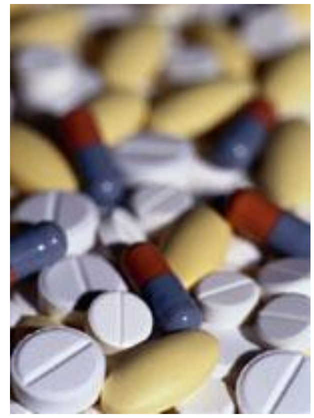
Nonparenteral medications



Capsules and unscored tablets are rounded to the nearest whole tablet. Scored tablets are rounded to the nearest 1/2 tablet. Liquid medications are rounded to one decimal place (tenths).

The dosage in which the drug is manufactured is considered a conversion factor; such as 1 tablet = 0.5 mg is 0.5 mg/tablet.

Ratio-proportions

Ratios indicate a relationship between two numbers with a colon between the numbers. The colon represents division. For example 3:4 = 3/4.

Proportions are equations containing ratios of equal value. For example 3:4 = 6:8. This may also be written as fractions, 3/4=6/8.

Means are the two inner numbers, in this case 4 & 6. Extremes are the two outer numbers, 3 and 8.

3 : 4 = 6 : 8

The product of the means (4 X 6) must equal the product of the extremes (3 X 8).

Therefore when you do not know one value (*x*), you can determine it, if the other three values are known.. When setting up a ratio, the known factor (on hand) is stated first, the desired is stated second. H = D *x*

3 : 4 = *x* : 8 **multiply the means and the extremes**
4*x* = 3 X 8
4*x* = 24
***x*= 24 ÷ 4 = 6**

If you set this up as a fraction:

$$\frac{3}{4} = \frac{x}{8}$$

$$4x = 3 \times 8 = 24$$

$$x = 24 \div 4 = 6$$

cross multiply to obtain the product of the means and extremes

Example: Ordered: 600mg of penicillin po q6h
Available: 400mg units per scored tablet
How many tablets will you administer?

400 mg : 1 tablet = 600mg : *x tablets*

$600 = 400x$

$\frac{600}{400} = x = 1.5$ tablets

OR set it up as a fraction

$$\frac{400}{1} = \frac{600}{x}$$

$400x = 600$

$x = \frac{600}{400} = 1.5$ tablets

When working with a complex fraction - either a fraction in the numerator or denominator - it helps to simplify the fraction. When dividing by a fraction, remember to invert and multiply.

The formula method:

D/H X Q = *X*

D - dosage desired or ordered
H - what is on hand (available)
Q - unit of measure that contains the available dose. When using solid products (tablets, capsules) Q is always 1 and can be eliminated. Q varies when using liquid measures.
X - the unknown dosage you need to administer

Example: Order: Potassium Chloride 20 mEq added to the IV.
Available: 40 mEq per 10cc.
How much potassium will you add?

D = 20 mEq H = 40 mEq Q = 10 cc

$$\frac{20 \text{ mEq}}{40 \text{ mEq}} \times 10 \text{ cc} = X$$

0.5 X 10 = *X* = 5 cc

It doesn't matter if you use ratios, fractions or the formula, the

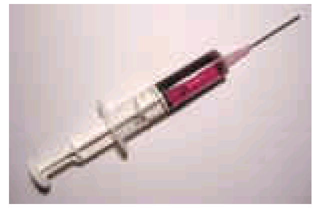
answer will be the same.

Points to remember:

1. The maximum number of tablets and capsules administered to achieve a desired dose is usually 3.
2. No more than 10% variation should exist between the dose ordered and the dose administered.
3. Make sure your answer seems reasonable. Think about whether the dose should be larger or smaller than what is available.

Parenteral Medications

The same methods, ratio-proportion or formula, are used to determine the amount to be given.



Injectable medication guidelines:

1. Intradermal - the volume to be administered is 0.1 ml or less
2. Subcutaneous - the volume to be administer is 1.0 ml or less
3. Intramuscular - depends upon the size of the person
   a. A healthy well developed person can tolerate 3.0 ml in large muscles - this does NOT include the deltoid.
   b. For elderly, thin clients or children the total amount should not exceed 2.0 ml.
   c. No more than 1.0 ml should be given to young children and older infants.

Calculating dosages in units (insulin, heparin, pitocin, vitamins, some antibiotics)

Example: Ordered: Heparin 8000 units subcutaneous q12h
Available: Heparin 10,000 units per ml
How much will you administer?

Formula: $\frac{8000 \text{ units}}{10{,}000 \text{ units}} \times 1 \text{ ml} = 0.8 \text{ ml}$

Ratio: 10,000 units : 1 ml = 8000 units : x
8000 units X 1 ml = 10,000 units x
8000 / 10,000 = x
0.8 ml = x

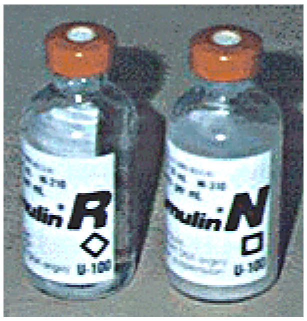
If the answer is greater than 1, you probably calculated the problem incorrectly. Rarely, the desired dose is large and you will have to administer it in more than one site.

Reconstituting powdered drugs:

Read the label for the amount of fluid to add, the type of fluid and the final concentration of the reconstituted fluid. The label will also tell you how long the mixture may be stored and what conditions are required for storage. The final volume will be larger than the amount of fluid you add because the powder will take up some room when diluted. If you are not given a final volume calculate the concentration based on the amount of fluid you added. You will calculate the amount to administer from the final concentration.

INSULIN

Insulin is administered only using an insulin syringe. Most insulin vials contain 100 units/ml. Insulin may be administered subcutaneously, intramuscularly (rarely used) and intravenously.



Regular insulin is the only type that may be given IV since it does not contain any additives to prolong the action. Regular insulin is clear. If the vial is cloudy, it has been contaminated and should be discarded.

Longer acting insulin is cloudy and may have a precipitate on the bottom of the vial. Be sure to mix the vial well by rotating it between the hands.

Mixing regular insulin and a longer acting insulin in the same syringe.

- Inject air into the longer acting insulin vial first - don't let the tip of the needle touch the surface of the fluid.
- Using the same syringe, inject air into the regular insulin then invert the bottle and withdraw the correct amount of regular insulin. Remove air bubbles.
- Still using the same syringe, withdraw the correct amount of the longer acting insulin. You cannot return any extra fluid withdrawn. If you withdraw too much, you must start over.

Intravenous calculations

As a nurse, you will be hanging IV solutions (Normal Saline, Dextrose, Lactate Ringer, etc). The physician will write an order for the specific solution and the RATE it is to infuse into the patient. For example: NS 1000ml in 8 hours. That means, when you hang a bag of Normal Saline (NS), but the end of your 8 hour shift, the bag should be empty. For these calculations, you are NOT using an IV Pump. You will learn how to do those calculations next. For these types of calculations, you are calculating the “drip rate”.

You will calculate the proper "drip rate" first, then hang the solution and adjust the rate so that it matches your calculation. Usually, you will count the drops for a full minute.

Because of this, your calculations must be in :
"drops per minute" or gtts/min.

To calculate the "drip rate", you will need to know the "Drop Factor" (DF). Every IV tubing has a drip chamber that is used to count drops (gtts) per minute. Each tubing is labeled with the number of drops per milliliter (drop factor).

Macrodrop tubing - has a drop factor of 10, 15 or 20 gtts/ml (drops per milliliter).

Microdrip tubing - has a drop factor of 60 gtts/ml.

Ex: If a tubing has a DF of 10gtts/1ml, that means for every 10 drops that you see fall into the chamber, you have delivered 1ml of solution.

Ex: DF = 60gtts/ml means 60 drops is 1ml.

Formula for calculating IV flow rate:

$$\frac{\text{VOLUME (mL)}}{\text{TIME (min)}} \times \text{DF} = \underline{\quad ? \quad} \text{ gtts/min}$$

IMPORTANT: You may need to do some converting before plugging into the formula

- ✓ Volume MUST be in ml (even if the doctor orders in L)
  - Remember: 1L = 1000ml
- ✓ Time MUST be in MINUTES (even if the doctor orders in hours)
  - Remember: 60min = 1hr

Example: Ordered: D5W 1L to infuse in 6 hours.
The drop factor of your tubing is 10 gtts/ml.
How many gtts/min will you infuse?

Step 1: Volume - Convert 1L to ml → 1L = 1000ml
Step 2: Time – Convert 6 hours to minutes → 360 minutes
Step 3: Plug numbers into formula

$$\frac{VOL\ (mL)}{T\ (min)} \times DF = \underline{\ ?\ }\ \text{gtts/min} \; ; \quad V = 1000\ mL,\ T = 360\ min,\ DF = 10\ \text{gtts/mL}$$

$$\frac{VOL}{T} \times DF \rightarrow \frac{1000}{360} \times 10 = \underline{27.8}\ \text{gtts/min}$$

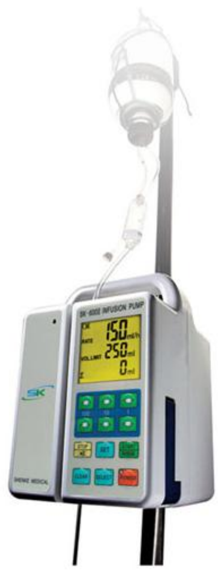
Example: Ordered: Gentamycin 40 mg/100 ml IVPB q 6h
Drop factor 15 gtts/ml
Your drug book says you can give this in 45 min
How many gtts/min will you infuse the Gentamycin

$$\frac{VOL\ (mL)}{T\ (min)} \times DF = \underline{\ ?\ }\ \text{gtt/min} \; ; \quad V = 100\ mL,\ T = 45\ min,\ DF = 15\ \text{gtts/min}$$

$$\frac{VOL}{T} \times DF \rightarrow \frac{100}{45} \times 15 = \underline{33.3}\ \text{gtt/min}$$

You may give 33 gtts/min because it is easier to count.

You will adjust the drip until you can verify, for an entire minute, that the rate is 33 gtts/min



I.V. PUMPS

When using an IV pump, the rate is in **ml/hr**. Therefore, you do not need to determine a **drop factor**.

Since you are programming the pump to accurately administer the medication, you no longer have to calculate drops/minute.

WHAT YOU DO HAVE TO CALCULATE NOW IS : milliliters per hour (ml/hr).

The formula you will use is:

$$\frac{\text{Volume (ml)}}{\text{Time (hours)}} = \text{ml/hr}$$

Example: Dr. A would like you to infuse 1000ml of Normal Saline every 8 hours.

What do you set your IV Pump to? (Remember: pumps can only be programmed to ml/hr)

$$\frac{\text{VOLUME (mL)}}{\text{T (hr)}} = \frac{1000\text{ mL}}{8\text{ hr}} = \boxed{125\text{ mL/hr}}$$

That means, for every hour, my patient should receive 125ml. All you have to do is type in 125 and the pump should infuse 125ml/hr.

Example: Infuse Ancef 1 g/50 ml IVPB q6h. The IV handbook states this can be given in 20 minutes. What rate will you set on the IV pump?

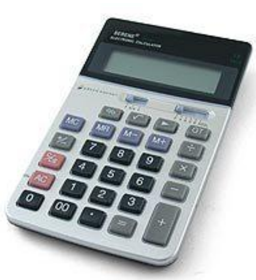
Remember… your answer MUST be in ml/hour. But in this case, the medication must be completed in 20minutes. You will have to do a conversion calculation first.

50mL : 20 min = XmL : 60min

3000 = 20x

x = 150 mL ⇒ 150 mL/HR IS THE SAME AS 50 mL / 20 min

So, you will type in 150 and the pump will automatically administer 150ml/hour. But don't forget that it will only take 20 minutes for the infusion to complete!!



TRY THIS ONE: See if you can set up the problem correctly.

Order: 250ml of Normal Saline in 30 hours
(the answer should be 500ml/hour)

Pediatric calculations

Accurate doses are especially important in giving medications to infants and children because even small errors can be dangerous due to their small body size.

Two methods are used to calculate pediatric dosages:

-According to the weight in kilograms (kg)
-According to the child's body surface area (BSA)

Calculations based on body weight

1. The first step is to convert the child's body weight into kg. The formula is 2.2 lb. = 1 kg.
2. The second step is to calculate the medication dose.
   a. Calculate the daily dose
   b. Divide the daily dose by the number of doses to
   be administered.
   c. Use either the ratio-proportion or formula method to calculate the number of tablets/ capsules or volume to be administered with each dose.

Example: A child weighing 76 lbs. is ordered to receive 150 mg of Clindamycin q6h. The pediatric drug handbook states the recommended dose is 8-20 mg/kg/day in four divided doses. The Clindamycin is supplied in 100 mg scored tablets.

1. What is the weight in kg?

76 lbs. ¸ 2.2 kg/lb. = 34.5 kg

2. What is the safe total daily dose?

Minimum: 8 mg/kg/day X 34.5 kg = 276 mg/day
Maximum: 20 mg/kg/day X 34.5 kg = 690 mg/day

3. Is this a safe dose?

150 mg/dose X 4 doses/day = 600 mg/day

Yes this is within the recommended safe range.

4. Calculate the number of tablets to give.

100 mg : 1 tablet = 150 mg : *x*

100 *x* = 150 *x* = 1.5 tablets

Calculations based on Body Surface Area (BSA)

BSA is determined from a nomogram using the child's height and weight.
When you know the child's BSA the dosage is determined by multiplying the BSA by the recommended dose.
To determine whether the dose is safe, compare the ordered dose and the calculation based upon the BSA.
The formula for calculating child's dosage is

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

Example: The child has a BSA of 0.67 M^2. the adult dose is 40 mg. The physician ordered 8 mg. Is the dosage correct?

$$\frac{0.67}{1.7} \times 40 = \frac{26.8}{1.7} = 15.8 \text{ mg}$$ No, the dose is too small