# LESSON 14 Medication Math

## What is Med Math? (Drug/Dosage Calculations)

Nurses must perform dosage calculations when administering medications and intravenous fluids. Pharmacology math requires the nurse to know systems of measurement (metric, household, apothecary, and avoirdupois) and how to convert within those systems of measurement. Other system of measurements include units (common for insulin and heparin), milliequivalents (mEq) (common for some drugs such as potassium chloride), and international units (IU) (common for vitamins). Since nurses need to accurately calculate medication dosages, it is essential to understand drug weights and measures.

Math computation skills (addition, subtraction, division, multiplication, fractions, etc) are necessary to calculate medication dosages.

To interpret physician's orders, the nurse must also understand abbreviations used to describe those units of measurement and frequency of administration.

Other instances in which the nurse may use math (pharmacology) includes calculating safe dosages of medications.

Nurses may use basic math to determine intake and output

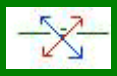
Setting up the Problem: Ratio & Proportion (Some refer to this as the "fraction" method.)

**Problem:**

Doctor's order: 0.25 mg of digoxin p.o.
On hand: 0.5 mg tablets

**Tip:**
Your exams may use varied terms to designate the 2 components necessary to calculate the correct dosage to administer. The key is to clarify the 2 parts of the equation (what to give and what is available).

**Process:**

| | | | |
|---|---|---|---|
| Fill in the 2 units of measurement you are dealing with to make the equation EQUAL. | ___ mg / tab | = | ___ mg / tab |
| Add the information from the problem. | **0.25 mg / x tab** | = | **0.5 mg / 1 tab** |
| Cross multiply.  Always place x on the left hand side of the equation. | **0.5 x** | = | **0.25** |
| _____ | _____ | | _____ |
| Now solve for "x" by dividing 0.25 by 0.5 | **x** | = | **0.25/0.5** |

**X = 0.25/0.5**

**(x is equal to 0.25 divided by 0.5)**

**Answer = 0.5 tablet**

**Tips:**

- Make sure both sides of the equation are equal. As necessary, change mg to mcg, grams to milligrams, etc. It is easier to calculate if the conversion is changed to the measurement one has "on hand". **LABEL** all terms you are dealing with so that it will be apparent if you are trying to calculate something that is not EQUAL.
- X can be placed in any of 4 places on the "skeleton" as shown below.

| | | |
|---|---|---|
| 0.25 mg / **X** tab | = | 0.5 mg / 1 tab |
| 0.5 mg / 1 tab | = | 0.25 mg / **X tab** |
| 1 tab / 0.5 mg | = | **X** tab / 0.25 mg |
| **X** tab / 0.25 mg | = | 1 tab / 0.5 mg |

- Cross multiply.

- Whatever is cross-multiplied by **X** will always be placed on the left side of the equation. This automatically sets up your division schematic.
- Draw your division sign and divide. This way you will not have to worry what gets divided by what. It is already set up for you.

With this method and excellent computation skills, you should be **100%** correct **100%** of the time.

When expressing an amount less than a whole, place a "0" in front of the decimal so there is never a question that a decimal is present. This represents a safety factor.

Example: Instead of .75 write **0.**75 ml or mg or whatever measure is.

## Critical vs Extraneous information

- An important principle in setting up your problem is to identify what is critical information for calculation and what is extraneous to calculating the problem.

**Example**:
John has an order "Oxacillin 550 mg IVPB q 6°". The nurse has a one gram vial with the following information on the vial: Mix 5.7 ml of sterile water to yield 250 mg/1.5 ml. How many ml will the nurse withdraw from the reconstituted vial?
What is the **critical information**?

- The dosage (550 mg)
- The end concentration (250 mg/1.5 ml)

What is **extraneous information** not needed for calculating?

- Mixing instructions (Adding the 5.7 ml to the vial tells you that this is the volume necessary to add to the powder to yield a specific concentration.) Can you figure how much volume the powder has in the vial? (0.3 ml)
- q 6° (Since you are calculating a **single dose**, this information is not necessary to calculate.)
- 1 gram vial (This is not important because the end concentration is given to you in this case.)

| | | |
|---|---|---|
| **550 mg / x ml** | **=** | **250 mg / 1.5 ml** |
| **250 x** | **=** | **825** |

| | | |
|---|---|---|
| | x | = 3.3 |

The nurse will withdraw 3.3 ml of medication from the vial after reconstitution.

**Tip**:

- Remember, the problem **may** contain information necessary for preparing the medication and **should** contain information necessary to solve the problem.
- This may require Critical Thinking to differentiate which is which.

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# IV CALCULATIONS

## Calculating drip rate:

- **Drip rate** is the number of drops per minute to be infused (**gtt/min**).
- Drip **factor** of the tubing is found on the manufacturer's packaging. (expressed as **gtt/m**l)
- If the problem states microdrops (microgtts), then the drip factor of the tubing is 60 gtt/ml.

**Formula:**

| | | | |
|---|---|---|---|
| **total # of milliliters (volume)**<br>**total # of minutes (time)** | **x** | **drip factor** | **= gtt/min** |

## Example:

The physician orders IV fluids to hydrate a client. The order is written as "D5NS 4 Liters over 24 hours." Looking at the package indicates the drip factor of the tubing is 15 gtt/ml. What is the drip rate?

## Critical information:

- Volume = 4000 ml
- Time = 24 hours
- Drip factor of tubing = 15 gtt/ml.

**Tip:**

- How many minutes is the ordered time period?
  - 24 (hr) x 60 (minutes) = 1440 minutes

| | | |
|---|---|---|
| 4000 ml / 1440 minutes | X | 15 gtt / 1 ml |
| 4000 x 15 | = | 60000 |
| 60000 / 1440 | = | 41.66 |

**Answer**: 41.66 gtt/min or 42 (if your instructor wants you to "round").

## Example:

Order: Run current IV fluids at 175 ml/hr for 2 hours.

## Critical information:

- Volume = 175 ml
- Time = 1 hr
- (What is the drip factor of the tubing? Assume 15 gtt/ml unless otherwise indicated. Exception would be: If on infusion pump or problem states microgtts, use 60 gtt/ml)

## Extraneous information for calculating:

- 2 hours (but important in carrying out the order).

| | | |
|---|---|---|
| 175 ml / 60 min | x | 15 gtt / 1 ml |
| 175 x 15 | = | 2625 |
| 2625 / 60 | = | 43.75 |

Answer: 43.75 gtt/min or 44 (if your instructor wants you to "round").

**Shortcut method when you know the ordered ml/hr:**

| |
|---|
| **15 gtt/ml: divide the ml/hr by 4** |
| **10 gtt/ml (typically blood products): divide ml/hr by 6** |
| **20 gtt/ml: divide ml/hr by 3** |

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# Calculating flow rate:

- Flow rate refers to number of ml of fluid to be infused over one hour (ml/hr).

## Formula:

| | | |
|---|---|---|
| total # of milliliters (volume)<br>total # of hours | = | **X** ml/hr |

## Example:

Order: 500 ml NS bolus over 3 hours

## Critical information:

- Volume = 500 ml
- Time = 3 hours

| | | | | | | |
|---|---|---|---|---|---|---|
| 500 ml<br>3 hrs | = | ? | or | 500 ml 3 hrs | = | x ml<br>1 hr |
| 500 / 3 | = | 166.67 | | 3x | = | 500 |

**Answer**: 166.67 ml/hr or 167 (if your instructor wants you to "round").

# Calculating time if given the flow rate:

- The nurse needs to know how long a volume of fluid in the IV bag at the current flow rate will last, i.e.., When will a new bag need to be hung?

## Formula:

| | | |
|---|---|---|
| Volume<br>Flow rate | = | (Infusion) time |

## Example:

The nurse makes rounds and notes that the current IV bag contains approximately 450 ml. The IV flow rate is 150 ml/hr. How long will it be before the nurse must hang a new bag?

Critical information:

- Volume = 450 ml
- Flow rate = 150 ml/hr

| | | |
|---|---|---|
| $\frac{450\ ml}{150\ ml/hr}$ | = | |
| 450 / 150 | = | 3 hr |

## Calculating time if given the drip rate:

Sometimes exam problems provide you with the volume to be given and the drip rate of the IV and you must calculate how long (time) it will take to infuse.

## Critical information for calculation:

- Must be given volume to be infused
- Must be given drip rate (gtt/min)
- Must know drip factor (gtt/ml)
- Time is constant (1 hr = 60 minutes)

## Formula:

| drip rate | | volume | | drip factor | | time constant | | time |
|---|---|---|---|---|---|---|---|---|
| $\frac{1\ min}{x\ gtt}$ | x | (ml) | x | $\frac{x\ gtt}{1\ ml}$ | x | $\frac{1\ hr}{60\ min}$ | = | x hr |

## Example:

Order:  Administer 1000 cc at 50 gtt/min.

## Critical information:

- Volume = 1000 ml
- Drip rate =  50 gtt/min
- Known = time constant (1 hr = 60 min)
- Missing = drip factor of tubing (You would use what is available or standard protocol for the unit you are working in.  Assume 15 gtt/ml unless otherwise indicated.)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\frac{1 \text{ min}}{50 \text{gtt/min}}$ | x | $\frac{1000}{\text{ml}}$ | x | $\frac{15 \text{ gtt}}{1 \text{ ml}}$ | x | $\frac{1 \text{ hr}}{60 \text{ min}}$ | = | $\frac{x}{\text{hr}}$ |

$$\frac{1 \times 1000 \times 15 \times 1}{50 \times 1 \times 60} =$$

$$\frac{15000}{3000} =$$

Answer =  5 hr

## TIP:

- You can use the principle of reducing to minimize the number you will have to deal with.

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# Below is a list of common conversion factors:

**Short list**

**1 cup (c) = 8 ounces (oz)**
**1 dram (dr) = 60 grains (gr)**
**1 dram (fl dr) = 60 minims**
**1 gallon (gal) = 4 quarts (qt)**
**1 glass = 8 ounces (oz)**
**1 grain (gr) = 64.8 milligrams (mg)**
**1 gram (g) = 15.43 grains (gr)**
**1 inch (in) = 2.54 centimeters (cm)**
**1 kilogram (kg) = 2.2 pounds (lb)**
**1 liter (L) = 1.057 quarts (qt)**
**1 milliliter (mL) = 16.23 minims**
**1 minim = 1 drop (gt)**
**1 ounce (oz) = 2 tablespoons (tbsp)**
**1 ounce (oz) = 8 drams (dr)**
**1 ounce (fl oz) = 29.57 milliliters (mL)**
**1 pint (pt) = 16 ounces (oz)**
**1 pound (lb) = 16 ounces (oz)**
**1 quart (qt) = 0.946 liters (L)**
**1 quart (qt) = 2 pints (pt)**
**1 tablespoon (tbsp) = 3 teaspoons (tsp)**
**1 teacup = 6 ounces (oz)**
**1 teaspoon (tsp) = 4.93 mL**

**Long list**

**1 cental = 45,359 grams (g)**
**1 centimeter (cm) = 10 millimeters (mm)**
**1 cubic centimeter (cc) = 1 milliliter (mL)**
**1 cup (c) = 8 ounces (oz)**
**1 drachm = 3.55 milliliter (mL)**
**1 dram (dr) = 60 grains (gr)**
**1 dram (fl dr) = 60 minims**
**1 gallon (gal) = 4 quarts (qt)**
**1 gill = 4 ounces (oz)**
**1 glass = 8 ounces (oz)**
**1 grain (gr) = 64.8 milligrams (mg)**
**1 gram (g) = 1,000 milligrams (mg)**
**1 gram (g) = 1,000,000 micrograms (mcg)**
**1 gram (g) = 15.43 grains (gr)**
**1 hand = 4 inches (in)**
**1 inch (in) = 2.54 centimeters (cm)**
**1 kilogram (kg) = 1,000 grams (g)**
**1 kilogram (kg) = 2.2 pounds (lb)**
**1 liter (L) = 1000 milliliters (mL)**
**1 liter (L) = 1.057 quarts (qt)**
**1 meter (m) = 1,000 millimeters (mm)**
**1 meter (m) = 100 centimeters (cm)**
**1 milligram (mg) = 1,000 micrograms (mcg)**
**1 milliliter (mL) = 1 cubic centimeter (cc)**
**1 milliliter (mL) = 15 drops (gt)**
**1 milliliter (mL) = 16.23 minims**
**1 minim = 1 drop (gt)**
**1 ounce (fl oz) = 2 tablespoons (tbsp)**
**1 ounce (oz) = 20 pennyweights (dwt)**
**1 ounce (oz) = 24 scruples**
**1 ounce (oz) = 31.1 grams (g)**
**1 ounce (oz) = 480 grains (gr)**
**1 ounce (oz) = 8 drams (dr)**
**1 ounce, fluid (fl oz) = 29.57 milliliters (mL)**
**1 palm = 3 inches (in)**
**1 pennyweight (dwt) = 24 grains (gr)**
**1 pint (pt) = 16 ounces (oz)**
**1 pint (pt) = 4 gills**
**1 pound (lb) = 16 ounces (oz)**
**1 pound (lb) = 350 scruples**
**1 quart (qt) = 0.946 liters (L)**
**1 quart (qt) = 2 pints (pt)**
**1 scruple = 20 grains (gr)**
**1 stone = 0.14 centals**
**1 tablespoon (tbsp) = 3 teaspoons (tsp)**
**1 teacup = 6 ounces (oz)**
**1 teaspoon (tsp) = 60 drops (gtt)**
**1 teaspoon (tsp) = 4.93 mL**