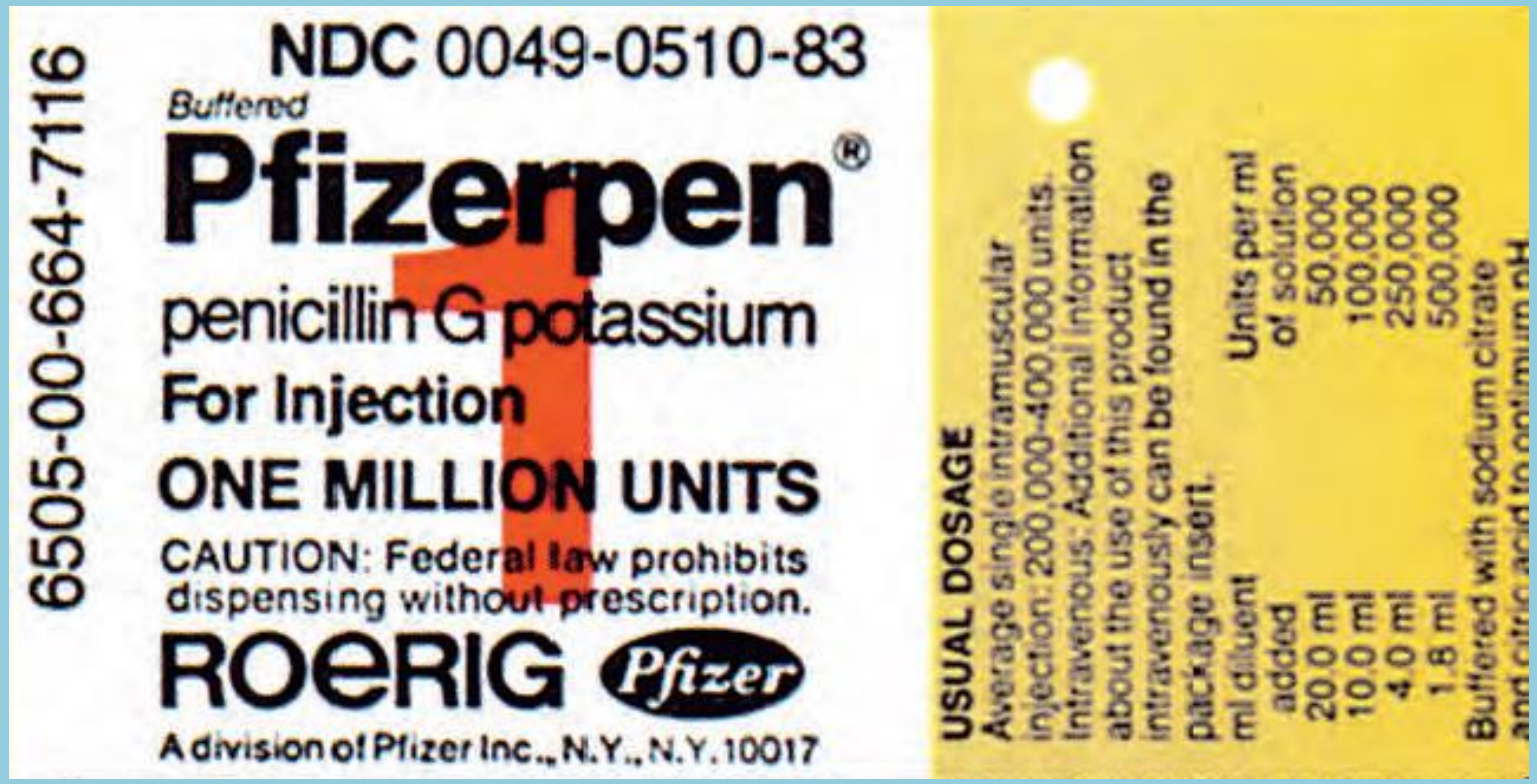
   Example: Reconstitute with 23 mL, 18 mL, and 8 mL to provide concentrations of 200,000 units per mL, 250,000 units per mL, and 500,000 units per mL, ***respectively***

   - 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

How Much Diluent Would You Add to Yield 500,000 Units?



How Much Diluent Would You Add to Yield 500,000 Units?

STOP HERE

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.

Learning Objectives (Cont.)

5. calculate dosages for reconstituted medications.

6. determine the rate in milliliters per hour for enteral feedings.

7. calculate the amount of solute and solvent needed to prepare a desired strength for enteral feedings, irrigations, and soaks.

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:

1 g:3 mL = *x* mg:1 mL (needs conversion)

1,000 mg:3 mL = *x* mg:1 mL

x = 333 mg per mL

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

Order: Penicillin 2,000,000 units IM q6h

Ratio and Proportion Method

$$1{,}000{,}000 \text{ units} : 1 \text{ mL} = 2{,}000{,}000 \text{ units} : x \text{ mL}$$

$$1{,}000{,}000(x) = 2{,}000{,}000(1)$$

$$\frac{1{,}000{,}000x}{1{,}000{,}000} = \frac{2{,}000{,}000}{1{,}000{,}000}$$

$$x = 2 \text{ mL}$$

Formula Method

Desired 200,000 units

Have is 1,000,000 units

Quantity is 1 mL

$$\frac{\text{(D) } \cancel{200,000}\text{ units}}{\text{(H) } \cancel{100,000}\text{ units}} \times \text{(Q) } 1\text{ mL} = x\text{ mL}$$

$x = 2$ mL

Fractional Equation Method

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

$$1{,}000{,}000(x) = 2{,}000{,}000\ (1)$$

$$\frac{1{,}000{,}000x}{1{,}000{,}000} = \frac{2{,}000{,}000}{1{,}000{,}000}$$

$$x = 2 \text{ mL}$$

Case Study

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

Case Study (Cont.)

You reconstitute per manufacturer instruction in a 50 mL bag of 0.9% NaCl sterile solution. What is the dosage strength?

Case Study (Cont.)

ANS:

Tazicef 20 mg per mL

Case Study (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 (Cont.)

ANS:

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

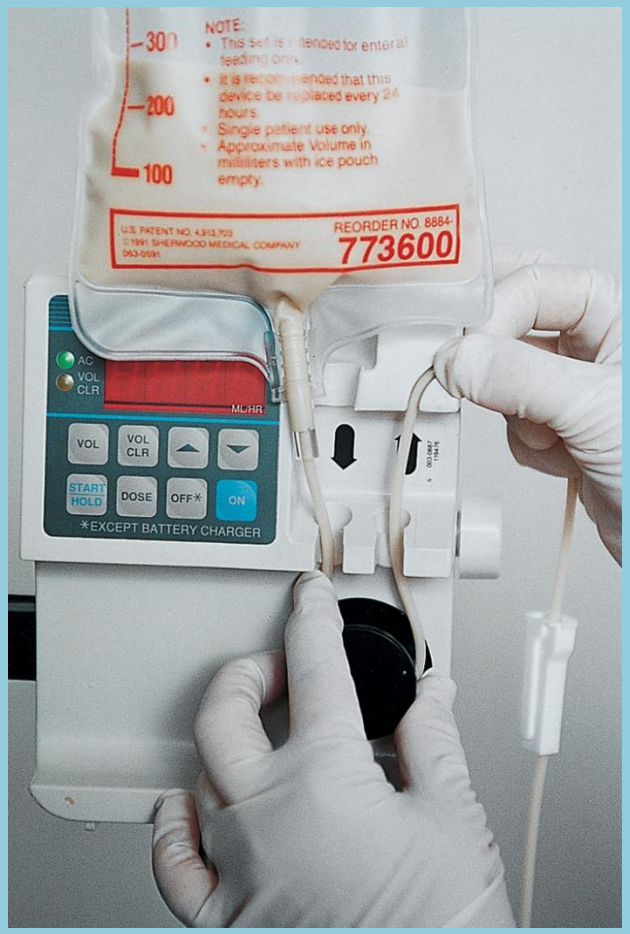


Figure 19-2 Kangaroo pump. (From Potter PA, Perry AG, Stockert P, Hall A: *Fundamentals of nursing,* ed 9, St Louis, 2016, Mosby.)

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. | Desired solution strength | × | Amount of Desired Solution | = | 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. | Amount of desired solution | - | Solute | = | Amount of liquid needed to disolve substance (*solvent*) |

Order: 1/3 Strength Ensure® 900 mL via NG over 8 hr

Step 1

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

$$\left|\begin{array}{c}\text{desired}\\ \text{strength}\end{array}\right| \times \left|\begin{array}{c}\text{ordered}\\ \text{amount of}\\ \text{solution}\end{array}\right| = \left|\begin{array}{c}\text{amount of solute}\\ (\textit{Ensure})\end{array}\right|$$

$$x = \frac{900}{3} = 300 \text{ mL of Ensure}$$

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 ¼ strength hydrogen peroxide solution diluted with NS

¼	x	180 mL	=	*x* mL
(Desired Strength)		(Amount of Solution)		(Solute)

$x = \frac{180}{4}$

x = 45 mL Hydrogen Peroxide

Case Study

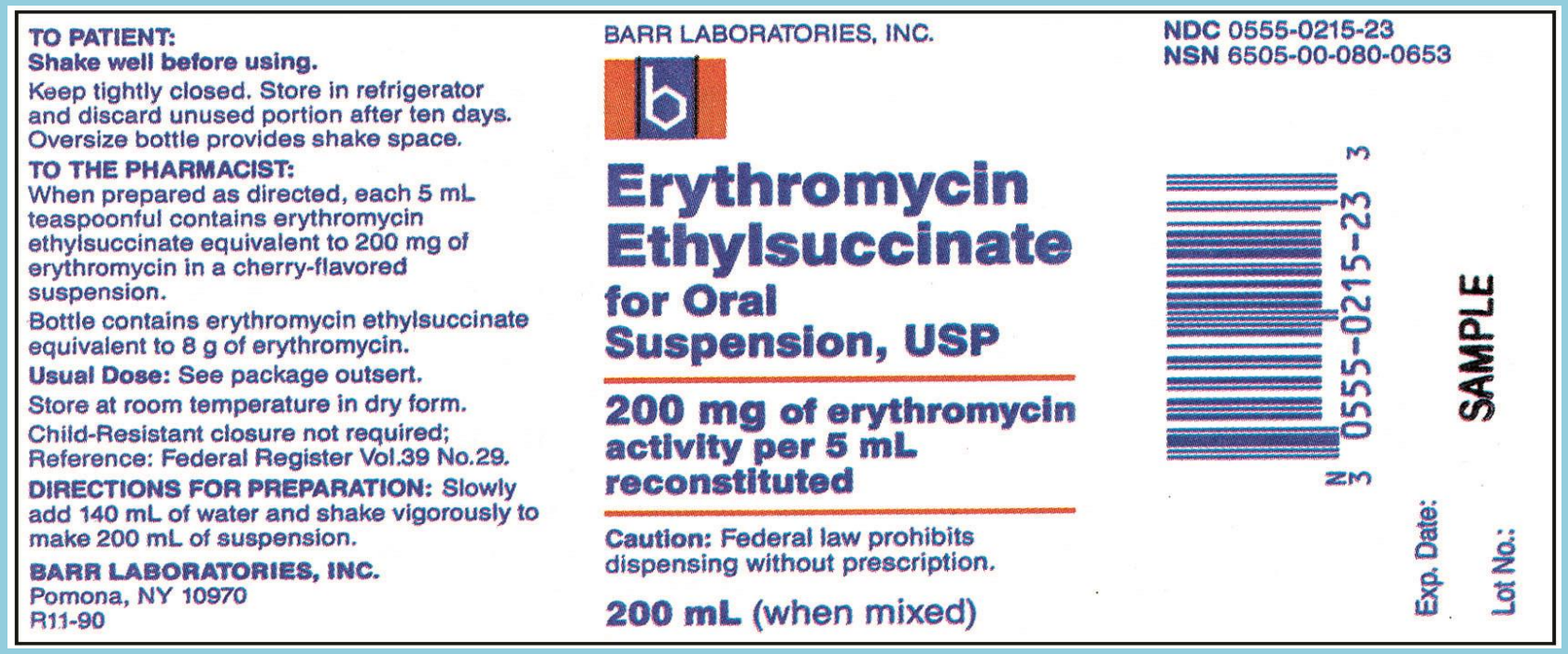
Mrs. Garcia receives 2/3 Strength Jevity® 240 mL q8h. You clear the pump from the earlier administration and prepare to administer a new bag. How much solute is necessary and what is the hourly rate?

Case Study (Cont.)

ANS:

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

Practice Problems



TO PATIENT:
Shake well before using.
Keep tightly closed. Store in refrigerator and discard unused portion after ten days. Oversize bottle provides shake space.

TO THE PHARMACIST:
When prepared as directed, each 5 mL teaspoonful contains erythromycin ethylsuccinate equivalent to 200 mg of erythromycin in a cherry-flavored suspension.

Bottle contains erythromycin ethylsuccinate equivalent to 8 g of erythromycin.

Usual Dose: See package outsert.

Store at room temperature in dry form.

Child-Resistant closure not required; Reference: Federal Register Vol.39 No.29.

DIRECTIONS FOR PREPARATION: Slowly add 140 mL of water and shake vigorously to make 200 mL of suspension.

BARR LABORATORIES, INC.
Pomona, NY 10970
R11-90

BARR LABORATORIES, INC.

Erythromycin Ethylsuccinate for Oral Suspension, USP

200 mg of erythromycin activity per 5 mL reconstituted

Caution: Federal law prohibits dispensing without prescription.

200 mL (when mixed)

NDC 0555-0215-23
NSN 6505-00-080-0653

N 3 0555-0215-23 3

SAMPLE

Exp. Date:

Lot No.:

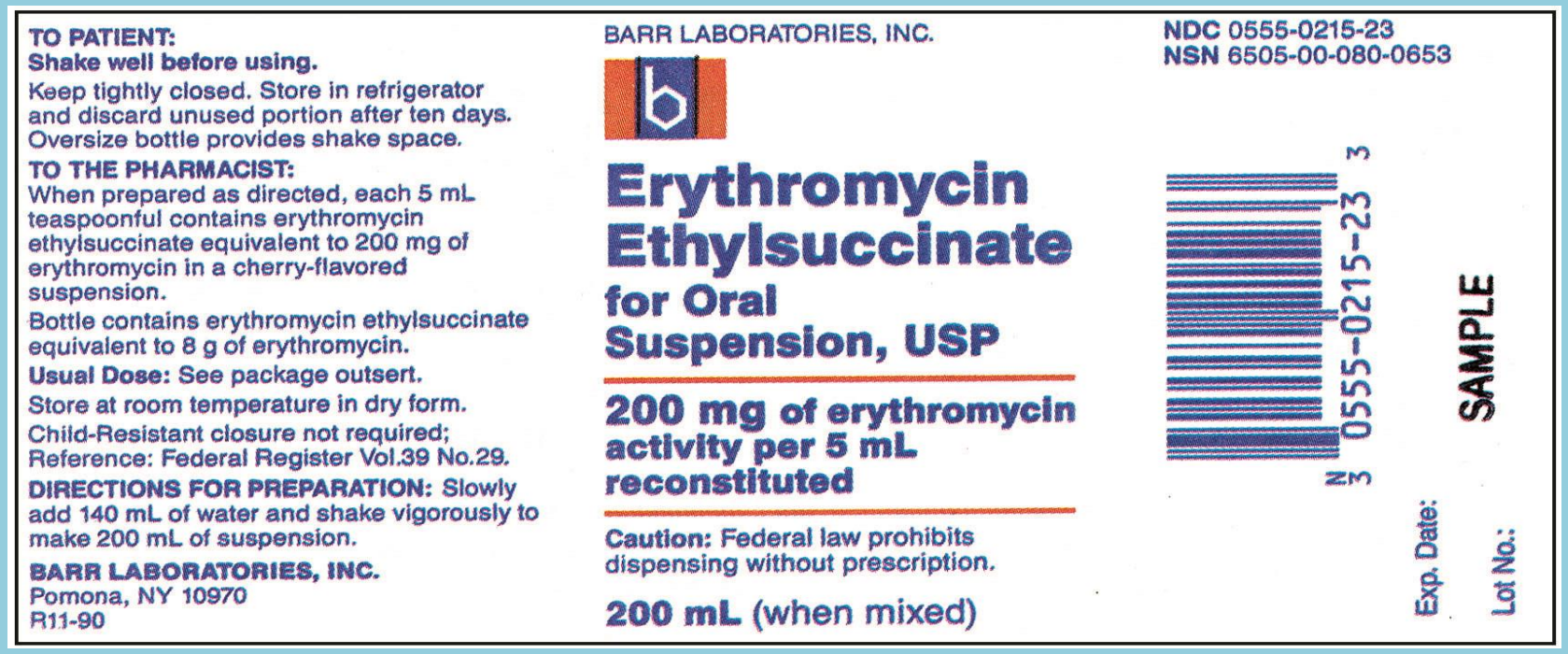
How much diluent must be added to prepare the solution?

What is the volume after preparation?

What is the final concentration?

For how long is the reconstituted solution stable?

Practice Problems



How much diluent must be added to prepare the solution? 140 mL

What is the volume after preparation? 200 mL

What is the final concentration? 200 mg / 5 mL or 40 mg / mL

For how long is the reconstituted solution stable? 10 days

Practice Problems (Cont.)

Prepare the following solutions using full strength hydrogen peroxide (solute) and normal saline (solvent):

1. 160 mL of 1/2 strength
2. Prepare 10 oz of 2/3 strength
3. Prepare 120 mL of 5/8 strength

How many mL of solvent would you use for each solution?

Practice Problems (Cont.)

Prepare the following solutions using full strength hydrogen peroxide (solute) and normal saline (solvent):

1. 160 mL of 1/2 strength 80 mL
2. Prepare 10 oz of 2/3 strength 200 mL
3. Prepare 120 mL of 5/8 strength 45 mL

How many mL of solvent would you use for each solution?