Lurleen B. Wallace College of Nursing and Health Sciences

DOSAGE CALCULATIONS

Objectives:

1. Define the medical symbols and abbreviations.
2. Calculate medication dosages by converting from one unit of measure to another within a system or from one system of measurement to another.
3. Calculate dosages involving the administration of intravenous fluids.
4. Calculate dosages involving the preparation of medications from powders to crystals.

Objective Key: 6.11, 6.12, 6.13

Activities:

1. Attend class.
2. Work practice problems.
3. Memorize apothecary, metric, and household conversions.
4. Complete the modules Basic Math Review, Methods of Calculation, Systems of Measurement, and Reading Medication Labels on CD-ROM, *Calculating Drug Dosages*. Complete exam at end of module, print, and turn in with your name on exam.

Content:

1. Systems of Measurement

   1.1 Metric System- has become the system of choice for dealing with the weights and measures involved in the calculation of drug dosages. All answers within the metric system need to be expressed as **decimals,** not as fractions.
   1.11 Mass
   1.12 Volume
   1.13 The cubic centimeter (cc) and the milliliter (ml) are considered **equivalent and are used interchangeably.**
   1.14 Uses whole numbers and decimals

   1.2 Household System

   1.21 Household Measurements (teaspoon, pint, quart)

   1.3 Apothecaries' System
   1.31 Uses Roman Numerals
   1.32 Common fractions (except one-half) are written using hindu-arabic numerals
   1.33 Mass

2. Conversions within the Metric System

2.1 Certain prefixes identify the multiples of 10 that are being used. The four most commonly used prefixes of the metric system involved with the calculation of drug dosages are the following:

- Micro= 0.000001 or one millionth
- Milli= 0.001 or one thousandth
- Centi= 0.01 or one hundredth
- Kilo= 1000 or one thousand (1,000)

    - *These prefixes may be used with any of the base units of weight (gram), volume (liter), or length (meter).*

2.2 To change milligrams (mg) to Grams (G), or milliliters (ml) to liters (L), move the decimal point three places to the left.

Example: 750 mg. = 0.75 Gm.
500 mg. = 0.5 Gm.

2.2 Rule: To change Grams to milligrams or liters to milliliters, move the decimal three places to the right.

Example: 0.25 Gm. = 250 mg.
0.35 Gm. = 350 mg.

3. Conversions between the Household and Metric Systems
Note: Household measures are not accurate enough to be used by nurses in the calculation of drug dosages in the hospital.

Metric Conversion	**Household Measurements**
1000cc (1 liter)	**1 quart**
500 cc	**1 pint**
5 cc	**1 teaspoon & 1 dram**
15 cc	**1 TBSP**
30 cc	**1 ounce**
240 cc	**8 ounces (a glass)**
180 cc	**1 Cup (c)**
1 Kg (kilogram) or 1000 grams	**2.2 pounds (lbs.)** Example- A person who weighs 110 lbs weighs 50 Kg using the metric scale.
2.5 cm (centimeters)	**1 inch**
1 foot	**12 inches**
1 cc	**1 ml**

4. Conversion between the Apothecaries' and the Metric System

gr 1 = 60 mg.
gr 15 = 1 Gram
gr= Grain, however drug dosages are rarely expressed in grains.
1 dram= 5 ml= 1 teaspoon (dram rarely utilized as a form of measurement)

5. Household Measurements to Apothecaries'

5.1

Household Measurements	**Apothecaries'**
1 pint	16 fluid ounces (fl oz)
2 pints (pt) or 1 quart (qt)	32 fluid ounces (fl oz)
1 coffee cup	6 fluid ounces
1 medium size glass	8 fluid ounces

5.2 When writing orders in the apothecary system, physicians often use **Roman numerals**. All parts of a whole are expressed as a fraction except the fraction one half, which is commonly represented as ss. Only addition and subtraction may be performed in the Roman numeral system.

5.21 Addition is performed when a smaller numeral follows a larger numeral (xi = 11, x = 15) or when a numeral is repeated (iii = 3, xx = 20)
5.22 Subtraction is performed when a smaller numeral is placed before a larger numeral (ix = 9, iv = 4) or when a smaller numeral is placed between two larger numerals. The smaller numeral is subtracted from the larger numeral following the smaller numeral (xiv = 14, xxiv = 24)

6. Changing pounds to kilograms or kilograms to pounds

5.1 Example 2.2 lbs = 1 kg.
50 pounds is = how many kilograms?
50lbs divided by 2.2 kilograms = 22.7 kilograms
22.7 kilograms times 2.2 kilograms = 49.9 pounds

7. Preparing Medications from Powders and Granules

7.1 Example:

Physician ordered Geopen 0.5 Gm IM q 6 h. You have available a vial of Geopen containing 2 Gm. The directions read, "Add 4 ml of sterile water to yield a concentration of 1 Gm/ 2.5 ml Solution is stable at room temperature for 24 hours.

When 4 ml. of sterile water is added to the Geopen powder, it increases the volume to 5 ml. which is equal to 1 Gm./2.5 ml.

8. Most problems concerning drug dosage can be solved by a proportion problem. A **proportion** consists of two ratios of **equal** value. The ratios are connected by a double colon (::) which symbolizes the word *as*.

For example: 2 : 3 :: 4: 6 This is read as "Two is to three as four is to six."

In a proportion the product of the means equals the product of the extremes because the ratios are of equal value (3 and 4 are the means; 2 and 6 are the extremes).

2 : 3 :: 4 : 6

3 x 4 = 12 (product of the means)
2 x 6 = 12 (product of the extremes)

If three terms are known and one term is unknown, an *x* is inserted in the space for the unknown term.

For example: 2 : 3 :: 4 : *x*

$2x = 3 \times 4$

$2x = 12$

$x = \frac{12}{2}$ therefore $x = 6$

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Guide for Calculating Medications

The physician ordered gr xv of a medication. The medication is available in tablets containing 0.25 Gm of medication. How many tablet(s) should you give?

1. Begin the solution to the problem by asking yourself: What is the amount of medication ordered to be given? What is the amount of the medication available for administration?
   Amount Ordered: gr xv Amount Available: 0.25 Gm in 1 tablet

2. Next ask yourself: are the units of measurement the same for what is ordered and what is available?

   Ordered: grains Available: Grams **These are <u>not</u> the same!**

3. If they are not in the same units of measurement, you have to change them to the same units before you can solve the problem.

   Example: Change grains to grams: 15 gr. = 1 Gm.

   Note 15 gr. = 1 Gm. is from the list of equivalencies.

4. Think! What do you know from the above problem? Write what you know first to set up ratio and proportion problem: 0.25 Gm : 1 tablet

   The other side of the ratio must be written in the same order as the first side:
   0.25 Gm. : 1 tablet :: ____ Gm. : ____ tablet

   Next fill in blank spaces: 0.25 Gm. : 1 tablet :: __1__ Gm. : __X__ tablet

   Multiply the extremes (numbers on ends of problem) times each other:
   $0.25 \times =$

   Multiply the means (numbers in center of problem) times each other:
   1 x 1 = 1
   Place unknown value on left side of equal sign: $0.25X = 1$

   Divide each side of equal sign by number that precedes "X": $\frac{0.25X}{0.25} = \frac{1.00}{0.25}$

   $X = 4$ tablets

Medications for oral administration are supplied in a variety of forms, such as tablets, capsules and liquids. It is safest and most accurate to give the fewest number of whole, undivided tablets as possible.

Simple Three-Step Approach to Dosage Calculations:

Step 1: Convert: Ensure all measurements are in the same system of measurement and the same size unit of measurement. If not, convert.

Step 2: Think: Estimate what is a reasonable amount of the drug to be administered.

Step 3: Calculate: Apply the formula: $\frac{D}{H} \times Q = X$

$\frac{D(\text{desired})}{H(\text{have})} \times Q(\text{quantity})$

Guide for Calculating Intravenous Fluid Infusion Rates

The rate of flow at which intravenous infusions are administered is determined by the physician. However, the nurse is given the responsibility of regulating and maintaining this rate of flow. Intravenous sets are equipped with a drip chamber, which is a short tube inserted into the bottle cap and connected to the tubing and needle assembly. The drop chamber contains a small-diameter tube through which drops form as the infusion flows. The flow rate is adjusted by means of a clamp placed on the tubing. The dropper in the drip chamber is calibrated, and each set is labeled with this calibration. The drops per milliliter calibration of the solution administration set is sometimes referred to as the "drop factor". The same calibration can be used for the administration of various solutions.

Formulas for Calculating Intravenous Fluids

a. **ml/hr** $\frac{\text{Total ml fluid to be given}}{\text{hours to be infused}} = \text{desired ml/hr}$

b. **drops/min** $\frac{\text{Desired volume} \times \text{drop factor}}{\text{total number of minutes}}$ (if # minutes is > 1 hour, then write

as $\frac{\text{Desired volume} \times \text{drop factor}}{\text{\# hours} \times 60 \text{ (minutes)}} = \text{gtts/minute}$

Example: The physician orders read "Give 1000 ml. of D5W IV in 2 hours. You have available to use an administration set with a drop factor of 15. How many gtts/min should the fluids infuse?

a. $\frac{1000 \text{ ml} \times 15}{2 \times 60} = \frac{15{,}000}{120}$ **= 125 gtts/minute**

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Abbreviations used in Prescriptions and Doctor's Orders

a.c.	before meals
ad lib	as desired
b.i.d.	twice a day
c	with
gtt	drop(s)
h.s.	at bedtime
IM	intramuscular
IV	intravenous
p.c.	after meals
p.o.	by mouth
p.r.	per rectum
p.r.n.	when necessary
q.d.	every day
q.h.	every hour
q.i.d.	four times a day
s	without
stat.	immediately
t.i.d.	three times a day
IVPB	intravenous piggyback
SL	sublingual, under the tongue
SC	subcutaneous
NG	nasogastric tube
O.D.	right eye
O.S.	left eye
O.U.	both eyes
A.D.	right ear
A.S.	left ear
A.U.	both ears

Calculations Worksheet

Show work:

1. The physician ordered Phenobarbital 30 mg. You have on hand an ampule of Phenobarbital containing 60 mg per 5 ml. How many ml of medication will you give?

2. You have an order to give Atropine 1 mg. You have on hand to use an ampule of Atropine containing 0.4mg per ml. How many ml will you give?

3. The physician ordered Morphine 4 mg IM. You have Morphine containing 10 mg in 2 ml. How many ml should you give?

4. The physician ordered 0.5Gm of Streptomycin IM. Available is a 3 ml vial of the drug containing 1 Gm. How many ml should you give?

5. You have an order for 1500ml of D5 ½ NS IV to infuse over 24 hours. The administration set has a drop factor of 15. How many drops per minute should you infuse?

Practice Problems –Set I

1. Physician ordered ASA 650 mg. P.O. for a temperature above 101 F. Your patient develops a temperature of 102 F. How many tablets of ASA 325 mg should you give?

2. The label on a 5 ml. ampule of Quinine Hydrochloride reads, "100 mg. per ml.", and the doctor's order reads, "Give Quinine Hydrochloride 125 mg." How many ml. should the patient receive?

3. The physician orders 8 mg. of a medication. The medication is available in 1 ml. ampules containing 10 mg. How many ml. should you give?

4. The label on the medication bottle reads, "Penicillin 1,000,000 units in 10 ml. of solution". The physician's order reads, "Give 500,000 units Penicillin IM". How many ml. will you give?

5. The physician orders Streptomycin 500 mg. IM, B.I.D. You have available Streptomycin 1 Gm/3 ml. How many ml. should you give?

6. The physician ordered Chloromycetin 0.5 Gm. P.O. q6hr. You have available Chloromycetin capsules 250 mg. per capsule. How many capsules will you give?

Practice Problems – Set II

1. The doctor orders sodium salicylate 0.6 Gm. The medication on hand contains 300 mg. per tablet. How many tablet(s) should the patient receive?

2. The physician ordered Benadryl 50 mg. The medication on hand contains 0.025 Gm. per capsule. How many capsule(s) should the patient receive?

3. The dosage for a medication is 25 mg. per kg. The patient weighs 90 pounds. How many mg. should the patient receive?

4. The physician ordered 250 ml. of IV fluid to infuse in 3 hours. You have available the pediatric administration set with a drop factor of 20. How many drops per minute should you infuse?

5. You are to give 1000 ml. of IV fluid over a 24-hour period of time. You have available an administration set with a drop factor of 20. How many drops per minute should you infuse?

6. You are to infuse 1500 ml. of IV fluid in 12 hours. The administration available for use has a drop factor of 15. How many gtts. per minute should you infuse?

7. The doctor ordered Codeine 75 mg p.o. You have available Codeine tablets containing 30 mg. per tablet. How many tablets should you give the patient?

8. The doctor ordered Tranxene 375 mg p.o. q hs. You have available a 125 mg. tablet. How many tablets will the nurse give?

9. The physician ordered Penicillin 1,200,000 units IM. You have available a 10 ml. vial of penicillin containing 600,000 units per ml. How many ml.(s) should the patient receive?

10. Ordered: Kantrex 300 mg. IM. Directions on bottle read "Add 2.7 ml. sterile water for injection to make 1 Gm. per 3 ml." After reconstitution, how many ml. will you give?

11. Ordered: Penicillin G 300,000 units IM q 4 hr. Pharmacy sent a vial with 3,000,000 units of Penicillin G in dry crystal form. Directions were to dilute with 4.2 ml. NS to make 5 ml. After dilution, the vial contains 3,000,000 units per 5 ml. How many ml. will you give per dose?

12. You administer an IV of 1500 ml. D5W over an 8 hour period. The administration set has a drop factor of 15. How many drops per minute will you give?

13. The physician ordered an IV of 500 ml. of D5W to be infused over a 12 hour period. The administration set has a drop factor of 60 (microdrip). How many gtts/minute will you regulate the flow?

14. The physician ordered Gentamycin 80 mg IVPB q 12 hours. The pharmacy sends the medication dissolved in NS 100 ml. Your tubing has a drip factor of 10. The medication is to infuse in 30 minutes. How many <u>drops/minute</u> should the medication infuse? How many <u>ml per hour</u> should the medication infuse?

15. The MD orders 6 mg of Morphine sulfate to be given by injection q 6 hours prn pain. The dose on hand contains 10mg/ml. How many ml. will you administer?

16. The physician orders 650 mg. of ASA. The dose on hand is in 0.3 Gm. tablets. How many tablets will you give?

17. The physician ordered Cefaclor 500 mg. P.O. The dose on hand is in 250 mg. tablets. How many tablets are needed for this dose?

Practice Problems – Set III

1. The physician ordered Kanamycin 17 mg. IM. You have available a 2 ml. vial of Kanamycin containing 75 mg. How many ml. should you give?

2. The doctor ordered Ceclor 35 mg. The drug is labeled 125 mg. per 5 ml. How many ml. of the drug will you give?

3. A patient is to receive 300 mg. of a medication. The drug is labeled "1 Gm. per 4 ml." How many ml. will you give?

4. The IV fluid order for a patient is 2000 ml. D5W to infuse in 24 hours. You have available an administration set with a drop factor of 20. How many drops per minute will you give the patient?

5. The physician ordered Crystalline Penicillin 300,000 units IM q4hr. You have a vial containing 3,000,000 units of Crystalline Penicillin in dry form. The directions state "add 9.6 ml. of diluent to yield 10 ml. of reconstituted solution". How many ml. of Penicillin will you give the patient per dose?

6. The physician ordered "Kantrex 35 mg. IM B.I.D." You have available to use a vial of Kantrex labeled "Kantrex 75 mg. per 2 ml.". How many ml. will you give?

7. The doctor ordered D51/2 NS 500 ml. to infuse in 6 hours. You are to use the microdrip administration set with a drop factor of 60. How many drops per minute will you infuse the fluid?

8. The medication order reads “Ampicillin 250 mg. P.O. q4hr”. You have available Ampicillin liquid containing 125 mg/5 ml. How many ml. of Ampicillin will you give per dose?

9. The physician orders Heparin 2500 units subq. qd. Heparin is dispensed in a vial labeled “5000 units/1 ml.” How many ml. of Heparin should the nurse give?

10. The physician’s order reads “Give Erythromycin 1.6 Gm/day in four equally divided doses. The patient should receive Erythromycin _____mg. per dose. If the medication is available in tablets containing 400 mg., how many tablet(s) should the patient receive?

11. The physician ordered D5NS to infuse at 100 ml/hr. You have available to use an administration set with a drop factor of 20. How many drops/minute should the fluids infuse?

12. The doctor ordered Gentamycin 40 mg. to be infused as an IV piggyback in 100 ml. of IV fluid. The piggyback is to be infused in 30 minutes. How many gtts/min should the fluids infuse if the administration set being used has a drop factor of 15?

13. The physician ordered Demerol 75 mg. IM. You have available a tubex of Demerol which contains 100 mg. per 2 mL. How many ml. (s) should the patient receive?

14. A child weighing 33 pounds is to receive 0.1 mg/kg. of body weight. What is the correct dose in mg. for the patient?

15. The physician orders D5RL 500 ml. to infuse in 12 hours. The administration set to be used is the micro drip (pediatric) infusion set which has a drop factor of 60. How many gtts/min. should the fluids infuse?

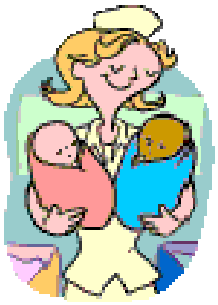
16. The physician orders 2000 ml. of fluids to infuse in 16 hours. You have available the Baxter administration set with a drop factor of 10. How many cc/hour should the fluids infuse? _____How many drops/minute? _____

Pediatric Dosages

Dosages for infants and children are based on their unique and changing body differences. The most common method currently used for calculating safe pediatric dosages is body weight (such as mg/kg). Numerically, the infant's or child's dosage appears smaller, but proportionally pediatric dosages are frequently much larger than the usual adult dosage.

RULE: To verify safe pediatric dosing:

1. Convert the child's weight from pounds to kilograms.
2. Calculate the safe dosage in mg/kg or mcg/kg for this weight child as recommended.
3. Compare the ordered dose to the recommended dose, and decide if the dosage is safe.



Example: The physician orders morphine sulfate 1.8 mg IM stat. The child weighs 79 lb. Is this dosage safe?

Step 1: Convert lbs. to kiligrams (2.2 lb. = 1 kg)
79 ⁄ 2.2 = 35.91 or 35.9 kg.

Step 2: Calculate mg/kg as recommended by a reputable drug resource. (A reputable drug resource indicates that the usual IM/SC dosage may be initiated at 0.05 mg/kg/dose.)

Per dose= 35.9 kg x 0.05 mg = 1.79 mg = 1.8 mg/dose

Step 3: Decide if the dosage is safe by comparing ordered and recommended dosages. For this child's weight, 1.8 mg is the recommended dosage and 1.8 mg is the ordered dosage. Yes, the order is safe.

1. The physician's order reads "Keflin 1000 mg. IV q6hrs." The PDR gives the dosage range as 50-80 mg. per kg. per day to be given in divided doses of q 8 hours. The child weighs 32 pounds. ? Is the dosage ordered in the safe range? _____If so, How many mg should be given per dose? _____

2. A 50-pound child is to receive 0.2 mg/kg. How many mg. of a medication is the correct dose for this child?

3. Albuterol 1.2 mg po t.i.d. for an 18 kg child with severe asthma. Recommended dosage from the manufacturer: 0.2mg/kg/day orally in three equally divided doses. Is the order safe?

4. The physician ordered Phenobarbital 2 mg/ kg. q 6 hours. The patient's weight is 80 pounds. How many mg. of Phenobarbital should be given per dose?_____ How many mg of Phenobarbital will the patient receive per day?_____

5. The physician ordered Aminophylline 5 mg. per kg. STAT. The patient's weight is 60 pounds. How much Aminophylline should be given?

6. Ordered: Dilantin 30 mg T.I.D. PO for a 2 year old child weighing 39.6 pounds. Safe dose for this age group is 5mg/kg/day. On hand is Dilantin Pediatric Suspension 125mg/5ml. How many ml. would you give per dose?

Answers to Practice Problems

Calculations Worksheet

1. 2.5 ml
2. 2.5 ml
3. 0.8 ml
4. 1.5 ml
5. 16 gtts/minute

Practice Set I

1. 2 tablets
2. 1.3 ml
3. 0.8 ml
4. 0.5 ml
5. 1.5 ml
6. 2 tablets

Practice Set II

1. 2 tablets
2. 2 capsules
3. 1025 mg
4. 28 gtts/minute
5. 14 gtts/minute
6. 31 gtts/minute
7. 2.5 tablets
8. 3 tablets
9. 2 ml
10. 0.9 ml
11. 0.5 ml
12. 47 gtts/minute
13. 42 gtts/minute
14. 100 cc/hr, 33 gtts/min
15. 0.6 ml
16. 2 tablets
17. 2 tablets

Practice Set III

1. 0.5 ml
2. 1.4 ml
3. 1.2 ml
4. 28 gtts/min
5. 1 ml
6. 0.9 ml
7. 83 gtts/min
8. 10 ml
9. 0.5 ml
10. 1 tablet
11. 33 gtts/min
12. 50 gtts/min
13. 1.5 ml
14. 1.5 mg/dose
15. 42 gtts/min
16. 125 cc/hr, 21 gtts/min

Pediatric Practice Problems

1. Not Safe
2. 4.5 mg/dose
3. 1.2 mg is safe for this child, 1.2 is ordered….YES, safe to administer.
4. 72.7 per dose, 291 mg/day
5. 136.4 mg
6. Order is safe, 1.2 ml/dose