DOSAGE CALCULATIONS FOR NURSES

- Dosage calculation can be fun and can be accomplished through several methods including ratio and proportions, formula, and dimensional analysis.

- Only one method will be demonstrated by the instructor to avoid confusion for other students.

- Choose your preferred calculation method and one of the other two methods to check your answer.

- Use the online resources provided to you.

- Approved abbreviations will be included in some test questions. You need to start learning these abbreviations.

- Learn the rules for the systems of medication measurement.

- Memorize Conversions! Memorize Formulas!

- Practice! Practice! Practice!
Dosage Calculations

Systems Rules for Medication Measurement:

(1) Metric:
- Decimals are used in the metric system and conversions are completed by moving the decimal point.
- A zero should always be placed in front of the decimal when the quantity is not a whole number (less than 1). (Ex. 0.35 mg)
- Do not place a trailing zero after a decimal. (Ex. 10 mL is correct and 10.0 mL is incorrect).
- The amount is always written before the abbreviation or symbol. (Ex. 1000 mg)
- Omit unnecessary zeros. (Ex. 0.35 mg is correct but 0.350 mg is incorrect.)
- Use commas when values greater than 1,000 are written. (not 1000)
- The gram is the basic unit of weight and volume is the basic unit of volume.
- When converting a smaller unit to a larger one, divide by 1,000 or move the decimal point 3 places to the left. (350 mg = .350 g = 0.35 g)
- When converting a larger unit to a smaller one, multiply by 1,000 or move the decimal point 3 places to the right. (0.75 L = 0.750 L = 750 mL)

(2) Apothecary:
- The abbreviation or symbol is written before the amount.
- Apothecaries' measures are approximate measures.
- Fractions, Roman numerals, and Arabic numerals are used.
- When possible, convert apothecary to metric measures.
- Weight is measured in grains (gr). Volume is measured in minims (m), drams (dr), and ounce (oz).

(3) Household:
- This is the least accurate system of measure.
- Arabic numerals and fractions are used to express quantities.
- Drop (gtt) is the smallest unit of measure. Because the size of a drop varies from dropper to dropper, drops should never be used as a measure for medications. The only exception to this rule is when standard drop sizes are used with intravenous (IV) flow rates.
- Doses less than a teaspoon should be measured with a syringe-type device.
- When possible, convert household to metric measures.
**Rounding Guides:**

- A general rule is to round to the hundredths (two decimal places) if the amount is less than (<) 1 mL. (Ex. 0.8892 mL is rounded to 0.89 mL).
- A general rule is to round to the tenths (one decimal place) if the amount is greater than (>) 1 mL. (Ex. 1.784 mL is rounded to 1.8 mL).
- When calculating weight-based medications, *round at the end.*
- A general rule is to round to a whole number for remaining or infused mL, mL/hr, units, and gtt/min. Tablets can be half or whole. (1 tablet, 1.5 tablet)
- Always read the dosage calculation question and determine what measurement it is asking for. (Ex. If the question asks for the dose in grams (g), do not leave the answer in milligrams (mg).)

You must know/understand the following, regardless of the method you choose to use:

<table>
<thead>
<tr>
<th>Household equivalents of liquid volume</th>
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<tbody>
<tr>
<td>1 quart (qt) = 2 pints (pt)</td>
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<tr>
<td>1 pint = 2 cups (C)</td>
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<tr>
<td>1 cup/glass = 8 ounces (oz)</td>
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<tr>
<td>1 oz = 2 Tablespoons (Tbsp)</td>
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<tr>
<td>1 Tablespoon = 3 teaspoons (t)</td>
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<table>
<thead>
<tr>
<th>Metric equivalents of liquid volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 cubic centimeter (cm) = 1 milliliter (mL)</td>
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<tr>
<td>1,000 mL = 1 liter (L)</td>
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<table>
<thead>
<tr>
<th>Metric equivalents of weight</th>
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<tbody>
<tr>
<td>1 kilogram (kg) = 1,000 grams (g)</td>
</tr>
<tr>
<td>1 gram = 1,000 milligrams (mg)</td>
</tr>
<tr>
<td>1 milligram = 1,000 micrograms (mcg)</td>
</tr>
<tr>
<td>1 grain (gr) = 60 milligrams</td>
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<table>
<thead>
<tr>
<th>Metric equivalents of length</th>
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</thead>
<tbody>
<tr>
<td>1 centimeter (cm) = 10 millimeters (mm)</td>
</tr>
<tr>
<td>100 centimeters = 1,000 millimeters</td>
</tr>
<tr>
<td>1 meter = 100 centimeters</td>
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<table>
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<tr>
<th>Approximate equivalents between systems</th>
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<tbody>
<tr>
<td>1 kg = 2.2 lbs</td>
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<tr>
<td>2.5 cm = 1 inch</td>
</tr>
<tr>
<td>5 mL = 1 t</td>
</tr>
<tr>
<td>15 mL = 1 Tbsp</td>
</tr>
<tr>
<td>30 mL = 1 oz</td>
</tr>
<tr>
<td>240 mL = 1 C</td>
</tr>
<tr>
<td>500 mL* = 1 pt</td>
</tr>
<tr>
<td>1,000 mL* = 1 qt</td>
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</tbody>
</table>

*Although these are listed as equivalents, it is better to use the 30 mL=1 oz equivalent. (1 pt=16 oz; 16 oz=480 mL). (1 qt=32 oz; 32 oz=960 mL)
TEMPERATURE CONVERSIONS

°C → °F  
1.8 \times (\text{°C}) + 32  
Example: 36 °C = x °F  
(1.8 \times 36) + 32 = 96.8° F

°F → °C  
\( \left( \text{°F} - 32 \right) \div 1.8 \)  
Example: 99 °F = x °C  
\( \left( 99 - 32 \right) \div 1.8 = 37.2° C \)

Easy conversion: 37° C is 98.6° F. Add or subtract 0.9 degrees for every \( \frac{1}{2} \) (0.5) °C. Example: to change 37.5° C to °F, add 98.6 + 0.9 = 99.5° F.

MILITARY TIME

Military time is used in healthcare. There are no colons or a.m./p.m. designations.

**Standard → Military**

Midnight to noon: place zero (as necessary) in front of the number to make a 4-digit-number.  
Example: 
4:10 a.m. = 0410  
11:30 a.m. = 1130

Noon – 11:59 p.m.: add 12 to the time.  
Example: 
10:25 p.m. = 1025 + 12 = 2225  
4:08 p.m. = 408 + 12 = 1608

**Military to Standard**

Midnight to 11:59 a.m.: Insert colon, add a.m., and delete any zero before number.  
Example: 0625 = 6:25 a.m.  
1019 = 10:19 a.m.

Noon – 11:59 p.m.: subtract 12, insert colon, and add p.m.  
Example: 2200 = 2200 – 12 = 10:00 p.m.  
1340 = 1340 – 12 = 1:40 p.m.
BASIC CALCULATION METHODS

Choose from the following methods: ratio/proportion, formula, or dimensional analysis. If you already know how to use one of these methods and feel comfortable with it, go ahead and use it. You can use one of the other methods to check your answer.

\[ H = \text{Dose on Hand} \]
\[ Q = \text{Quantity or } V = \text{Volume} \]
\[ D = \text{Desired Dose} \]
\[ X = \text{Unknown} \]

(1) Ratios and Proportions:
\[ \frac{H}{Q(V)} = \frac{D}{X} \]

(2) Formula:
\[ \frac{D}{H} \times Q(V) = X \]

(3) Dimensional Analysis:
\[ \frac{D}{1} \times \frac{Q(V)}{H} \]

**Level 1 Dimensional Analysis: The easiest conversions**

In dimensional analysis, you always start with what is ordered. You will write this as a fraction with the ordered dose on the top and 1 on the bottom.

Next, you need to know what dosage amounts the medication comes in. This is known as the conversion factor. The next step is to add the conversion factor also as a fraction.

As we move forward into more complicated math calculations with multiple conversions, it will become more evident that you know when to stop the conversions. This will be when you are left only with the information needed to give the dose.

**Example 1:** The order reads 650 mg acetaminophen PO every 6 hrs prn mild pain. The blister pack shows that each tablet is 325 mg.

Start with what is ordered: \( \frac{650 \text{ mg}}{1} \)

Look and see what dosage amount your medication comes in: \( \frac{650 \text{ mg}}{1} \times \frac{1 \text{ tab}}{325 \text{ mg}} \)

(1) Multiply across the top: 650 x 1.
(2) Then divide across the bottom: \( \div 325 \).

\[ \frac{650 \text{ mg}}{1} \times \frac{1 \text{ tab}}{325 \text{ mg}} = 2 \text{ tabs} \]
Example 2: The order reads 2.5 mg midazolam PO every 8 hrs prn anxiety. The blister pack shows each tablet is 5 mg.

\[
\frac{2.5 \, mg}{1} \cdot \frac{1 \, tab}{5 \, mg} = 0.5 \, tabs
\]

**Level 2 Dimensional Analysis: Multiple Conversions**
Rather than deal with actual drugs, I am going to use made up medication names.

Example 3: The order reads 2,000 mcg Smartella every 8 hrs IV.

You find the drug in the med room and see that it comes in vials that have 4 mg of drug per mL.

How much Smartella do you need to draw up? Start with the order: \( \frac{2,000 \, mcg}{1} \)

Next, look at the vial and see that you need to ultimately get to mg, so convert mcg to mg in the next step.

\[
\frac{2,000 \, mcg}{1} \cdot \frac{1 \, mg}{1,000 \, mcg} \cdot \frac{1 \, mL}{4 \, mg} = 0.5 \, mL
\]

Example 4: The order reads 60 mg Awesome Sauce IV every 8 hrs

You look at the vials of Brainzy and see they contain 1 gram of drug in 10 mL of solution.

\[
\frac{60 \, mg}{1} \cdot \frac{1 \, gram}{1000 \, mg} \cdot \frac{10 \, mL}{1 \, gram} = 0.6 \, mL
\]

**Level 3 Dimensional Analysis: Weight-based Calculations**
You will do a LOT of weight-based calculations not only in the adult population but in pediatrics as well.

Example 5: The order reads 1.4 mg per kg (mg/kg) Brainzy every 12 hrs IV.

You see that Brainzy comes in a 10 mL vial that contains 100 mg of the drug so you would write:

\[
\frac{1.4 \, mg}{kg} \cdot \frac{4 \, kg}{1 \, baby} \cdot \frac{10 \, mL}{100 \, mg} = 0.56 \, mL
\]

Example 6: Your nursing instructor may try to trick you and give you the client’s weight in pounds (lbs) with the dosage needed in kilograms (kgs). (I would never do this!)

The order reads 2 mcg per kg Calm Down every 2 hrs prn agitation.
Your client weighs 283 lbs. You find the drug in the med room and see it comes in a dosage of 1 mg per 10 mL bag. You then need to set up your equation, including all the conversion factors you need to end up with X number of mL.

\[ \frac{2 \text{ mcg}}{kg} \cdot \frac{1 \text{ kg}}{2.2 \text{ lbs}} \cdot \frac{283 \text{ lbs}}{1 \text{ angry client}} \cdot \frac{1 \text{ mg}}{1000 \text{ mcg}} \cdot \frac{10 \text{ mL}}{1 \text{ mg}} = 2.57 \text{ mL} \]

**Other Formulas You Will Work With in Dosage Calculations**

*Formula for IV Flow Rate Calculations (drops/min):*
Total volume (mL) X drop factor(gtts/mL) = Drops per minute (gtt/min)

Time in minutes

Microdrop = 60 gtt/mL
Macrodrop = Usually 20 gtt/mL (Some manufacturers use 10 or 15 gtt/mL)

*Formula for Volume per Hour (mL/hr):*
Total volume = mL/hr
Time in hour

*Formula for IV infusion time calculations:
Total volume to be infused
Volume per hour

*Formulas for m² (BSA):*  
\[ \sqrt{\frac{\text{Ht in cm} \times \text{Wt in kg}}{3600}} \]

\[ \sqrt{\frac{\text{Ht in in} \times \text{Wt in lbs}}{3131}} \]
*Formula for Pediatric Dosing with an Adult Dose:

Adult dose X Child’s BSA
1.7 m²

Questions to ask yourself while completing dosage calculations

❖ What is the question asking me to do?
❖ What information is needed to answer the question?
❖ Do I have all the information needed to answer the question?
❖ Is the quantity/volume, of the ordered dose, going to be more or less than what is available?
❖ How do I setup the equation so all units of measure cancel except the one needed to answer the question?

NOTES