Dosage Study Guide and Practice Problems

Dosage Question Steps

1. Determine problem type:
    - Mass for Mass
    - Mass/Liquid For Liquid
    - Amount in IV Fluid
    - Volume/Time - IV mL Rate
    - Volume/Time - IV Drop Rate
    - Fluid Maintenance Requirement
    - Dosage By Weight
    - Mass/Time - IV mL Rate
2. Identify what is the value of each variable in formula.
3. Make units consistent as necessary.
4. Fill in values for formula and solve the problem.

Unit Conversion

Mass:

- mcg → mg → g → kg (÷ by 1,000)
- mcg ← mg ← g ← kg (x by 1,000)
- lb → kg (÷ by 2.2)
- lb ← kg (x by 2.2)

Volume:

- mcL → mL → L → kL (÷ by 1,000)
- mcL ← mL ← L ← kL (x by 1,000)

Time:

- min → hr (÷ by 60)
- min ← hr (x by 60)

Example: Convert 5,000 mcg to mg.

- mcg → mg → g → kg (÷ by 1,000)
- 5,000 mcg ÷ 1,000 = 5 mg

Example: Convert 44 lb to kg.

- lb → kg (÷ by 2.2)
- 44 lb ÷ 2.2 = 20 kg

Example: Convert 0.003 L to mcL.

- mcL ← mL ← L ← kL (x by 1,000)
- 0.003 L x 1,000 = 3 mL
- 3 mL x 1,000 = 3,000 mcL

Example: Convert 5 hours to minutes.

- min ← hr (x by 60)
- 5 hr x 60 = 300 min

Conversion Chart / Table

microgram to milliliters Conversion Chart / Table:

mcg = ml	microgram = milliliters
1.0 = 0.000001	6.0 = 0.000006
2.0 = 0.000002	7.0 = 0.000007
3.0 = 0.000003	8.0 = 0.000008
4.0 = 0.000004	9.0 = 0.000009
5.0 = 0.000005	10 = 0.00001

milliliters to micrograms Conversion Chart / Table:

ml = mcg	milliliters = micrograms
1.0 = 1000000	6.0 = 6000000
2.0 = 2000000	7.0 = 7000000
3.0 = 3000000	8.0 = 8000000
4.0 = 4000000	9.0 = 9000000
5.0 = 5000000	10. = 10000000

The **microgram** (**mcg** or **µg**) is the unit of mass in the metric system (SI, International System of Units). 1 **microgram** (**mcg** or **µg**) = weight of 0.000001**milliliters** (**ml**) of pure water at temperature 4 °C = 0.000001 grams (g) = 0.001**milligrams** (**mg**) = 0.000000001 kilogram (kg) = 0.0000000352739619 ounces (oz).

Conversion table above can be found at the following link: http://calculator-converter.com/converter_mcg_to_ml_micrograms_to_milliliters_calculator.php

Mass for Mass Questions

Given an amount of mass per tablet, how many tablets do you require?

Formula:

$$\frac{\textit{Ordered}}{\textit{Have}} = \textit{Y (Tablets Required)}$$

Example: Metroprolol (Lopressor), 25 mg PO, is ordered. Metropolol is available as 50 mg tablets. How many tablets would the nurse administer?

$$\frac{\textit{Ordered}}{\textit{Have}} = \textit{Y (Tablets Required)}$$

$$\frac{25\text{ mg}}{50\text{ mg}} = 0.5 \text{ tablets}$$

Example: Potassium chloride is available as 10 mg per tablet. Potassium Chloride (K-Dur), 40 mg, is ordered. How many tablets would the nurse administer?

$$\frac{\textit{Ordered}}{\textit{Have}} = \textit{Y (Tablets Required)}$$

$$\frac{40\text{ mg}}{10\text{ mg}} = 4 \text{ tablets}$$

MM1: Metroprolol (Lopressor), 10,000 mg PO, is ordered. Metropolol is available as 10 g tablets. How many tablets would the nurse administer? 1 tablet

MM2: Potassium chloride is available as 0.016 kg per tablet. Potassium Chloride (K-Dur), 16,000 mg, is ordered. How many tablets would the nurse administer? 1 tablet

MM3: Potassium chloride is available as 13,000 mg per tablet. Potassium Chloride (K-Dur), 19 g, is ordered. How many tablets would the nurse administer? 1.5 tablets

MM4: Potassium chloride is available as 23,000 mg per tablet. Potassium Chloride (K-Dur), 0.011 kg, is ordered. How many tablets would the nurse administer? 0.5 tablets

MM5: There is an order for 9,000,000 mcg of Ampicillin. Ampicillin is available as 9 g tablets. What should the nurse administer? 1 tablet

Mass/Liquid For Liquid Questions

Given an amount of mass per liquid, how much liquid do you require?
Formula:

$$\frac{Ordered}{Have} \times Volume\ Per\ Have = Y\ (Liquid\ Required)$$

Example: Phenytoin (Dilantin), 0.1 g PO, is ordered to be given through a nasogastric tube. Phenytoin is available as 30 mg / 5 mL. How much would the nurse administer?

$$\frac{Ordered}{Have} \times Volume\ Per\ Have = Y\ (Liquid\ Required)$$

Convert 0.1 g to mg.

- mcg ← mg ← g ← kg (x by 1,000)
- 0.1 g x 1,000 = 100 mg

$$\frac{100\ mg}{30\ mg} \times 5\ mL = 16.7\ mL$$

Example: Ordered Lasix 40 mg IV push now. Available: 80 mg in 1 mL. How much will the nurse draw up?

$$\frac{Ordered}{Have} \times Volume\ Per\ Have = Y\ (Liquid\ Required)$$

$$\frac{40\ mg}{80\ mg} \times 1\ mL = 0.5\ mL$$

MLL1: Phenytoin (Dilantin), 22,000,000 mcg PO, is ordered to be given through a nasogastric tube. Phenytoin is available as 6,000 mg / 15 mL. How much would the nurse administer? 55 mL

MLL2: Ordered Lasix 0.02 kg IV push now. Available: 9 g in 4 mL. How much will the nurse draw up? 8.9 mL

MLL3: Ordered 12,000,000 mcg of Amoxicillin. Amoxicillin is available as 18,000 mg per 17 mL. How much will the nurse draw up? 11.3 mL

MLL4: Ordered 0.015 kg of Amoxicillin. Amoxicillin is available as 0.025 kg per 3 mL. How much will the nurse draw up? 1.8 mL

MLL5: Ordered 0.019 kg of Amoxicillin. Amoxicillin is available as 17,000 mg per 3 mL. How much will the nurse draw up? 3.4 mL

IV Concepts, Terms, and Problems

The following is an overview of key IV concepts that are useful for dosage calculation problems.

Important IV Terms

- gtts: drops
- Drop Factor: Number of drops per volume of IV fluid. Varies depending on the tubing used. Usually measured in gtts/mL.
- Flow Rate: Measure of the flow of liquid from an IV. Usually measured in gtts/minute (how many drops are released every minute) or in mL/hour (how many mL flow through each hour). gtts/minute is used for manually regulating an IV while mL/hour is used when utilizing an electronic IV regulator.

Important IV Abbreviations

- D: Dextrose
- W: Water
- S: Saline
- NS: Normal Saline (0.9% NaCl)
- RL or LR: Lactated Ringer's

Example: **D5W** = 5% Dextrose in Water
Example: **D5 x NS** = 5% dextrose in 0.225% saline solution

Amount in IV Fluid Questions

Given a volume of IV fluid and a dosage expressed in percent, what is the mass of a particular dosage?

Formula:

$$\frac{\text{Concentration \%}}{100} \times \text{Volume (mL)} = \text{Y (Dosage Amount in g)}$$

Example: Calculate the amount of dextrose in 1000 mL D5W.

$$\frac{\text{Concentration \%}}{100} \times \text{Volume (mL)} = \text{Y (Dosage Amount in g)}$$

$$\frac{5\%}{100} \times 1000 \text{ mL} = 50 \text{ g}$$

Example: Calculate the amount of sodium chloride in 2000 mL NS. Recall NS is 0.9% NaCl (sodium chloride)

$$\frac{\text{Concentration \%}}{100} \times \text{Volume (mL)} = \text{Y (Dosage Amount in g)}$$

$$\frac{0.9\%}{100} \times 2000 \text{ mL} = 18 \text{ g}$$

IVF1: Calculate amount of sodium chloride in 1,875,000 mcL 1/2 NS. **8.4 g**

IVF2: Calculate the amount of dextrose in 1,677 mL D5W. **83.9 g**

IVF3: Calculate amount of sodium chloride in 1.69 L NS. **15.2 g**

IVF4: Calculate amount of sodium chloride in 328,000 mcL 1/4 NS. **0.7 g**

IVF5: Calculate the amount of dextrose in 0.0019 kL D10W. **190 g.**

Volume/Time - IV mL Rate Questions

Given a certain amount of liquid and a time period, what is the necessary IV flow rate in mL/hr? Measurement used when IV regulated electronically by infusion pump.

Formula:

$$\frac{\textit{Volume (mL)}}{\textit{Time (hr)}} = \textit{Y (Flow Rate in mL/hr)}$$

Example: Infuse 250 mL over the next 120 minutes by infusion pump.

$$\frac{\textit{Volume (mL)}}{\textit{Time (hr)}} = \textit{Y (Flow Rate in mL/hr)}$$

Convert 120 minutes to hours.

- min → hr (÷ by 60)
- 120 min ÷ 60 = 2 hr

$$\frac{250 \text{ mL}}{2 \text{ hr}} = 125 \text{ mL/hr}$$

Example: Ordered 1000 mL D5W IV to infuse in 10 hours by infusion pump.

$$\frac{\textit{Volume (mL)}}{\textit{Time (hr)}} = \textit{Y (Flow Rate in mL/hr)}$$

$$\frac{1000 \text{ mL}}{10 \text{ hr}} = 100 \text{ mL/hr}$$

IVR1: Ordered 0.00078 kL D5W IV to infuse in 438 min by infusion pump. What is the IV flow rate in mL/hr? **106.8 mL/hr**

IVR2: Ordered 0.00087 kL D5W IV to infuse in 11.5 hr by infusion pump. What is the IV flow rate in mL/hr? **75.7 mL/hr**

IVR3: Ordered 0.042 L NS IV to infuse in 17.4 hr by infusion pump. What is the IV flow rate in mL/hr? **2.4 mL/hr**

IVR4: Ordered 257 mL D5W IV to infuse in 2.1 hr by infusion pump. What is the IV flow rate in mL/hr? **122.4 mL/hr**

IVR5: Ordered 0.4 L D5W IV to infuse in 792 min by infusion pump. What is the IV flow rate in mL/hr? **30.3 mL/hr**

Volume/Time - IV Drop Rate Questions

Given a certain amount of liquid, a time period, and a drop factor (gtts/mL), what is the necessary IV flow rate in gtts/min? Measurement used when IV is regulated manually. Because it is not possible to give a patient a fraction of a drop, it is typical to round answers for these problems up or down to the nearest whole number.

Formula:

$$\frac{\textit{Volume (mL)}}{\textit{Time (min)}} \textit{ x Drop Factor (gtts/mL) = Y (Flow Rate in gtts/min)}$$

Example: Calculate the IV flow rate for 1200 mL of NS to be infused in 6 hours. The infusion set is calibrated for a drop factor of 15 gtts/mL.

$$\frac{\textit{Volume (mL)}}{\textit{Time (min)}} \textit{ x Drop Factor (gtts/mL) = Y (Flow Rate in gtts/min)}$$

Convert 6 hours to minutes.

- min ← hr (x by 60)
- 6 hr x 60 = 360 min

$$\frac{1200 \text{ mL}}{360 \text{ min}} \text{ x } 15 \text{ gtts/mL} = 50 \text{ gtts/min}$$

Example: Calculate the IV flow rate for 200 mL of 0.9% NaCl IV over 120 minutes. Infusion set has drop factor of 20 gtts/mL.

$$\frac{\textit{Volume (mL)}}{\textit{Time (min)}} \textit{ x Drop Factor (gtts/mL) = Y (Flow Rate in gtts/min)}$$

$$\frac{200 \text{ mL}}{120 \text{ min}} \text{ x } 20 \text{ gtts/mL} = 33 \text{ gtts/min}$$

IVDR1: Calculate the IV flow rate for 0.68 L of NS to be infused in 18.7 hr. The infusion set is calibrated for a drop factor of 90 gtts/mL. What is the IV flow rate in gtts/min? **55 gtts/min**

IVDR2: Calculate the IV flow rate for 469 mL of D5W IV over 552 min. Infusion set has drop factor of 15 gtts/mL. What is the IV flow rate in gtts/min? **13 gtts/min**

IVDR3: Calculate the IV flow rate for 171,000 mcL of NS to be infused in 3.9 hr. The infusion set is calibrated for a drop factor of 26 gtts/mL. What is the IV flow rate in gtts/min? **19 gtts/min**

IVDR4: Calculate the IV flow rate for 93,000 mcL of 0.9% NaCl IV over 1,170 min.

Infusion set has drop factor of 94 gtts/mL. What is the IV flow rate in gtts/min? **7 gtts/min**

IVDR5: Calculate the IV flow rate for 0.65 L of NS to be infused in 17.5 hr. The infusion set is calibrated for a drop factor of 1 gtts/mL. What is the IV flow rate in gtts/min? **1 gtts/min**

Fluid Maintenance Requirement Questions

Given the weight of a child or infant, calculate the necessary amount of fluid per day. Different hospitals may have different policies, but for learning how to perform these pediatric dosage calculations, the following commonly used table of fluid requirements may be used.

Weight Range	*Required Daily Fluid*
0-10 kg	*100 mL per kg*
10-20 kg	*1,000 mL + 50 mL per each kg above 10 kg*
20-70 kg	*1,500 mL + 20 mL per each kg above 20 kg*
Over 70 kg	*2,500 mL (adult requirement)*

Example: An infant weighs 4 kg. What is the required amount of fluid per day in mL?

0-10 kg	100 mL per kg

4 kg x 100 mL/kg = 400 mL

Example: An infant weighs 30.8 lb. What is the required IV flow rate in mL/hr to maintain proper fluid levels?
Convert 30.8 lb to kg.

- lb → kg (÷ by 2.2)
- 30.8 lb ÷ 2.2 = 14 kg

10-20 kg	1,000 mL + 50 mL per each kg above 10kg

14 g - 10 kg = 4 kg (There are 4 kg over 10 kg).

1,000 mL + (50 mL/kg x 4 kg) = 1,200 mL/day

This is now an ordinary IV Flow Rate - mL Rate Question. The required volume is 1,200 mL and the time is one day.

$$\frac{\textit{Volume (mL)}}{\textit{Time (hr)}} = \textit{Y (Flow Rate in mL/hr)}$$

There are 24 hours in one day.

- 1 day x 24 = 24 hr

$$\frac{1{,}200 \text{ mL}}{24 \text{ hr}} = 50 \text{ mL/hr}$$

FM1: An infant weights 34 kg. What is the required IV flow rate in mL/hr to maintain proper fluid levels? **74.17 mL/hr**

FM2: An infant weights 32 kg. What is the required IV flow rate in mL/hr to maintain proper fluid levels? **72.5 mL/hr**

FM3: An infant weights 31 kg. What is the required amount of fluid per day in mL? **1,720 mL**

FM4: An infant weights 12 lb. What is the required amount of fluid per day in mL? **545.45 mL**

FM5: An infant weights 24 kg. What is the required IV flow rate in mL/hr to maintain proper fluid levels? **65.83 mL/hr**

Dosage By Weight Questions

Given the weight of a patient and a dosage specified in terms of weight, calculate the necessary dosage. These problems are a type of pediatric dosage calculations.

Formula:

*Weight in Kg * Dosage Per Kg = Y (Required Dosage)*

Example: A doctor orders 200 mg of Rocephin to be taken by a 15.4 lb infant every 8 hours. The medication label shows that 75-150 mg/kg per day is the appropriate dosage range. Is this doctor's order within the desired range?

Weight in Kg * Dosage Per Kg = Y (Required Dosage)

Convert 15.4 lb to kg.

- lb → kg (÷ by 2.2)
- 15.4 lb ÷ 2.2 = 7 kg

7 kg * 75 mg/kg = 525 mg (Minimum Desired Dosage)

7 kg * 150 mg/kg = 1,050 mg (Maximum Desired Dosage)

24 hours in one day and the medication is ordered every 8 hours.

- 24 hrs / 8 hrs = 3 times per day doctor ordered medication
- 200 * 3 = 600 mg ordered per day
- 600 mg is within the desired range of 525-1,050 mg

Yes, the doctor has ordered a dosage within the desired range.

Example: Solumedrol 1.5 mg/kg is ordered for a child weighing 74.8 lb. Solumedrol is available as 125 mg / 2mL. How many mL must the nurse administer?

Weight in Kg * Dosage Per Kg = Y (Required Dosage)

Convert 74.8 lb to kg.

- lb → kg (÷ by 2.2)
- 74.8 lb ÷ 2.2 = 34 kg

34 kg * 1.5 mg/kg = 51 mg

This is now an ordinary Mass/Liquid For Liquid Question. 51 mg is ordered and the medication is available as 125 mg / 2 mL.

Ordered x Volume Per Have = Y (Liquid Required)

Have

$$\frac{51\ mg}{125\ mg} \times 2\ mL = 0.82\ mL$$

DW1: Solumedrol 2.5 mg/kg is ordered for a child weighing 1 kg. Solumedrol is available as 125 mg / 3 mL is available. How many mL must the nurse administer? **0.06 mL**

DW2: Solumedrol 2.5 mg/kg is ordered for a child weighing 27 kg. Solumedrol is available as 125 mg / 1 mL is available. How many mL must the nurse administer? **0.54 mL**

DW3: Solumedrol 2.5 mg/kg is ordered for a child weighing 18 kg. Solumedrol is available as 125 mg / 2 mL is available. How many mL must the nurse administer? **0.72 mL**

DW4: Solumedrol 1.5 mg/kg is ordered for a child weighing 57 lb. Solumedrol is available as 75 mg / 1 mL is available. How many mL must the nurse administer? **0.52 mL**

DW5: Solumedrol 2.5 mg/kg is ordered for a child weighing 11 kg. Solumedrol is available as 125 mg / 2 mL is available. How many mL must the nurse administer? **0.44 mL**

Mass/Time - IV mL Rate Questions

Give an order in quantity of mass per time, determine the necessary IV flow rate in mL/hr based on the given mass per volume. These types of problems are often used in critical care nursing.

Formula:

$$\frac{\textit{Ordered Per Hour}}{\textit{Have}} \textit{ x Volume (mL) = Y (Flow Rate in mL/hr)}$$

Example: Give patient 500 mg of dopamine in 250 mL of D5W to infuse at 20 mg/hr. Calculate the flow rate in mL/hr.

$$\frac{\textit{Ordered Per Hour}}{\textit{Have}} \textit{ x Volume (mL) = Y (Flow Rate in mL/hr)}$$

$$\frac{20 \text{ mg/hr}}{500 \text{ mg}} \text{ x } 250 \text{ mL} = 10 \text{ mL/hr}$$

Example: Aggrastat at 12.5 mg in 250 mL is prescribed to be infused at a rate of 6 mcg/kg/hr in a patient who weighs 100 kg. At what flow rate in mL/hr will you set the pump?

$$\frac{\textit{Ordered Per Hour}}{\textit{Have}} \textit{ x Volume (mL) = Y (Flow Rate in mL/hr)}$$

The first step is to convert the order per time to the amount required for this particular patient. This is a Dosage By Weight Question. 100 kg is the weight in kg and 6 mcg/kg/hr is a dosage in terms of kg.

Weight in Kg * Dosage Per Kg = Y (Required Dosage)

100 kg * 6 mcg/kg/hr = 600 mcg/hr

Convert 600 mcg/hr to mg/hr.

- mcg → mg → g → kg (÷ by 1,000)
- 600 ÷ 1,000 = 0.6 mg/hr

$$\frac{0.6 \text{ mg/hr}}{12.5 \text{ mg}} \text{ x } 250 \text{ mL} = 12 \text{ mL/hr}$$

MTR1: Give patient 20.7 mg of dopamine in 259 mL of D5W to be infused at a rate of 8,205 mcg/hr. Calculate the flow rate in mL/hr. **102.7 mL/hr**

MTR2: Aggrastat at 15.3 mg in 315 mL is to be infused at 9 mcg/kg/hr in a patient who weighs 33 kg. At what flow rate in mL/hr will you set the pump? **6.1 mL/hr**

MTR3: Aggrastat at 14 mg in 170 mL is to be infused at 16 mcg/kg/hr in a patient who weighs 19 kg. At what flow rate in mL/hr will you set the pump? **3.7 mL/hr**

MTR4: Give patient 20.7 mg of dopamine in 86 mL of D5W to be infused at a rate of 16,133 mcg/hr. Calculate the flow rate in mL/hr. **67 mL/hr**

MTR5: Give patient 21.9 mg of dopamine in 254 mL of D5W to be infused at a rate of 15 mg/hr. Calculate the flow rate in mL/hr. **174 mL/hr**

Resources used to compile this study guide:

http://www.dosagehelp.com/

http://calculator-converter.com/converter_mcg_to_ml_micrograms_to_milliliters_calculator.php

Created/compiled by: Stacy Henry (June 2014)