Chapter 11

ORAL MEDICATIONS & DOSAGES

Learning Objectives

1. identify the forms of oral medication.
2. identify the terms on the medication label to be used in calculation of dosages.
3. calculate dosages for oral and liquid medications using ratio and proportion, the formula method, or dimensional analysis.
4. apply principles learned concerning tablet and liquid preparations to obtain a rational answer.

Learning Objectives
Dimensional Analysis Method

1. Using the dimensional analysis method to solve problems of oral dosages involving tablets, capsules, liquid medications, and those measured in milliequivalents
2. Converting all measures within the problem to equivalent measures in one system of measurement if required
3. Using a proportion to solve problems of oral dosages involving tablets, capsules, liquid medications, and those measured in milliequivalents
4. Using the stated formula as an alternative method of solving problems of oral drug dosages involving tablets, capsules, liquid medications, and those measured in milliequivalents

Background

- Enteral: meds administered directly into GI tract
  - Oral, rectal, through tube (NGT, PEG Tube)
  - Nasogastric Tube (NGT)
  - Percutaneous Endoscopic Gastrostomy Tube (PEG)
    - Inserted directly through the abdominal wall

Types of nutrition support

1. Oral
2. Enteral
3. Parenteral

TPN vs PPN

Total Parenteral Nutrition

- Only source of nutrition the patient is receiving

Peripheral Parenteral Nutrition

- Nutrition supplemental to other sources of nutrition

(Note: Both are administered intravenously)

Parenteral and Enteral Nutrition

PARENTERAL NUTRITION

Feeding intravenously, bypassing the usual process of eating and digestion.

A Feeding through the central vein

B Feeding through peripheral veins

ENTERAL NUTRITION

Liquid supplemental nutrition is either taken by mouth or is given via a feeding tube.

Nasal or oral feeding tube terminates at, either:

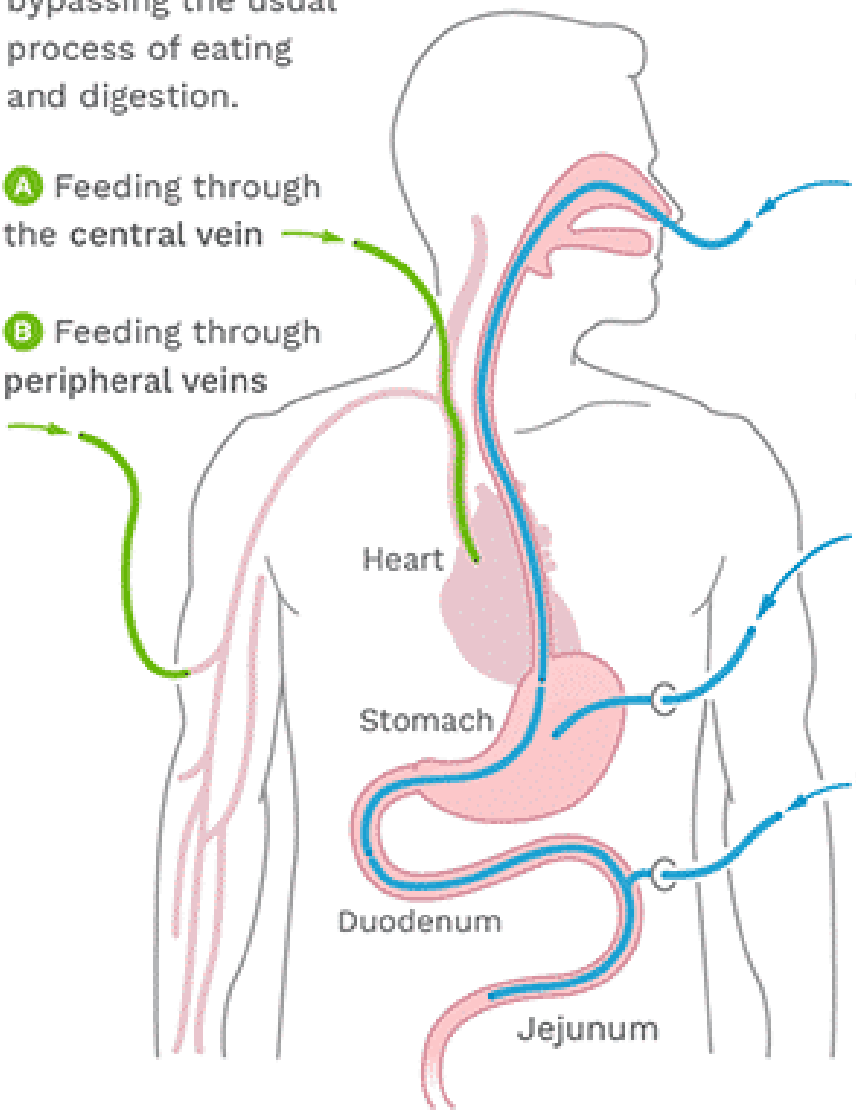
C Stomach (Nasogastric)

D Duodenum (Nasoduodenal)

E Jejunum (Nasojejunal)

F Feeding tube that leads though an artificial external opening into the stomach (Gastrostomy)

G Feeding tube that leads though an artificial external opening into the small intestine (Jejunostomy)

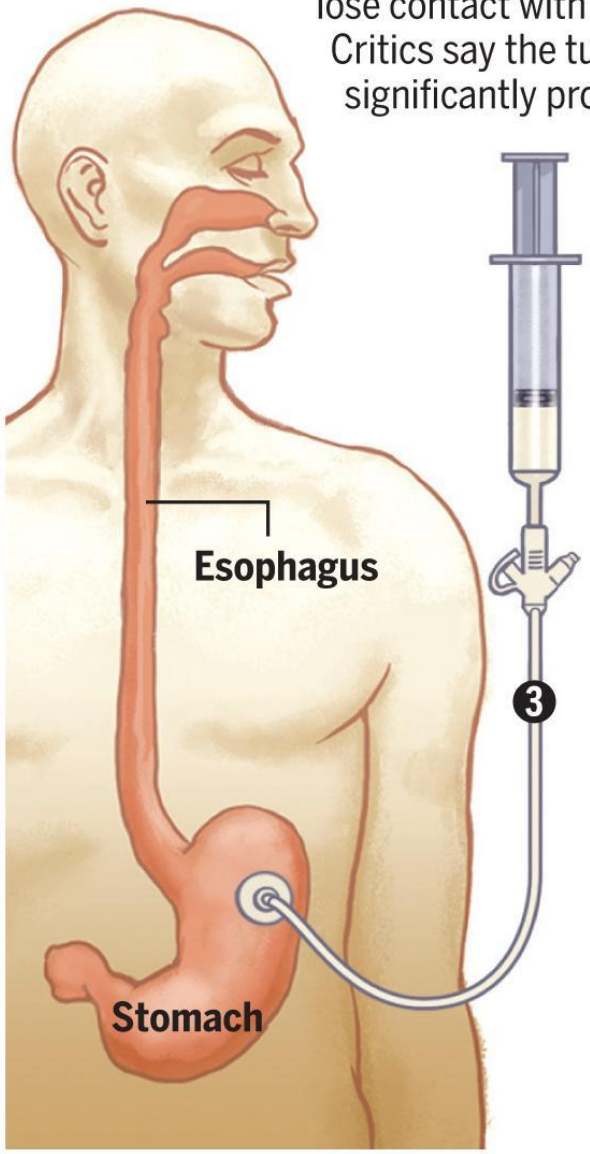


PEG Tube
Percutaneous Endoscopic Gastrostomy Tube

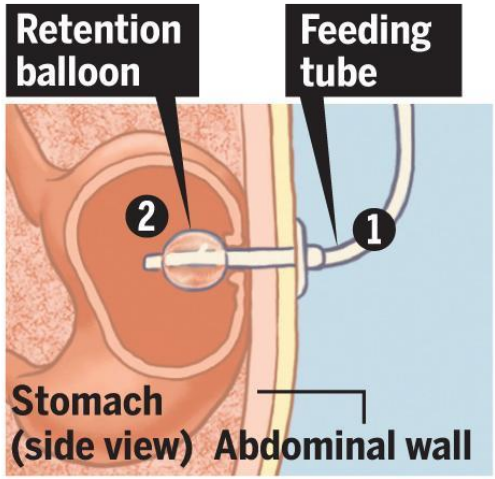
Feeding those who cannot feed themselves

Feeding tubes nourish patients with dementia who are unable to feed themselves. The tubes can keep patients alive long after they lose contact with the world.

Critics say the tubes prolong suffering without significantly prolonging life.



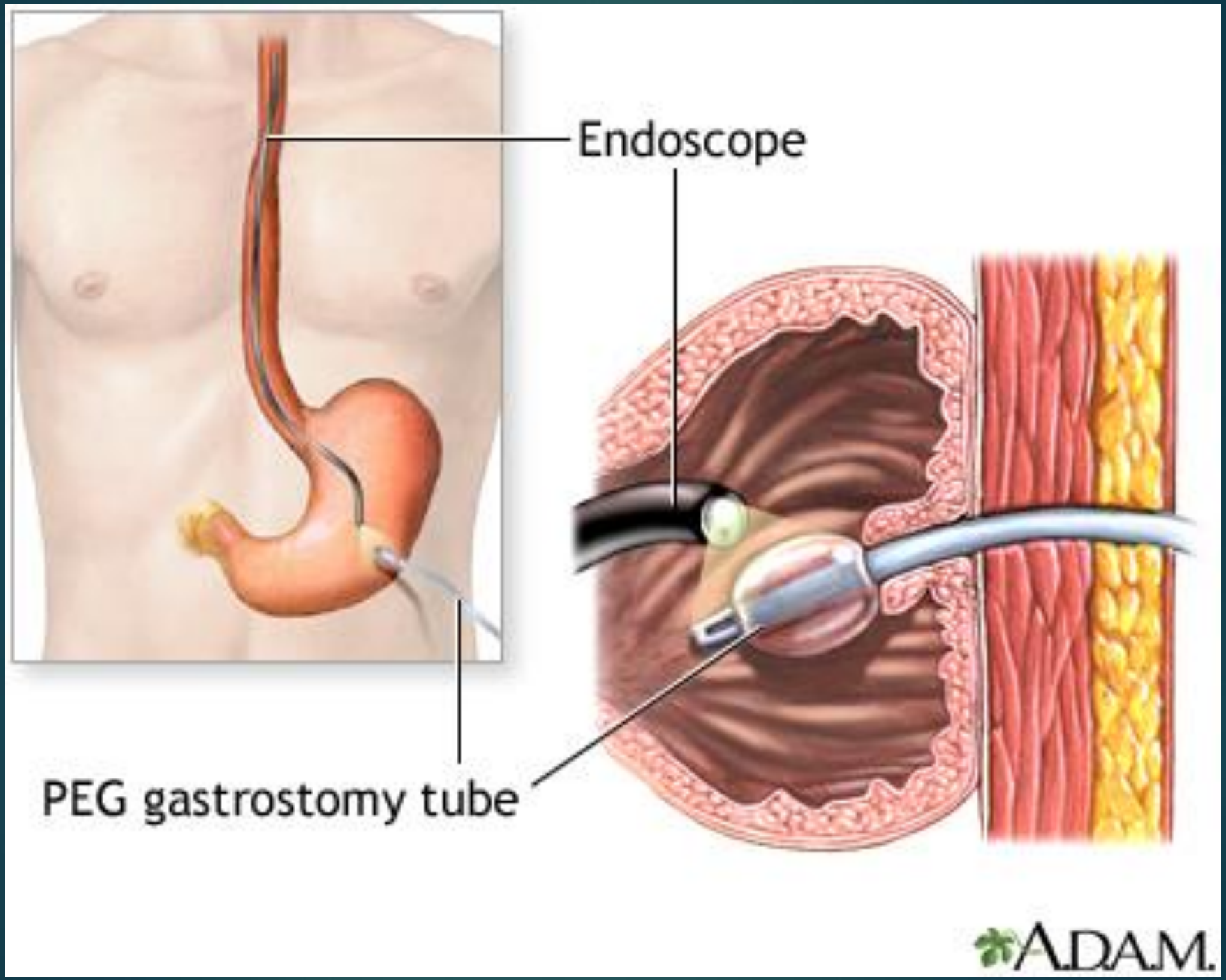
1. Feeding tube is surgically placed into the stomach.
2. Some tubes use a water-filled balloon to anchor the device.



3. Liquid nutrition or medication is administered with a syringe or by gravity.

Sources: A.D.A.M., Inc., Sunnybrook Health Sciences Center website, www.pinnt.com

BAY AREA NEWS GROUP

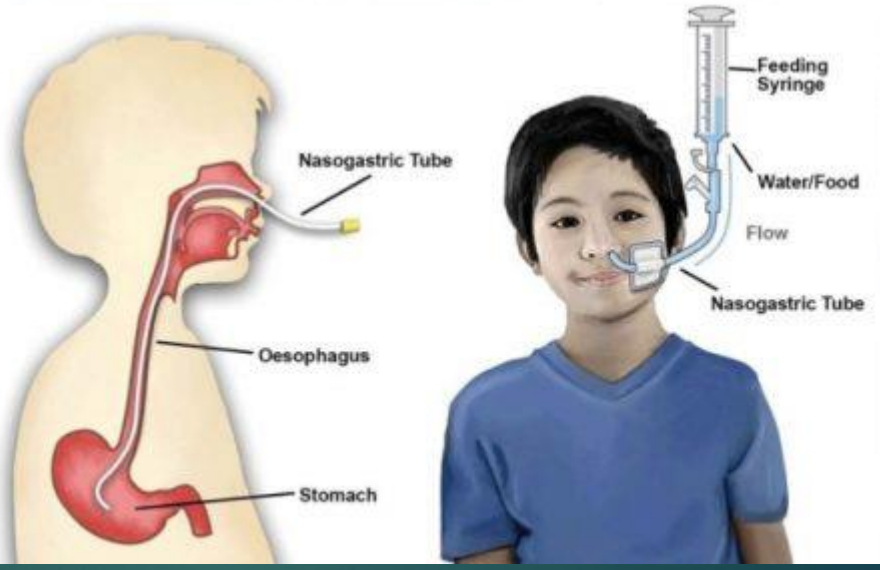

Endoscope
PEG gastrostomy tube
A.D.A.M.

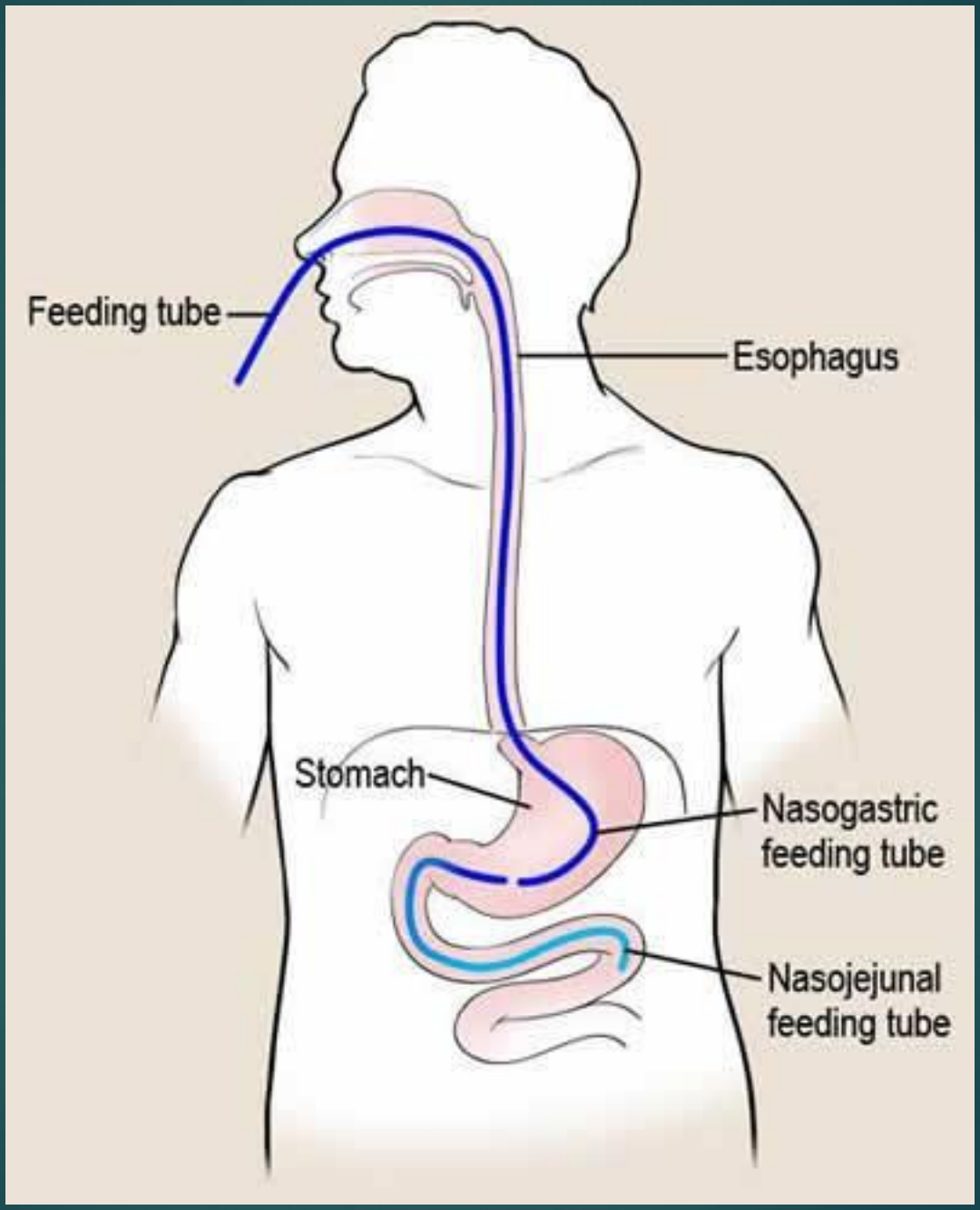
NGT
Nasogastric Tube

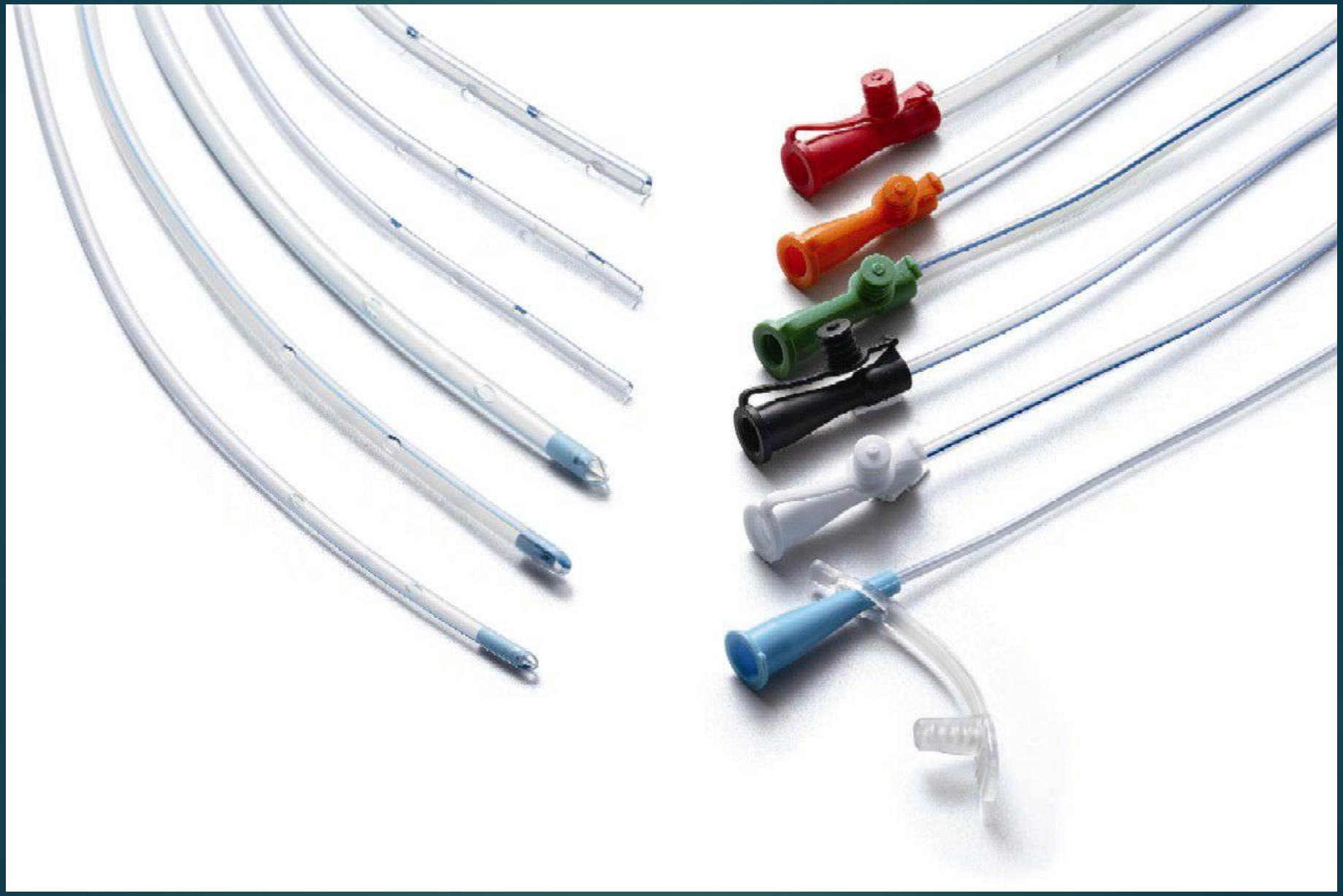
What is a nasogastric tube?

A nasogastric (NG) tube is a flexible tube that is passed through the nose, and down the throat to reach the stomach. It is used for two purposes:

- To drain the stomach if it is not working properly, which can sometimes happen after surgery;
- To provide nourishment (tube feeding) directly into the stomach if the patient cannot eat because of intubation,




Feeding tube
Esophagus
Stomach
Nasogastric feeding tube
Nasojejunal feeding tube



Enteral Feeding Tube

- **Duo Tube - smaller lumen**
  - weighted end
  - goes past stomach into duodenum
  - placement must be verified by x-ray before removing insertion wire.

Medications Via NG Tube

- Administer in meds in liquid form.
- Crush pills, dissolve in warm water.
- Give 1 at a time [best practice]
- Always check placement prior to medication administration.
- Check patency of tube by pre flushing.
- Post flush after medication administration.

Giving Medication Through an NG Tube

- Holding the nasogastric (NG) tube at a level some what above the patient's nose, pour up to 30 ml of the diluted medication into the syringe barrel. Hold the at a slight angle and add more medication before the syringe empties. rise the tube slightly higher to increase the flow rate.

NG/G Tube Medications

- Make sure the medications can be crushed or are in liquid form
- Check for proper placement of NG tube prior to giving meds and check for residual for all tubes
- Each medication is administered separately by gravity syringe method followed by a small water flush
- Water flush at the end of administration of medication

Background

- Oral Medications:
  - Most economical
  - Easiest to administer
  - Most common type of medication given
  - Available as solids and liquids
  - Unit dose and bulk packaging
  - Usually simple calculations

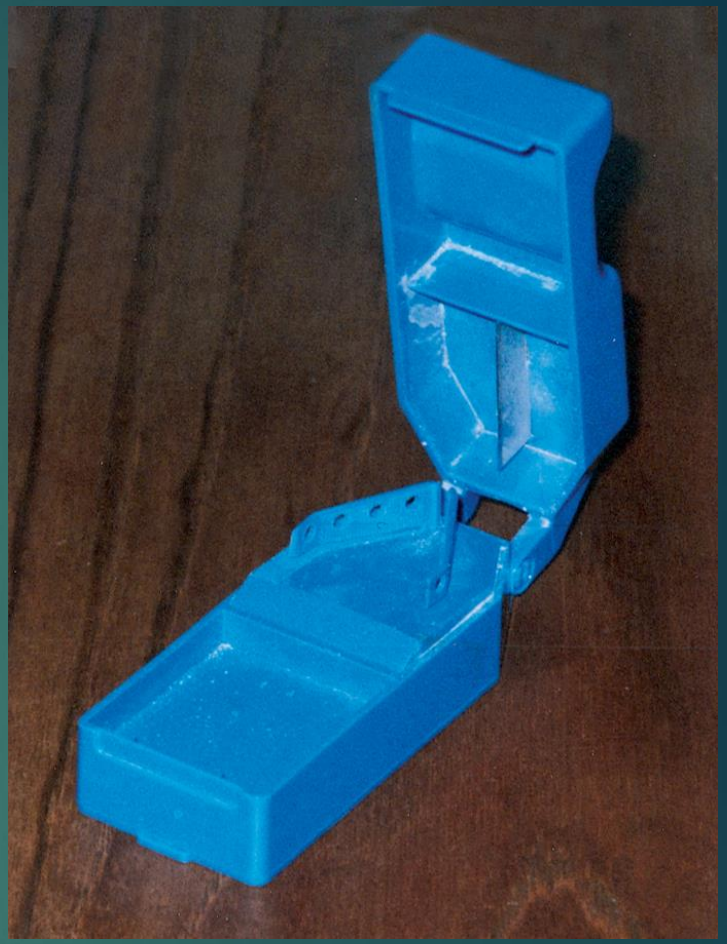
Forms of Solid Medications

- Tablets
  - Powdered medications molded in shapes
- Caplets
  - Elongated tablets coated to ease swallowing
- Scored tablets—use pill cutter
  - Tablets with indented markings designed to cut and deliver ½ or ¼ what is in a whole tablet


SAFETY ALERT


Breaking an unscored tablet is dangerous and can result in an unintended dose.

Clonazepam tablet scored

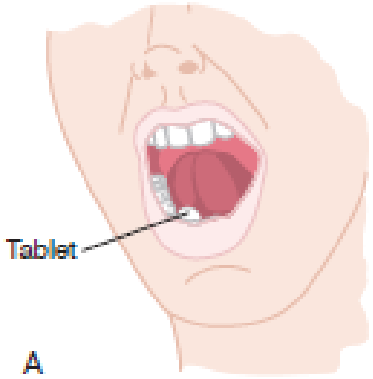


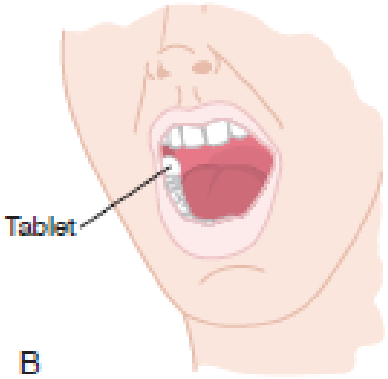
Pill/tablet cutter

Must wash out between usage

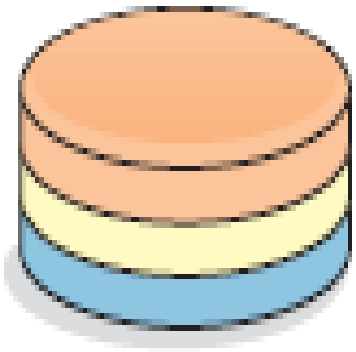
Forms of Solid Medications (Cont.)

- Enteric-coated tablets and film tablets
  - Special coating protects against gastric secretions
  - NEVER crush EC tablets—defeats the purpose
- Sublingual tablets
  - Placed under tongue for direct absorption
  - Buccal tablets placed between gums and cheek
  - NEVER swallow SL or Buccal tablets—prevents desired effect
- Layered tablets
  - Two meds with different components
- Film Tab
  - Tablet sealed with a film. The special coating helps to protect the stomach.
- Disintegrating and chewable tablets





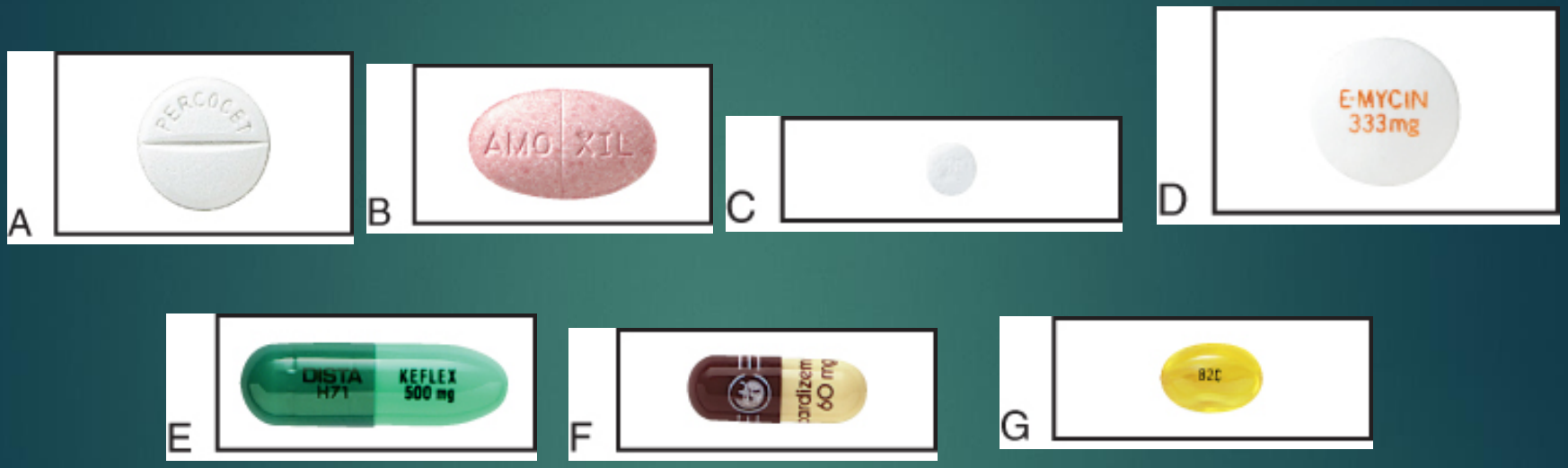
Sublingual (A) and buccal (B) tablets



Layered tablet.

Forms of Solid Medications (Cont.)

- Time-release and extended-release tablets
  - Labeled SA, LA, XL, SR, or ER
  - Released over a period of time
  - NEVER crush, chew, or break 
- Capsules
  - Contains powder, liquid, or oil with hard/soft gelatin coating
  - NEVER crush, chew, or break without consulting a pharmacist.
- Others: troches, lozenges, pulvules, spansules, sprinkle capsules 



Types of oral medications. A, Scored tablet. B, Chewable tablet. C, Sublingual. D, Timed-release tablet. E, Capsule. F, Timed-release capsule. G, Gelatin capsule.

Case Study

Mrs. Garcia is a 67-y/o female admitted at 1930 to the unit with gangrenous toes and heel of the left foot. Report from the ER nurse reveals a history of DM II, ESRD, HTN, and depression. She also has dysphagia and L-sided weakness due to a stroke last year. She receives enteral feedings and meds through a PEG tube. She has a Foley catheter and a 20-gauge IV to the R forearm running NS at a rate of 30 mL/hr. She is to have enteral feeding held after midnight and prepped for L BKA tomorrow at 0830.

Case Study

The doctor orders to continue home meds and you review the medication reconciliation form. What problems can you detect given the patient's history?

- Metoprolol ER 50 mg p.o. daily
- Lisinopril 5 mg p.o. daily
- HCTZ 12.5 mg p.o. daily
- Lasix 20 mg p.o. b.i.d.
- Glyburide 5 mg p.o. daily
- Wellbutrin XL 300 mg p.o. daily
- Percocet 5/325 1 tab q3h prn pain

Case Study

ANSWER:

Metoprolol *ER* and Wellbutrin *XL* are long-acting tablets. Long-acting tablets should NEVER be crushed.

You alert the physician and he changes the order accordingly.

Points to Remember

- Converting dosages from one system to another can result in discrepancies.
- 10% rule—no more than 10% variance should exist between dose ordered and dose administered.
- Capsules are administered whole only.
- Tablets are available in different strengths
  - Choose the least number of tablets or capsules without dividing a tablet.

Points to Remember (Cont.)

- It is safer to give whole tablets equal to the dose than to cut tablets.
- Maximum number of tablets or capsules used to deliver a dose is usually three (3).
  - Exceptions exist, such as some HIV meds—always double-check dosage.
- Some measures and units such as mEq and units do not convert to metric.

Examples

The following three examples are based on this order:

Give: Digoxin 0.375 mg p.o. daily

Available: Digoxin in scored tablets of 0.25 mg

Dimensional Analysis Method

$$x \text{ tab} = \frac{1 \text{ tab}}{0.25 \cancel{\text{mg}}} \times \frac{0.375 \cancel{\text{mg}}}{1}$$

$$x \text{ tab} = \frac{0.375}{0.25}$$

$$x = 1\frac{1}{2} \text{ tabs}$$

Reminders

1. Read the order carefully and
    a. identify known factors.
    b. identify unknown factors.
    c. eliminate unnecessary information that is not relevant.
2. Consider the system of measurement and units and whether or not a conversion will be necessary.
3. Consider what would be a reasonable answer based on what is ordered.
4. Set up the problem using dimensional analysis. Label each component in the setup, including x.
5. Label the final answer (tablet, capsule).
6. For administration purposes, for oral dosages that are given in fractional dosages (e.g., scored tablets), state answers to problems in fractions. Example: 1⁄2 tab or 1 1⁄2 tabs, instead of 0.5 tabs or 1.5 tabs.

Variations of Tablet/Capsule Problems

- To determine the number of tablets needed over a period of days, multiply doses per day by the number of days

  Example: Valium 10 mg p.o. q.i.d for 7 days. Tablets available are 5 mg tablets. How many will the client take in one week?

1. Multiply 5 mg × 2 for each dose = 2 tablets per dose.
2. Multiply 2 tablets × 4 for 4 doses/day = 8 tablets/day.
3. Multiply 8 tablets per day × 7 to find number needed for 7 days = 56 tablets.

Variations of Tablet/Capsule Problems (Cont.)

- You can also use dimensional analysis to solve this problem in one equation:

$$\frac{\text{tab}}{\text{week}} = \frac{1\,\text{tab}}{5\,\text{mg}} \times \frac{10\,\text{mg}}{1\,\text{dose}} \times \frac{4\,\text{doses}}{1\,\text{day}} \times \frac{7\,\text{days}}{1\,\text{week}}$$

$$= 56 \text{ tablets per week}$$

Variations of Tablet/Capsule Problems (Cont.)

- Determining dosage to be given each time

  Example: A client is to receive 1 g of a drug daily in four divided doses

$$\frac{\text{Total daily allowance}}{\text{Number of doses per day}} = \text{Dosage to be delivered}$$

$$\frac{1\text{ g or }(1{,}000\text{ mg})}{4} = 250\text{ mg each time the medication is given}$$

Case Study

It is time to give Mrs. Garcia her 2100 meds. She is also asking for a "pain pill" for 7/10 pain to LLE. What will you pull from the Pyxis?

Lasix 20 mg p.o. q8h at 2100, 0500, 1100

Available: Lasix 20 mg tablets

Wellbutrin 300 mg p.o. daily at 2100

Available: Wellbutrin 150 mg tablets

Percocet 5/325 1 tab q3h prn pain last given at 1700

Available: Percocet 5/325 tablets

Case Study (Cont.)

ANSWER:

Lasix—1 tab

Wellbutrin—2 tab

Percocet—1 tab

Case Study

The physician wants to know how many tablets of Percocet Mrs. Garcia typically takes in one week. Mrs. Garcia and her daughter report that she has been consistently taking 1 tablet of Percocet every 6 hours. What will you tell the physician?

Case Study 4 (Cont.)

- ANS:

Mrs. Garcia takes 28 tablets of Percocet per week.

Dimensional Analysis:

$$\frac{\text{tab}}{\text{week}} = \frac{1\,\text{tab}}{6\,\cancel{\text{hr}}} \times \frac{24\,\cancel{\text{hr}}}{1\,\cancel{\text{day}}} \times \frac{7\,\cancel{\text{day}}}{1\,\text{week}}$$

Calculating Oral Liquids

- For clients with dysphagia (difficulty swallowing) or nasogastric, jejunostomy, or gastrostomy tube
- For pediatric and geriatric patients
- Types—may contain multiple meds
  - Elixir: meds dissolved in alcohol and water
  - Suspension: meds dissolved in liquid such as water
  - Syrup: meds dissolved in sugar and water

SAFETY ALERT!

 NEVER give oral liquids by IV! 

Measuring Oral Liquids

1. Standard calibrated measuring cup
   - Capacity of 30 mL (1 fl oz)
   - Metric, apothecary, or household measure
   - Place on flat surface and view at eye level.
   - Pour with label facing you so that it can be read.
   - Read at the level of the meniscus (low point).
2. Calibrated droppers
   - Administer liquid meds to eyes, ears, nose and oral (pediatric).
   - Use only dropper supplied with medication.
3. Calibrated oral syringes (tsp/mL marks)
   - Used for accuracy of liquid doses (e.g., 6.4 mL)
   - Pour medication in cup and draw up into syringe.

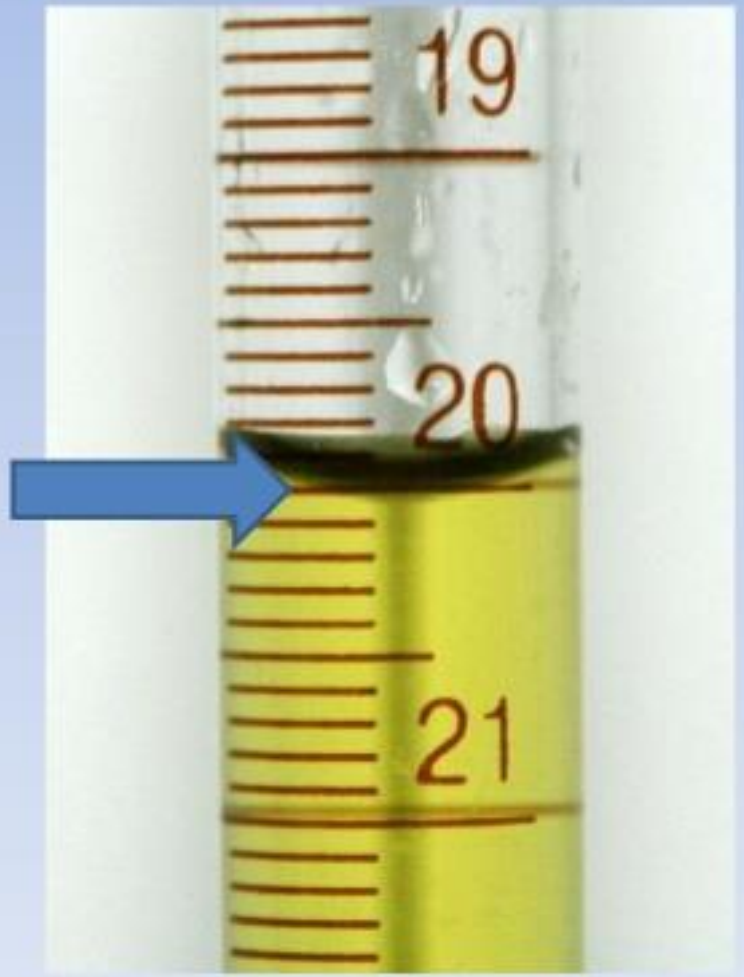
 NEVER use oral syringes for parenteral meds 

Volume- Meniscus

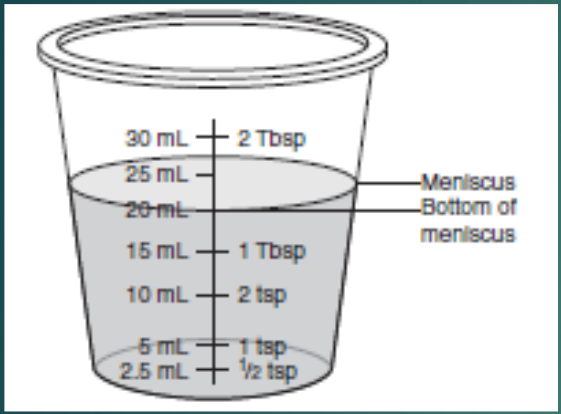
Meniscus is the curvature of the liquid in the container

Need to get eyelevel with liquid and read the low point of the meniscus as seen here

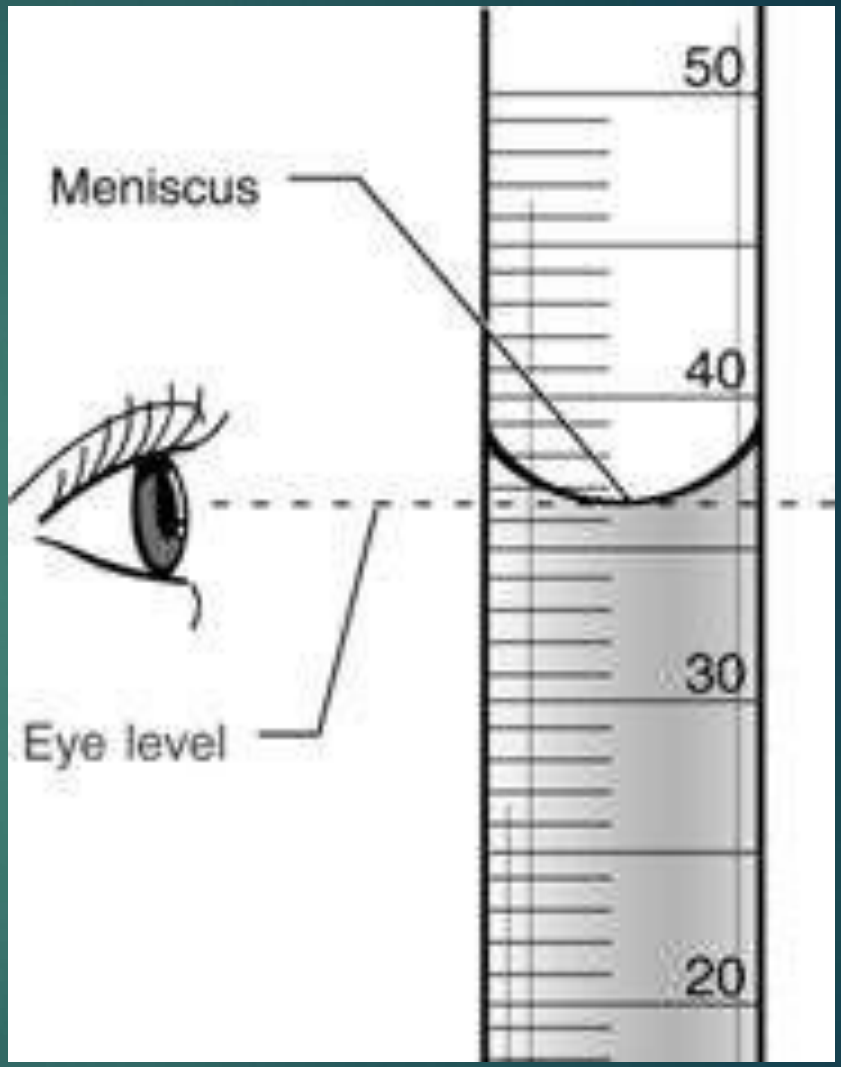
This can be a source of error if not read properly

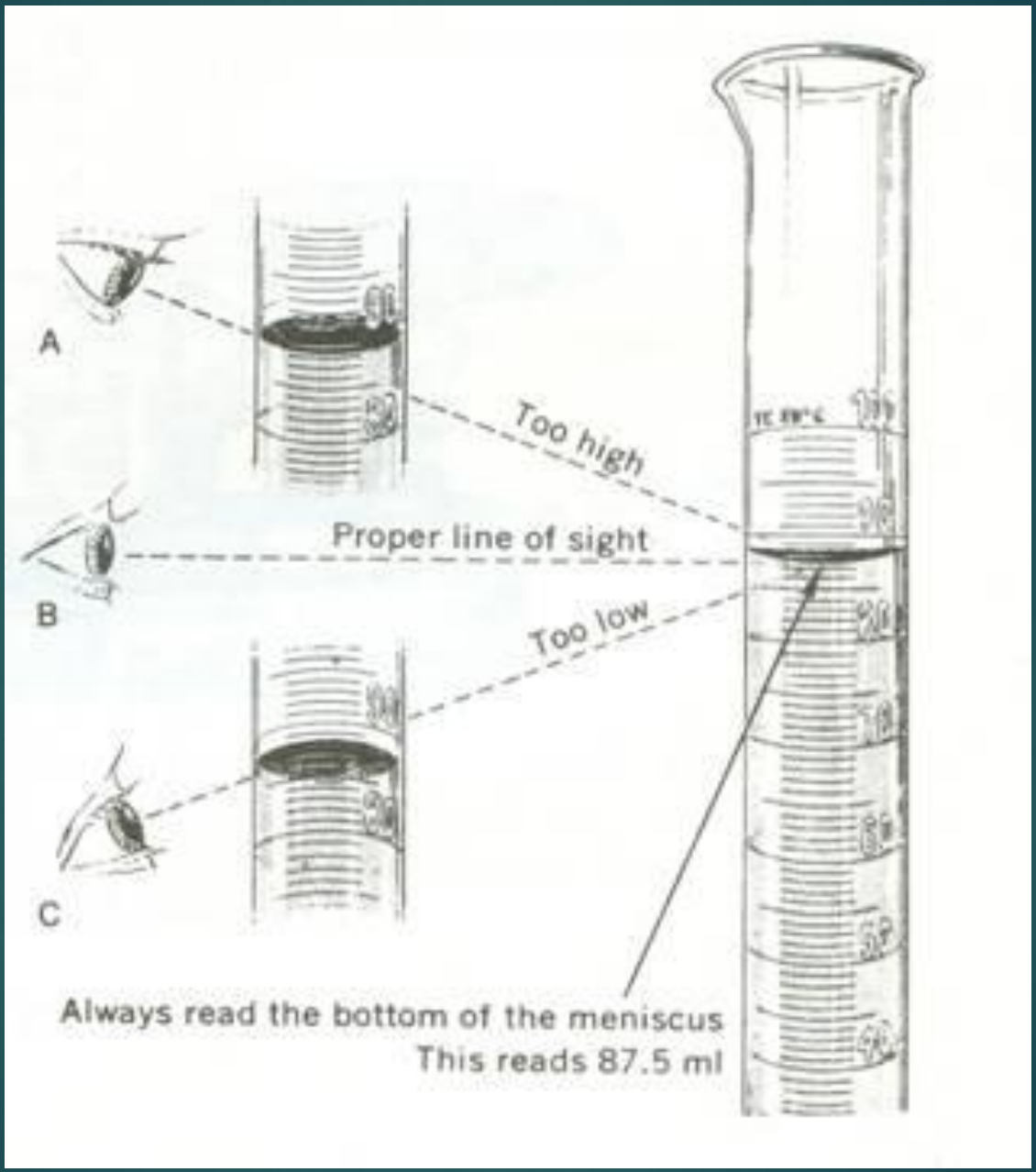


Meniscus



Reading meniscus. The meniscus is caused by the surface tension of the solution against the walls of the container. The surface tension causes the formation of a concave or hollowed curvature on the surface of the solution. Read the level at the lowest point of the concave.

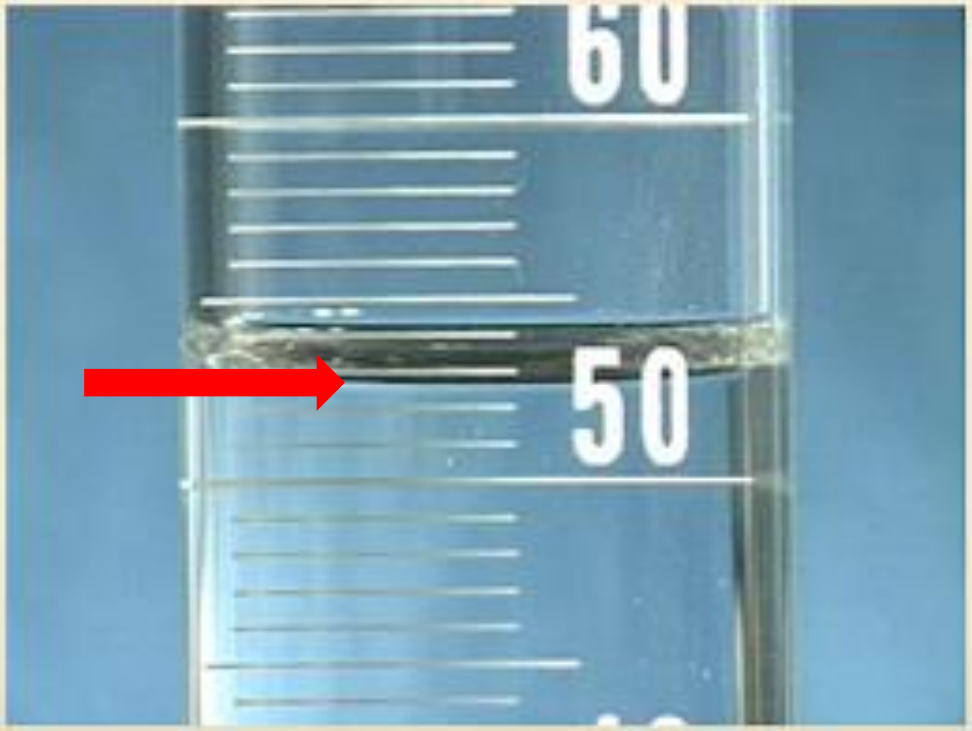



A
Too high
Proper line of sight
B
Too low
C
Always read the bottom of the meniscus
This reads 87.5 ml

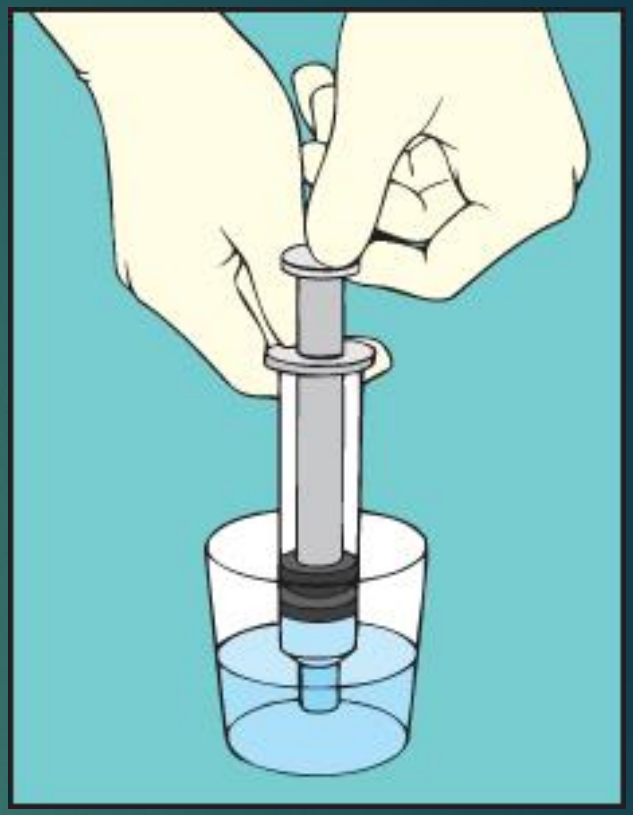
100mL graduated cylinder

What is the volume of liquid in the graduate?

5 2 . 7 mL



Oral syringes



Filling a syringe directly from medicine cup

Measuring Oral Liquids (Cont.)

- Do NOT confuse dosage strength with total volume in container

  Example: Med contains 100 mL in bottle, but strength is 125 mg in 5 mL.

- Calculations are performed in the same manner as for solid forms of medicines.

Med errors occur with oral liquids because they are least likely to be in unit doses and are prescribed often for pediatric and geriatric patients.

 Use the correct calibrated measuring device! 

Measuring Oral Liquids (Cont.)

- Review
  1. Read label carefully.
  2. Answers are labeled using liquid measures (ex. mL).
  3. Calculations should be done using the same method for consistency
     - Dimensional Analysis

Case Study

It is 0330 and the aide on the unit notifies you that Mrs. Garcia's oral temperature is 101.6° F. You review the chart and find the following order:

Tylenol Elixir 400 mg PEG- tube q4h prn fever greater than 100° F

(not to exceed 2,500 mg daily)

Available: Tylenol Elixir 160 mg per 5 mL

How many mL will you administer and what device will you use to measure the dosage?

Case Study 4 (Cont.)

ANS:

Tylenol Elixir 12.5 mL measured in a plastic medicine cup.

MEDICATION ALERT!

Acetaminophen is a component in the Percocet Mrs. Garcia takes for pain. Clients with hepatic or renal impairment should not exceed 2.5 g of acetaminophen daily. Make sure to include the 325 mg of acetaminophen in each Percocet when calculating totals before administration.

An overdose of acetaminophen is toxic!

Practice Problems

1. Order: KCl 20 mEq p.o. t.i.d.

   Available: KCl 40 mEq per 15 mL

How many mL will you give per dose?

2. Order: Imodium 2.5 mg p.o. now

   Available: Imodium 1 mg per 5 mL

How many mL will you give?

3. Order: Tagamet 250 mg p.o. q6h

   Available: Tagamet 300 mg per 5 mL

How many mg will you give per day?

Answers

1. 7.5 mL
2. 12.5 mL
3. 1,000 mg

Oral Dosages

- Tablets
- Capsules
- Liquids

Dimensional Analysis

- Basic steps
  - Place what you are solving for, x, on the left side of the equation.
  - Place available information on the right side of the equation that matches the measurement in the numerator on the left side.
  - Place other available information on the right side of the equation so that abbreviations "cancel."
  - Add any required equivalents to the right side of the equation so that the measurement abbreviation in the denominator matches the one on the left.
  - Cancel out the abbreviations on the right side of the equation and solve for x.

Oral Dosages Involving Capsules and Tablets: Dimensional Analysis Method

- For example:
  - The order states Augmentin 500 mg po daily. The drug is supplied in 250-mg tablets. How many tablets will the nurse administer?

Oral Dosages Involving Liquids: Dimensional Analysis Method

- For example:
  - The physician orders Thorazine 20 mg po q4h. The drug is available in 120-mL bottles of Thorazine syrup containing 10 mg/5 mL. How many milliliters will the nurse administer?

Oral Dosages Involving Milliequivalents: Dimensional Analysis Method

- For example:
  - The physician orders potassium chloride (KCl) 60 mEq three times a day with meals. KCl 40 mEq/30 mL is available. How many milliliters will the nurse administer?

Oral Dosages Involving Capsules and Tablets: Dimensional Analysis Method

- For example:
  - The physician orders minocycline 200 mg po daily. Minocycline 50 mg is available. How many capsules will the nurse administer?

Oral Dosages Involving Liquids: Dimensional Analysis Method

- For example:
  - The physician ordered atovaquone 750 mg twice daily pc. Atovaquone 150 mg/mL is available. How many milliliters will the nurse administer?

Oral Dosages Involving Milliequivalents: Proportion Method

- For example:
  - The physician ordered Slow-K 20 mEq four
    times a day with meals. The drug is available as 10 mEq/5 mL. How many milliliters will the nurse administer?

Oral Dosages Involving Capsules and Tablets: Dimensional Analysis Method

- For example:
  - The physician orders aspirin gr v po four times a day. Aspirin tablets gr ii are available. How many tablets will the nurse administer?

Oral Dosages Involving Liquids: Dimensional Analysis Method

- For example:
  - The physician orders phenobarbital gr ii po twice a day. Phenobarbital elixir 10 mg/5 mL is available. How many milliliters will the nurse administer?

Dosage Calculation Using the Dimensional Analysis Method

$$x \text{ caps} = \frac{1 \text{ cap}}{250 \cancel{\text{mg}}} \times \frac{1{,}000 \cancel{\text{mg}}}{1 \cancel{\text{g}}} \times \frac{0.5 \cancel{\text{g}}}{1}$$

$$x = \frac{1{,}000 \times 0.5}{250}$$

$$x = \frac{500}{250}$$

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

Learning Objectives

1

1. Define dimensional analysis.

2

2. Implement unit cancellation in dimensional analysis.

3

3. Perform conversions using dimensional analysis.

4

4. Use dimensional analysis to calculate dosages.

What is dimensional analysis?

- Is the use of a simple technique for the process of manipulating units.
- With the manipulations of units, you can eliminate or cancel unwanted units.
- This way there is no need to memorize formula and only one equation is needed.
- It is also referred to as the factor-label method or the unit factor method.

Dimensional Analysis - ORAL & PARENTERAL CALCULATIONS

A. CONVERTING (See Chapter 8 & 9)

Convert to / Given

unit X = _____ X _____

Example: *Convert 38 lb to kg*

38 lb = _____ kg

kg(x) = $\frac{1\ kg}{2.2\ \cancel{lb}} \times \frac{38\ \cancel{lb}}{1}$

$x = 17.3\ kg$

B. DOSAGE CALCULATIONS (See Chapter 16)

1. No conversion needed:

Available / Order

unit x = _____ X _____

Example:

Order: Vistaril 15 mg IM q4h

Available: Vistaril 30 mg/2mL

$mL(x) = \frac{2\ mL}{30\ \cancel{mg}} \times \frac{15\ \cancel{mg}}{1}$

$x = 1\ mL$

2. Conversion needed:

Available / Conversion / Order

unit x = _____ X _____ X _____

Example:

Order: Ampicillin 0.5 g IM q6h

Available: Ampicillin 250 mg per mL

$mL(x) = \frac{1\ mL}{250\ \cancel{mg}} \times \frac{1{,}000\ \cancel{mg}}{1\ \cancel{g}} \times \frac{0.5\ \cancel{g}}{1}$

$x = 2\ mL$

Tables to remember:

- **Box 6-3**
- **Metric Equivalents to Memorize**
- **Weight**
- 1 kilogram (kg) = 1,000 grams (g)
- 1 gram (g) = 1,000 milligrams (mg)
- 1 milligram (mg) = 1,000 micrograms (mcg)
- **Volume**
- 1 liter (L) = 1,000 milliliters (mL)
- 1 milliliter (mL) = 0.001 liter (L)
- **Length**
- 1 meter (m) = 100 centimeters (cm) = 1,000 mm
- 1 millimeter (mm) = 0.001 meter (m) = 0.1 cm

Tables to remember

- Box 7.1
- Household/Metric Equivalents

- Unit Abbreviation Equivalent Metric Equivalent
- teaspoon t (tsp) ———— 5 mL
- tablespoon T (tbs) 1 T = 3 t15 mL
- ounce (fluid) oz 1 oz = 2 T 30 mL
- cup (standard measuring C 1 cup = 8 oz 240 mL
- pint pt 1 pt = 2 cups (16 oz) 500 mL*
- quart qt 1 qt = 4 cups = 2 pt = 32 oz 1,000 mL*
- pound (weight) lb 1 lb = 16 oz2.2 lb = 1 kg (1,000 g)

Dimensional analysis

- Dimensional analysis allows for multiple factors to be entered in one equation.
- This is helpful when you have a medication ordered in one unit and is available in another unit.

To make conversions Using Dimensional Analysis:

1.Identify the desire unit-(What are they asking for? Tabs, caps, mL, g, etc.)

2. Identify the conversion factor > (X?) (if needed)

3. Write the conversion factor into a fraction> X=?

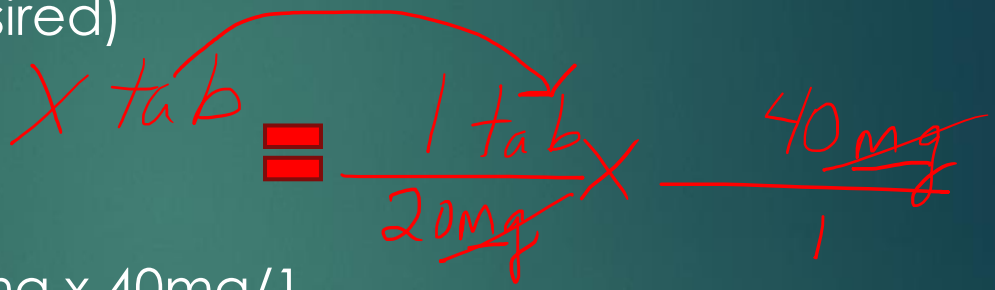
Dimensional Analysis

4. Label all factors in the equation, and label what you desire x (unit desired)

O: 40 mg

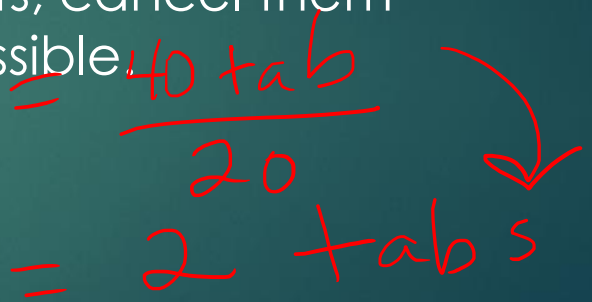
A: 20 mg/tab

Ex. X tab 1 tab/20mg x 40mg/1



Identify unwanted or undesired units, cancel them and reduce to the lowest terms possible.

1 tab/20~~mg~~ x 40~~mg~~/1



Dimensional Analysis

If all the labels except the answer label (unit desired), recheck equation.

1tab/20 x 40/1 (multiply across)

7. Perform the mathematical process indicated.

40 tabs/20 (Divide)

X =2 tabs

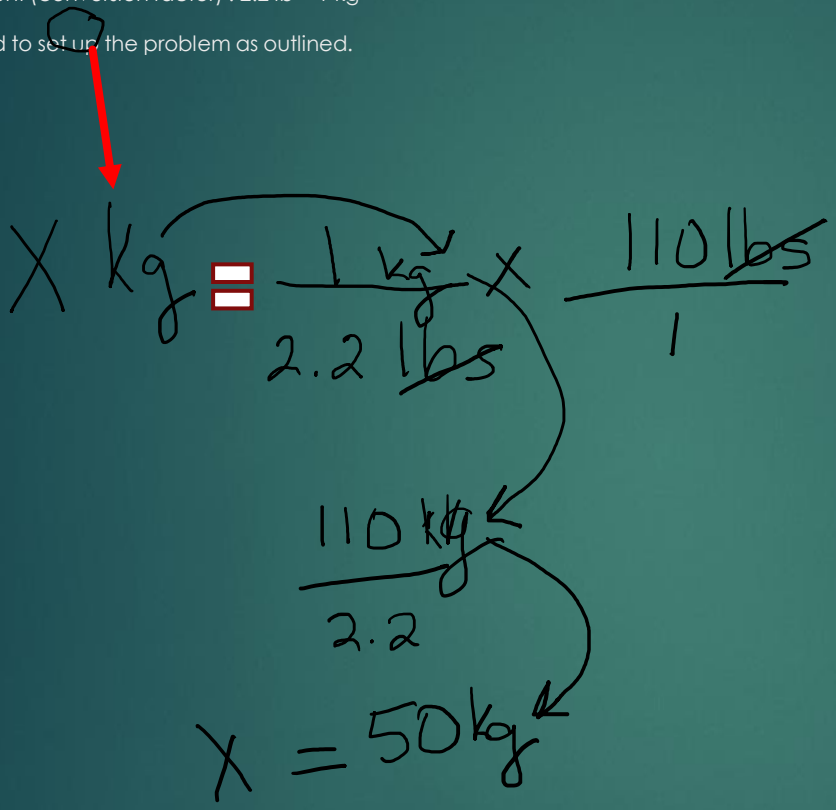
Example2:

110 lb = _____ kg

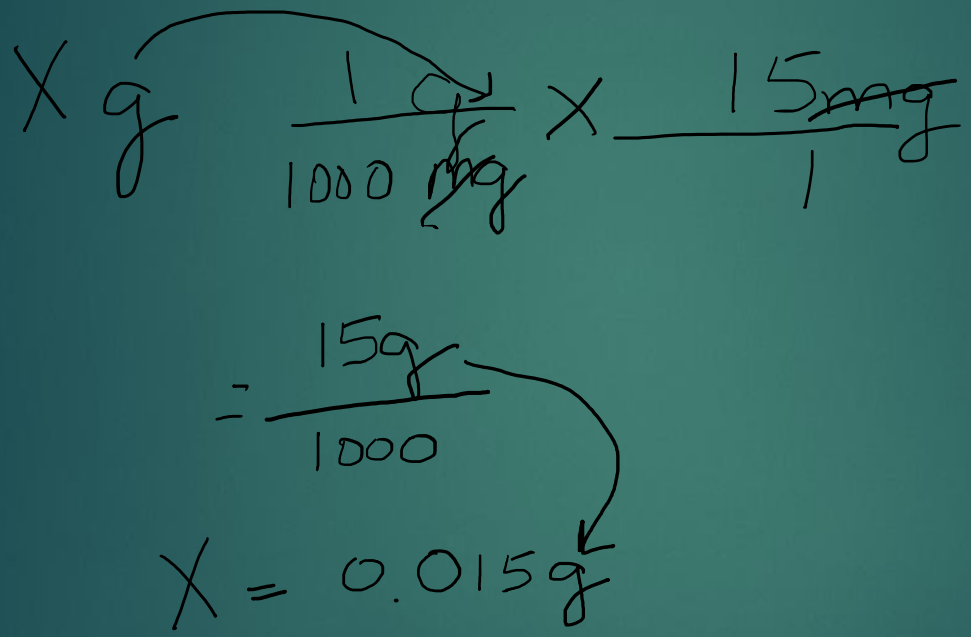
1. The desired unit is kg.

2. Equivalent (conversion factor) : 2.2 lb = 1 kg

3. Proceed to set up the problem as outlined.



15 mg = _____ g



0.5 L = _____ mL

$$X\ mL \quad \frac{1000\ mL}{1\ L} \times \frac{0.5\ L}{1}$$

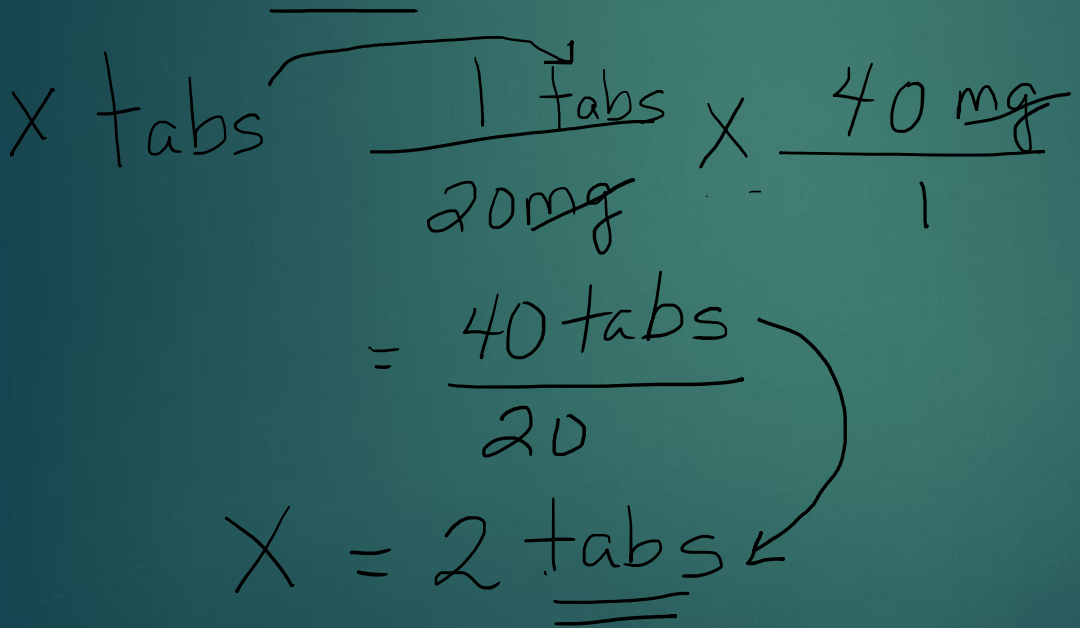
$$= \frac{500\ mL}{1}$$

$$X = 500\ mL$$

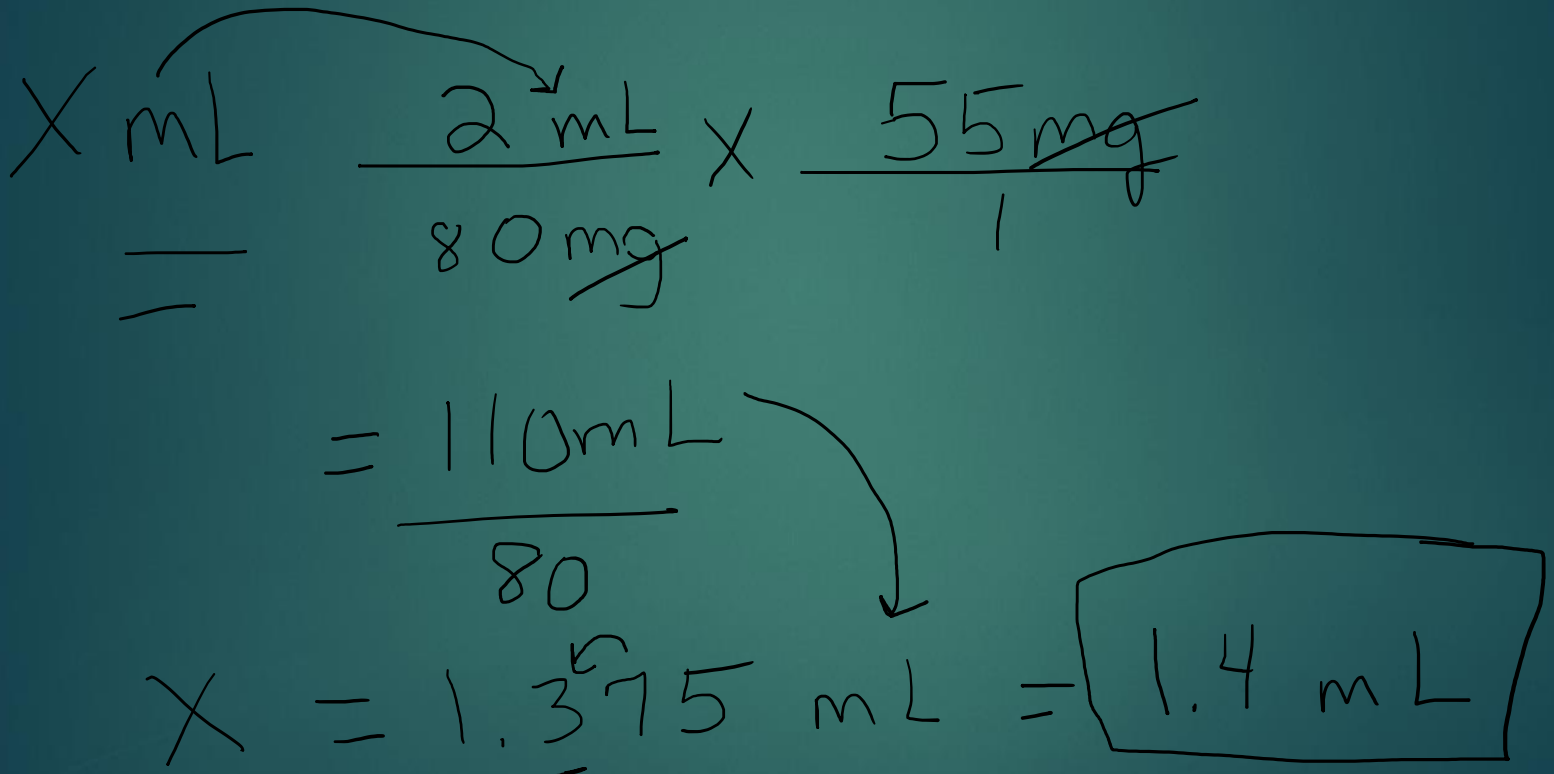
Calculating Dosage Using Dimensional Analysis

Order: Lasix 40 mg p.o. daily

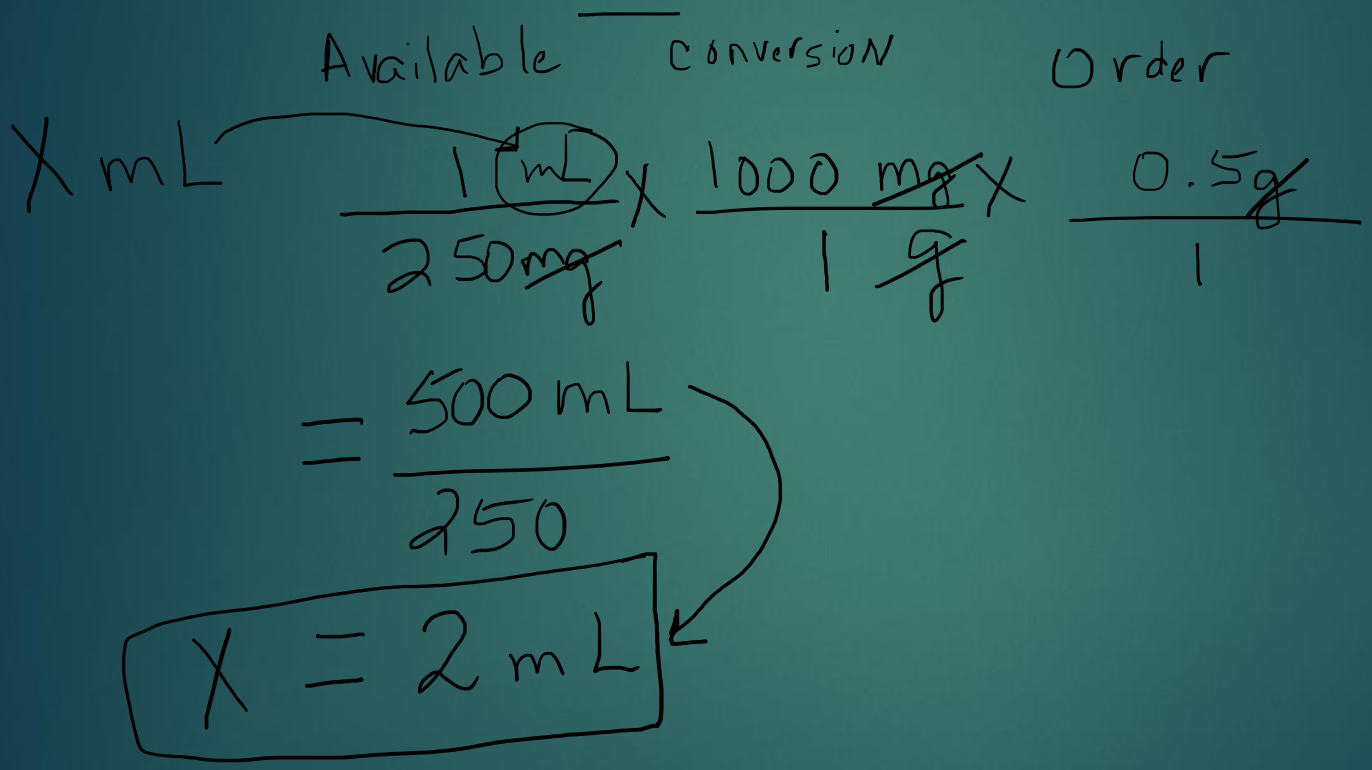
Available: Tablets labeled 20 mg



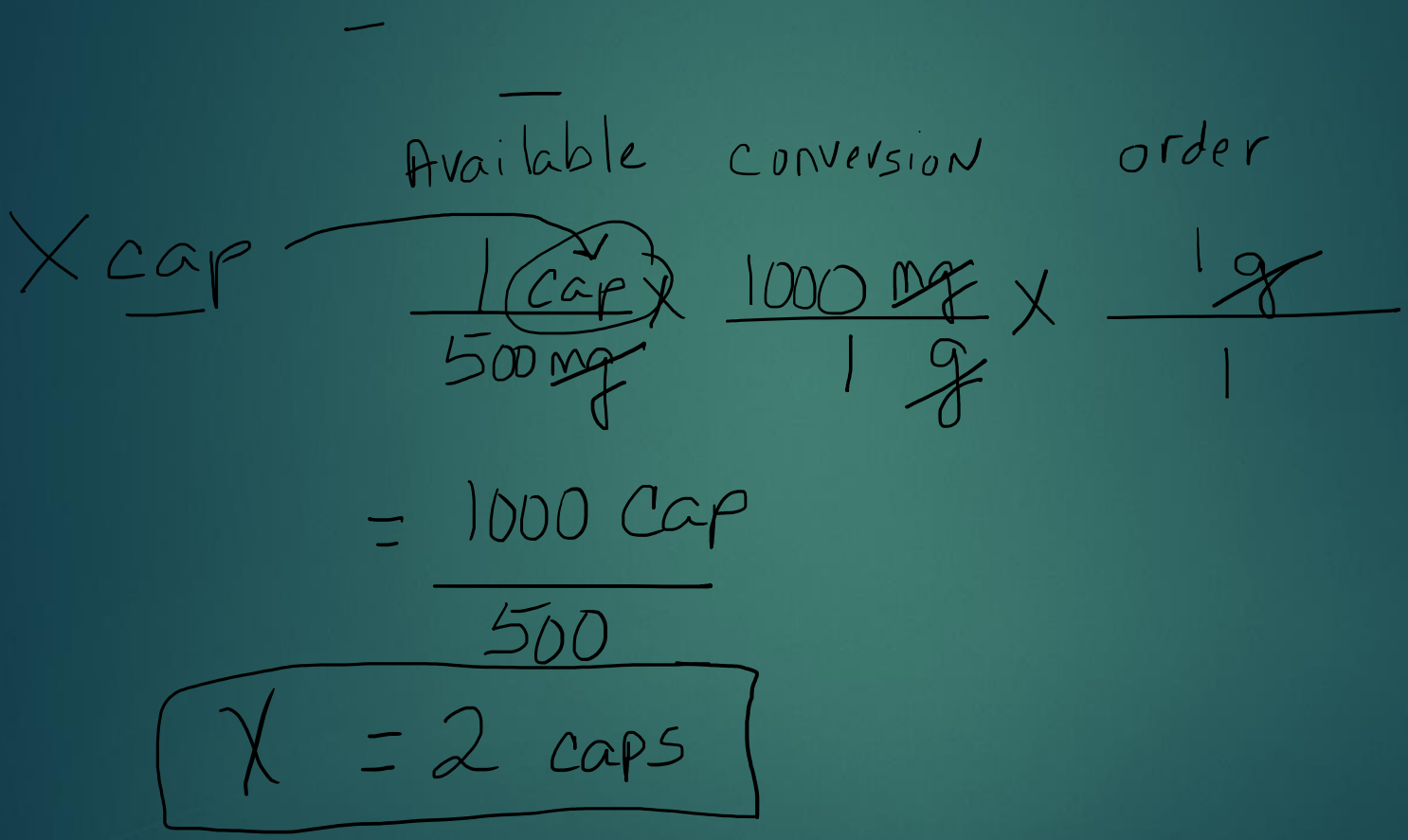
Order: 55mg
Available: 80 mg/2 mL



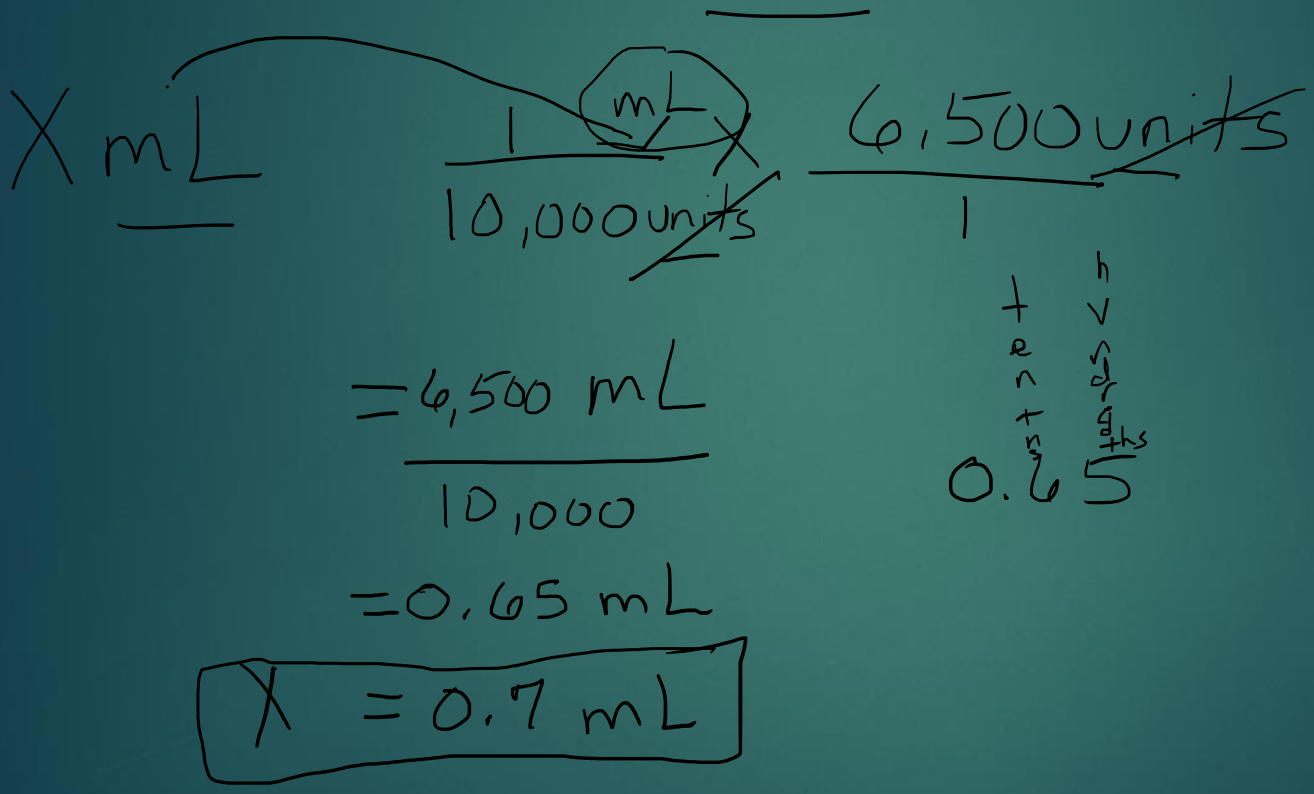
Order: 0.5 g
Available: 250mg/mL



Order: 1 g
Available: 500 mg/cap



Order: 6,500 units
Available: 10,000 units/mL



Safety Alert***

Incorrect placement of units of measure into the equation will not allow cancellation of units and can result in an error in calculation.