## *Dosage Calculations*

This unit looks at drug calculations. It's important to remember any time we do calculations we must have our measures in the same system and in the same sized units. The most common system we will use is the metric system. Let's review a few standard conversions related to the metric system. Remember the basic units are the meter (m), liter (L), and gram (g, gm, or Gm).

1 milligram (mg) = 1000 micrograms (mcg) or 0.001 grams (g)

1 g = 1000 mg

1 kilogram (kg) = 1000 g

1 kg = 2.2 pound (lb.)

1 liter (L) = 1000 milliliters (mL)

To convert larger to smaller, multiply by 1000 or move the decimal point three places to the right.

To convert smaller to larger, divide by 1000 or move the decimal point three places to the left.

**Formulas for Calculating Medication Dosage**

Basic Formula

$$\frac{D}{A} \times Q = X$$

Where D (desired) is the dosage the physician ordered, A (available) is the dosage strength as stated on the medication label, and Q (quantity) is the volume in which the dosage strength is available (e.g. tablets, capsules, milliliters)

For example: we have an order for Ceclor 0.5 g PO b.i.d. We have available 250 mg capsules. The first thing to do is get like units of measurement. Since we have 250 mg capsules, let's change our ordered dose to mg. We do this by moving our decimal point three places to the right, so the dosage to give is 500 mg. Now we can plug numbers into our formula.

$$\frac{D}{A} \times Q = X \qquad \frac{500\text{ mg}}{250\text{ mg}} \times 1\text{ capsule} = \qquad \frac{500}{250} = 2\text{ capsules}$$

Ratio and Proportion

$$\frac{\text{Known}}{H : V} : : \frac{\text{Desired}}{D : X}$$

Where the left side represents known quantities, the dose on hand (H) and the vehicle (V) such as tablets, capsules, milliliters; and the right side represents the desired dose (D) and the unknown amount to be given (X). Multiply the means (V and D) and the extremes (H and X), then solve for X.

So, using our previous example where we need to give Ceclor 0.5 g PO b.i.d, and we have 250 mg capsules available, we would work it as follows. (we still need to first convert to similar measures, so we need to give 500 mg of Ceclor).

H : V :: D : X
250 mg : 1 capsule :: 500 mg : X capsules

1 capsule x 500 mg = 250 mg x X

500 = 250X

2 = X

So we will give 2 capsules for our dose.

**Formulas for IV Infusion**

Flow Rate

$$\frac{\text{Total volume in mL x drop factor}}{\text{Time in minutes}} = \text{drops per minute}$$

This will be utilized any time we are using a gravity infusion. Don't forget the time always needs to be in minutes and the volume always needs to be in mL. Here are a few examples:

We need to give 1000 mL of D5W over 24 hours. Our Tubing has a drop factor of 20 gtt/mL. Our total volume is in mL, so we don't have to change it, but our time is in hours. To convert our time to minutes we need to multiply it by 60. So our total time in minutes will be 1440. Let's plug our numbers into our formula.

$$\frac{\text{1000 mL x 20 gtt/mL}}{\text{1440 minutes}} = \text{drops/minute} \quad \frac{20{,}000}{1440} = 13.89$$

so we will run our infusion at 14 gtt/min

We need to give 3 L of NS over 24 hours. Out tubing has a drop factor of 15 gtt/ml. Now we need to change our 3 L to mL by moving our decimal point (3000 mL) and our time to minutes (24 hours = 1440 minutes). Plugging this into our formula gives us:

$$\frac{\text{3000 mL x 15 gtt/mL}}{\text{1440 minutes}} = \frac{45{,}000}{1440} = \text{31.25 gtt/min = 31 gtt/min for our rate.}$$

Flow Rate for Infusion Pumps

$$\frac{\text{Volume to be infused in mL}}{\text{Time in hours}} = \text{mL per hour}$$

With most infusion pumps we need to program mL per hour. This formula allows us to calculate this. Let's use the same examples:

We need to give 1000 mL of D5W over 24 hours.

$$\frac{1000 \text{ mL}}{24 \text{ hours}} = \text{mL/hr} \quad = \quad 41.6 \text{ ml/hr.} = 42 \text{ ml/hr. for our pump rate}$$

We need to give 3L of NS over 24 hours. Here we need to change to mL (3000).

$$\frac{3000 \text{ ml}}{24 \text{ hours}} = 125 \text{ mL/hr}$$

**Complex Calculations**

Many times with IV therapy we have more complex calculations that we have to do. These are sometimes referred to as titrations. We will use some of our basic formulas to do these, but they have multiple steps that we must go through depending on what we need to administer them.

**Calculating in units per hour (U/h)**

200 U of regular insulin has been added to 500 mL of .9% NS. The order states to infuse the regular insulin IV at 10 U/h. How many mL/h should the IV pump be set at?

Now what do we do to figure this out? First we need to know how many units of insulin is in each mL.

200 u : 500 mL :: X units : 1 mL     500X = 200    X = 0.4 units/mL

We need to run our drip at 10 U per hour, so how many mL contains 10 U?

1 mL : 0.4 U  :: X mL :10 U     0.4 X = 10     X = 25 mL

We now know that there are 10 U of insulin in every 25 mL of fluid so we will run our pump at 25 mL per hour.

Let's try another one:

20,000 units of heparin have been added to 500 mL of D5W. The order is to infuse the heparin drip at 2000 U/h. How many mL/h will we set our pump for?

First, let's find out how many units of heparin are in each mL.

20,000 U : 500 mL :: X U : 1 mL   500X = 20,000   X = 40 units/mL

Now, how many mL contain our ordered 2000 U?

1 mL : 40 U :: X ml : 2000 U   40 X = 2000   X = 50 mL

So we will run our pump at 50 mL/h.

**Calculating by microgram per kilogram per minute (mcg/kg/min)**

$$\frac{\text{Ordered mcg/kg/min x Patient weight in kg x 60 minutes/h}}{\text{Medication concentration (mcg/1 mL)}} = \text{mL/h}$$

800 mg of dopamine is added to 250 ml of .9%Ns. The order is to begin the infusion at 3 mcg/kg/minute. The patient's weight is 70 kg. How many mL/hour will we set the IV pump for?

This calculation requires several steps. First we need to know the concentration of the solution. We have 800 mg in 250 mL. Remember we need to have like units, so we need to first change our mg to mcg by moving the decimal point three places to the right. Our solution therefore has 800,000 mcg in 250 mL.

800,000 mcg : 250 mL :: X mcg : 1 mL   250X = 800,000   X= 3200 mcg/mL

We will use this number shortly.

Our order is for 3 mcg/kg/min. Our patient weighs 70 kg. We need to multiply 70 by 3 to find out the total mcg/min. 70 x 3 = 210, so we will be giving 210 mcg/min.

Our pump rate is always mL/hour, so we need to multiply our mcg/min by 60 to get mcg/h. 210 x 60 = 12,600, so we will be giving 12,600 mcg/h.

Now we have to find out how many mL contain our 12,600 mcg. We will use our concentration number we got earlier.

12,600 mcg : X mL :: 3200 mcg : 1 mL   3200 X = 12,600   X = 3.9 mL

So our IV pump rate will be 4 mL/hour.

Let's look at another one:

A patient has propofol ordered at 30 mcg/kg/min. The propofol concentration is 15 mg/mL. The patient's weight is 75 kg. How many mL/h should the IV pump be programmed for?

First let's get our units the same. If we have 15 mg/mL, that means we have 15,000 mcg/mL.

Our order is for 30 mcg/kg/min. Our weight is 75 kg, so 75 x 30 = 2,250, so we will give 2,250 mcg/min. Pumps are always mL/h, so 2250 mcg/min x 60 minutes/h = 135,000 mcg/h.

We have 15,000 mcg/mL, and need 135,000 mcg/hour so to find our mL/h

1 mL : 15,000 mcg :: X mL : 135,000 mcg      15,000 X = 135,000   X = 9

So our pump rate will be 9 mL per hour.

**Calculating microgram per minute (mcg/min)**

$$\frac{\text{Ordered mcg/min x 60 min/h}}{\text{Medication concentration (mcg/mL)}} = \text{mL/h}$$

50 mg of nitroglycerin has been added to 500 mL of .9% NS. The order is to infuse the nitroglycerin at 5 mcg/min. The nurse needs to calculate how many mL/h the IV pump needs to be set at.

First we have to calculate the mcg of the solution. If we have 50 mg in 500 mL, by moving our decimal point three spots to the right we have 50,000 mcg in 500 mL.

To find the concentration:

50,0000 mcg : 500mL :: X mcg : 1 mL

500 X = 50,000     so X = 100 mcg/mL

so, plugging it into our formula gives us

$$\frac{\text{5 mcg/min x 60 min/h}}{\text{100 mcg/mL}} = \text{X ml/h} \quad \frac{300}{100} = X \quad X = 3 \text{ mL/h}$$

**Calculating milligrams per minute (mg/min)**

$$\frac{\text{Desired mg/min x 60 min/h}}{\text{Medication concentration (mg/ml)}} = \text{mL/h}$$

Lidocaine 1 g has been added to 500 mL of D5W. The order states to infuse the lidocaine at 2 mg/min. The nurse needs to calculate the mL/h for the infusion pump.

First we need to get like units – 1 g in 500 mL = 1000 mg in 500 ml. Now to find the concentration:

1000 mg : 500 mL :: X mg : 1 mL      500 X = 1000   X = 2 mg/mL

then using our formula:

$$\frac{2\text{ mg/min x }60\text{ min/h}}{2\text{ mg/ml}} = \frac{120}{2} = 60\text{ mL/h}$$

These are the basic calculations we will need to do for IV therapy. Now I have a practice set of exercises for you to complete before you take a quiz over this information. Again, please let me know if you are having difficulties with this information.