ACADEMIC CENTER FOR EXCELLENCE

How to Solve Drug Dosage Problems

General Information -- ----- ------------------ page 2

Converting between units --- page 4

Converting between metric units -- page 5

Calculating Drug Dosages --- page 6

Ratio (Rainbow) Method

Proportion Method

Formula Method

Dimensional Analysis

Useful Formulas for Calculating Drug Calculation Problems ---------------page 7-9

Calculating BSA

Calculating a child's dosage from an adult dosage

Calculating flow rate in ml/h

Calculating flow rate in gtt/min

Calculating Heparin dosages

Converting from °F to °C or °C to °F

Helpful Websites --- page 9

General Information

There are three different types of measurements you will encounter when dealing with medications: Household, Apothecary, and Metric.

Type	Number	Solids	Liquids
Household	Whole numbers and Fractions **before** unit. Ex: 1 ½ T	Teaspoons (tsp, t) Tablespoons (Tbs,T) Pounds (lb)	Drop (gtt) Ounce (oz) Cup (c) Pint (pt) Quart (qt) Glass
Apothecary	Whole numbers, Fractions, and Roman Numerals **after** unit. Ex: gr 15 ½ or dr iss	Grains (gr) Drams (dr or ʒ)	Minum (m) Fluid Dram (dr or ʒ)
Metric	Whole numbers and decimals **before** unit (always put a 0 in front of the decimal. Ex: 0.15 mL	Grams (g) Meter (m)	Liters (L)

Note: When two system-to-system conversion factors exist, consider the unit of the final answer. For example, if it is necessary in the drug dosage problem to convert a dosage from grains to mg, use the *gr 1 = 60 mg* conversion factor.

Approximate Conversion Factors

Solid conversions

gr 1 = 60 mg
gr 15 = 1 g
2.54 cm = 1 in
2.2 lb = 1 kg

Fluid conversions

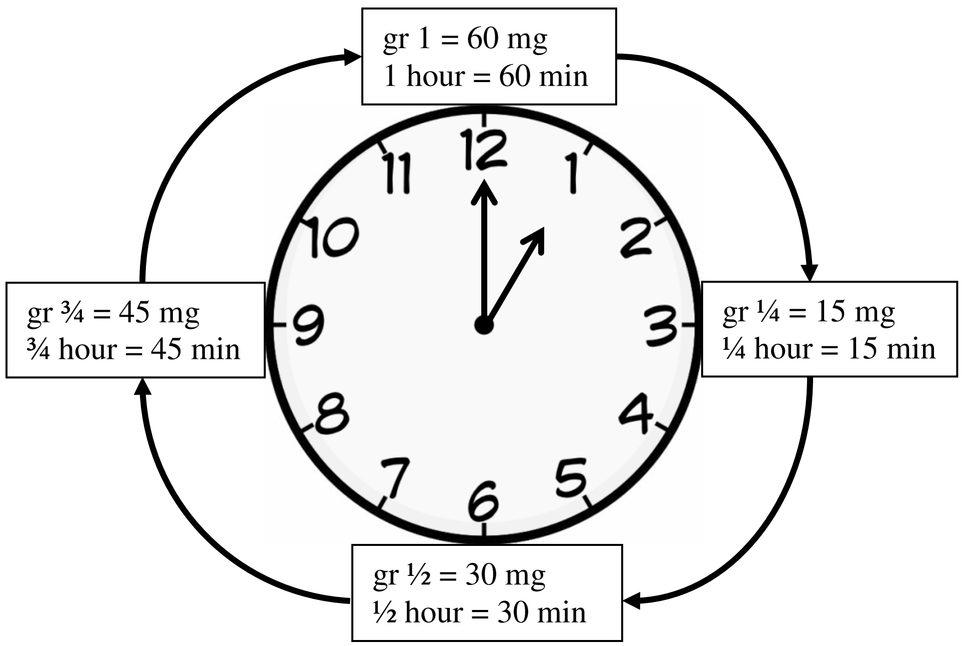
1 oz = dr 8 or ʒ 8
m 15 = 1 mL = 1 cc
4 mL = fluid dr 1 = ʒ 1
15 mL = 3 t = 1 T
30 mL = 1 oz

Extended conversions

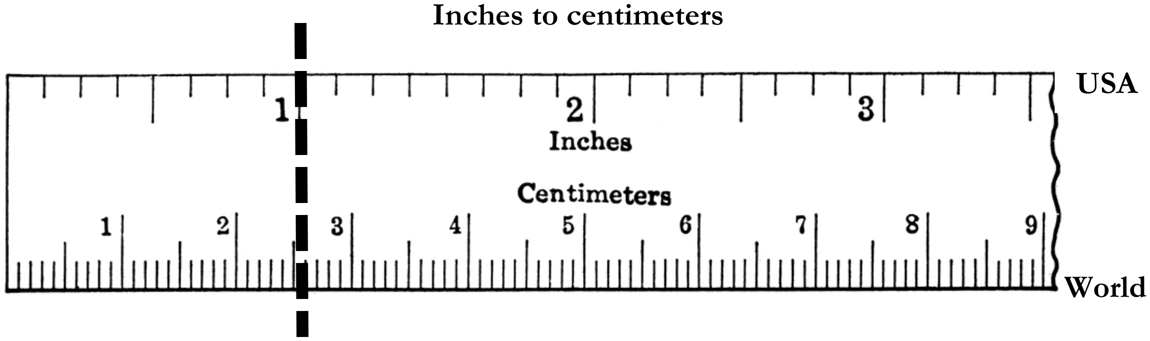
1 kg = 1000 g = 2.2 lbs
1 L = 1000 mL = 33 1/3 oz = 200 t = 66 2/3 T = ʒ 250

Visual Conversions

"The Grain Clock"
Convert grains to mg



Inches to centimeters



1 inch = 2.54 cm

Roman	Numerals
½ = ss or $\overline{ss}$	5 = v or $\overline{v}$
1 = I or i or $\overline{i}$	10 = x or $\overline{x}$
2 = II or ii or $\overline{ii}$	15 = xv or $\overline{xv}$
3 = III or iii or $\overline{iii}$	19 = xix [10 + (10-1)] or $\overline{xix}$
4 = IV or iv (i before v = 5-1) or $\overline{iv}$	20 = xx or $\overline{xx}$

Converting Between Units

Use of One Conversion Factor:

To convert from one unit to another, begin with the unit assigned. Next **find a conversion factor** that relates the *unit assigned* to the *unit needed*. Then multiply the unit assigned by the found conversion factor. This calculation results in the new unit.

Example: Convert 120 mg to gr________.

Step one: Think of a conversion factor that relates mg and gr**. 60 mg = gr 1** (This can be used as either 60 mg/gr 1 or gr 1/60 mg)

Step two: set up the multiplication equation.

Note: when using the conversion factor, always place the needed unit on top.

$$120\text{ mg} \cdot \frac{\textbf{gr 1}}{\textbf{60 mg}} = \text{gr } \_\_\_\_\_$$

Step three: Solve the equation.

First cancel mg units,

$$120\ \cancel{\text{mg}} \cdot \frac{\text{gr 1}}{60\ \cancel{\text{mg}}} = \text{gr } \_\_\_\_\_$$

Then solve the equation

$$120 \cdot \text{gr } 1 \div 60 = \text{gr } 2$$

Therefore: 120 mg = gr 2

Use of Multiple Conversion Factors:

If **a conversion factor** for the two units does not exist, then proceed through another unit to obtain the unit needed.

Example: Convert 1 T to _____oz.

Step one: Try to find a conversion factor that relates tablespoons to ounces. Looking at the list, there is not a conversion factor relating tablespoons and ounces. Therefore, two conversion factors are needed: **1 T = 15 mL** and **30 mL = 1 oz.**

Step two: Set up the equations

$$1\text{ T} \cdot \frac{\textbf{15 mL}}{\textbf{1 T}} = \_\_\_\_\_\text{mL} \qquad \_\_\_\_\_\text{ mL} \cdot \frac{\textbf{1 oz}}{\textbf{30 mL}} = \_\_\_\_\_\text{oz}$$

Step three: Solve the equations.

$$1\ \cancel{\text{T}} \cdot 15\text{ mL} \div 1\ \cancel{\text{T}} = 15\text{ mL} \qquad 15\ \cancel{\text{mL}} \cdot 1\text{ oz} \div 30\ \cancel{\text{mL}} = 0.5\text{ oz}$$

Therefore: 1 T = 0.5 oz

Converting Between Metric Units

To convert between metric units, simply move the decimal place. The easiest way to remember which way to move the decimal as well as the number of places to slide it is the mnemonic: "**King Henry died by drinking chocolate milk . . merrily**."

	King	Henry	died	by	drinking	chocolate	milk	merrily
symbol	**k**	h	D	**b**	d	c	**m †**	**mc**
name	**kilo**	hector	Deca	**"base"**	deci	**centi**	**milli**	**micro**
Ex.	**kg**	hg	Dg	**gram**	dg	**cg**	**mg**	**mcg**

† there are three decimal places between m and mc. This is commonly forgotten!

Using the "King Henry" method to convert between metric units involves locating the starting place then sliding the decimal to the desired unit and adding zeros as needed.

Example 1: Convert 25.3 g to __________mg

Step one: The given unit is gram, so start at "b".

Step two: The ending place is m, so slide the decimal from "b" to "m".

Step three: **K**ing **H**enry **d**ied **b**y **d**rinking **c**hocolate **m**ilk . . **m**errily

k h D b d c m . . mc

25.3 → 25. 3 0 0. → 25,300 mg Slide 3 decimal places to the right

Therefore: 25.3 g = 25,300 mg

Example 2: Convert 300 mcg to ________mg

Step one: The given unit is mc, so start at "mc".

Step two: The ending place is m, so slide the decimal from "mc" to "m".

Step three: **K**ing **H**enry **d**ied **b**y **d**rinking **c**hocolate **m**ilk . . **m**errily

k h D b d c m . . mc

300 → 3 0 0. → 0.300 mg slide decimal 3 places to left (mc to m)

Therefore: 300 mcg = 0.300 mg

Calculating Drug Dosages

When performing drug calculations, one of the following four methods should be used: **Ratio (Rainbow) Method, Proportion Method, Formula Method, or Dimensional Analysis**. Each of these methods works as well as the others. However, once the student decides which method is the most comfortable for them, they should stick with that method and not switch back and forth between the different methods.

Ratio (Rainbow):

Step one: Set up ratios.
Step two: Multiply means and extremes
Step three: Solve for "x" algebraically.

Proportion:

Step one: Set up proportions
Step two: Cross multiply
Step three: Solve for "x" algebraically

Formula:

$\frac{D}{H} \cdot Q = \text{answer}$ $\qquad \frac{D \text{ (dose ordered)}}{H \text{ (on hand)}} \cdot Q \text{ (unit quantity)} = \text{answer}$

Dimensional Analysis:

$D \cdot \frac{Q}{H} = \text{answer}$ $\qquad D \text{ (dose ordered)} \cdot \frac{Q \text{ (unit quantity)}}{H \text{ (on hand)}} = \text{answer}$

Use drug calculations when calculating the quantity of medications needed for a patient and the strength of medication is already known.

Example: If the doctor orders 20 mg of Benadryl, and 10 mg tablets are available, how many tablets should be given to the patient?

Ratio (Rainbow) Method

We know that 10 mg = 1 tablet, and we need 20 mg in an unknown number of tablets.

Step one: Set up ratios.

10 mg : 1 tab = 20 mg : x tab

Notice that on both sides of the equation, mg comes first, then tablets. This is **very important**. It does not matter which unit comes first, as long as units are in the same order on both sides of the equal "=" sign.

Step two: Multiply means and extremes

10 mg • x tab = 1 tab • 20 mg

Step three: Solve for "x" algebraically.

$x \text{ tab} = \frac{1 \text{ tab} \cdot 20 \cancel{\text{mg}}}{10 \cancel{\text{mg}}}$ $\qquad$ **x = 2 tablets**

Proportion Method

Step one: Set up proportions

$$\frac{10\ \text{mg}}{1\ \text{tab}} = \frac{20\ \text{mg}}{x\ \text{tab}}$$

Step two: Cross multiply

10 mg • x tab = 20 mg • 1 tab

Step three: Solve for "x" algebraically

$$x\ \text{tab} = \frac{20\ \cancel{\text{mg}} \cdot 1\ \text{tab}}{10\ \cancel{\text{mg}}} \qquad \mathbf{x = 2\ tablets}$$

Formula Method

$$\frac{D}{H} \cdot Q = \_\_\_\_ \qquad \text{So: } \frac{20\ \cancel{\text{mg}}}{10\ \cancel{\text{mg}}} \cdot 1\ \text{tab} = \mathbf{2\ tablets}$$

Therefore: give the patient 2 tablets.

Dimensional Analysis

$$D \cdot \frac{Q}{H} = \_\_\_\_ \qquad \text{So: } 20\ \cancel{\text{mg}} \cdot \frac{1\ \text{tab}}{10\ \cancel{\text{mg}}} = \mathbf{2\ tablets}$$

Useful Formulas for Calculating Drug Calculation Problems

Calculating BSA (m^2):

$$\sqrt{\frac{\text{Lb x in}}{3131}} \quad \text{or} \quad \sqrt{\frac{\text{kg x cm}}{3600}}$$

•Round to hundredths place <u>after</u> taking the square root

Example: If a patient weighs 140 lb and is 62 inches tall, calculate the BSA by simply plugging the numbers into the formula and solving.

$$\sqrt{\frac{140\ \text{lb x } 62\ \text{in}}{3{,}131}}$$

140 x 62 = 8,680 8,680 ÷ 3131 = 2.77 $\sqrt{2.77}$ = **1.66 m^2**

•Round to hundredths place
•Answer is always in m^2

Calculating a child's dosage using an adult dosage:

$\frac{\text{Child's BSA}}{1.7\ m^2} \times$ adult dosage = child's dosage

Example: The normal adult dosage of a medication is 150 mg. The child weighs 32 kg and is 120 cm tall. How much medication should be given to the child?

Step one: Find the child's BSA. To do so, use the formula given above.

$\sqrt{\frac{32\ kg \times 120\ cm}{3{,}600}} = \sqrt{1.0666\ldots}$ $\quad \sqrt{1.0666\ldots} = 1.032792\ldots\ m^2 = 1.03\ m^2$

•Round to hundredths place

Step two: Use the child's dosage formula.

$\frac{1.03\ m^2}{1.7\ m^2} \times 150\ mg =$ **90.88 mg**

•Round to hundredths place

Calculating Flow Rate in mL/h:

$\frac{\text{Total mL ordered}}{\text{Total hours ordered}}$ = mL/h (must round to a whole number)

Example: Calculate the flow rate for an IV of 1,820 mL Normal Saline IV to infuse in 15 h by controller. Flow rate = _________ mL/h

$\frac{1{,}820\ mL}{15\ h} = 121.33\ mL/h =$ **121 mL/h**

•Round to nearest whole number

Calculating Flow Rate in gtt/min:

$\frac{\text{Volume (mL)}}{\text{Time (min)}} \times$ drop factor (gtt/mL) = Rate (gtt/min) (MUST be whole #)

Example: The physician orders Lactated Ringer's IV at 150 mL/h. The drop factor is 15 gtt/mL. Find the flow rate in gtt/min.

$\frac{150\ \cancel{mL}}{60\ min} \times \frac{15\ gtt}{1\ \cancel{mL}} = 37.5 =$ **38 gtt/min**

Calculating Heparin Dosages:

Order: D5W Heparin 40,000 U in 1,000 mL D5W to infuse at 40 mL/h. What is the hourly heparin dosage?

Find how many Units are in 40 mL.

$$\frac{40{,}000\text{ U}}{1{,}000\text{ mL}} = \frac{x\text{ U}}{40\text{ mL}}$$ Cross multiply

$x\text{ U} \cdot 1{,}000\text{ mL} = 40{,}000\text{ U} \cdot 40\text{ mL}$ then divide by 1,000 mL

$$\frac{40{,}000\text{ U} \cdot 40\ \cancel{\text{mL}}}{1{,}000\ \cancel{\text{mL}}} = \frac{1{,}600{,}000\text{ U}}{1000} = \mathbf{1600\text{ U/hr}}$$

Converting from ºF to ºC or ºC to ºF:

$ºF = 1.8\,(ºC) + 32$ •Carry to hundredths and round to tenths

$$ºC = \frac{ºF - 32}{1.8}$$

Example: What is 212 ºF in Celsius?

$ºC = \frac{ºF - 32}{1.8}$ $ºC = \frac{212 - 32}{1.8}$ $ºC = \frac{180}{1.8}$ **ºC = 100º**

Example: What is 37 ºC in Fahrenheit?

$ºF = 1.8\,(ºC) + 32$ $ºF = 1.8\,(37) + 32$ $ºF = 66.6 + 32$ **ºF = 98.6º**

Helpful Websites

There are many helpful drug dosage calculation websites. The following links include practice problems and solutions. We encourage you to use them to your advantage. After all, the best way to become proficient at solving drug dosage problems is to PRACTICE!

http://nursesaregreat.com/articles/drugcal.htm

http://www.testandcalc.com/drugcalc_legacy/index.asp

http://www.unc.edu/~bangel/quiz/quiz5.htm

http://nursing.flinders.edu.au/students/studyaids/drugcalculations/page.php?id=1