Southwest Wisconsin Technical College

Dimensional Analysis in Nursing

Module 1.12

DRUG CALCULATIONS – WEIGHT-BASED DRUG CALCULATIONS

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Noteworthy

- These problems involve drugs where the amount given is based upon **patient weight**.
- If the drug amount per dose is not stated, begin your setup with *patient weight*.
- **Drug protocols** will help you make the jump from patient weight to quantity of drug.

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DRUG CALCULATIONS – WEIGHT-BASED DRUG CALCULATIONS

Introduction

In this module you will work with situations where the quantity of drug a patient receives is based upon his or her weight.

Drug Protocols

When you read these types of problems, you will note there is no explicit doctor's order other than specifying the drug required.

Instead, you will note the presence of a **drug protocol**, which is basically a dosing rate or guideline.

You will use the drug protocol in conjunction with the patient weight to determine the amount of drug to give the patient.

Here is a sample protocol: *When Vancomycin is used for treating adult patients with pneumonia, the IDSA (Infectious Diseases Society of America) recommends it be delivered IV at a rate of* ***15 mg/kg/dose*** *every eight hours*.

> The drug protocol indicates that the patient will receive 15 mg of Vancomycin for every kilogram of patient weight, per dose (every 8 hours).

Here is another protocol: *The maintenance dose for Metronidazole when prescribed for adults with a bacterial infection, is* ***7.5 mg/kg/dose*** *IV every 6 hours.*

> The drug protocol states the patient will receive 7.5 mg of Metronidazole for every kilogram of patient weight, per dose (every 6 hours).

Some Key Points for Weight-Based Drug Calculations

- In the absence of doctor's orders which specify the exact quantity of drug, the *starting point* for your calculation will always be the patient weight, expressed either in pounds or kilograms.

- You will need to use the drug protocol in order to switch from patient weight to quantity of medicine.

Example 1.12.1

An order is written for a 165 pound adult to receive Gentamicin for enterococcal endocarditis, 5 mg/kg/day IV according to AHA (American Heart Association) guidelines.

How many ***milligrams per day*** will be administered? Round to the nearest tenth.

Goal: Determine how many milligrams per day are required.

$$\boxed{\text{Goal: } \frac{\text{mg}}{\text{day}}}$$

Step 1 We will start the problem with the **patient's weight**. The reason this is done is because weight has the most influence on the amount of drug the patient receives.

$$\frac{165 \text{ lb}}{1}$$

$$\boxed{\text{Goal: } \frac{\text{mg}}{\text{day}}}$$

Step 2 Since the drug protocol (5 mg/kg/day) is based on *kilograms* (kg), let's convert from *pounds* to *kilograms*. Use the equivalency, 1 kilogram = 2.2 pounds.

$$\frac{165 \cancel{\text{ lb}}}{1} \times \frac{1 \text{ kg}}{2.2 \cancel{\text{ lb}}}$$

$$\boxed{\text{Goal: } \frac{\text{mg}}{\text{day}}}$$

Step 3 The drug protocol will allow us to switch from dealing with patient weight to determining the quantity of drug.

There are <u>three units of measure</u> in the protocol (5 mg/kg/day).

Since we want to get rid of *kilograms*, 1 kg must be written in the denominator to force cancelation. The quantity of drug, 5 mg, will go in the numerator. The last unit of measure, 1 day, is placed in the denominator. A raised dot which indicates multiplication is positioned to separate 1 kg from 1 day.

$$\frac{165 \cancel{\text{ lb}}}{1} \times \frac{1 \cancel{\text{ kg}}}{2.2 \cancel{\text{ lb}}} \times \frac{5 \text{ mg}}{1 \cancel{\text{ kg}} \cdot 1 \text{ day}}$$

$$\boxed{\text{Goal: } \frac{\text{mg}}{\text{day}}}$$

Step 4 Note that the remaining units of measure (*milligram* and *day*) match the goal.
It's time to compute the final answer. Multiply the numerators, then the denominators. Divide to finish.

$$\frac{165 \cancel{\text{ lb}}}{1} \times \frac{1 \cancel{\text{ kg}}}{2.2 \cancel{\text{ lb}}} \times \frac{5 \text{ mg}}{1 \cancel{\text{ kg}} \cdot 1 \text{ day}} = \frac{825 \text{ mg}}{2.2 \text{ days}} = \mathbf{375 \text{ mg per day}}$$

$$\boxed{\text{Goal: } \frac{\text{mg}}{\text{day}}}$$

Example 1.12.2

An order for Acyclovir is written for a 160 pound patient. Per CDC recommendations, this drug should be administered at 5 mg/kg/dose every 8 hours.

How many ***milligrams per dose*** will be administered? Round to the nearest whole number.

Goal: Determine how many milligrams (mg) are required per dose.

Goal: $\dfrac{\text{mg}}{\text{dose}}$

Step 1 We will start the problem with the **patient's weight**. As a reminder, this is done since the weight has the most influence on the amount of drug the patient is to receive.

$$\frac{160 \text{ lb}}{1}$$

Goal: $\dfrac{\text{mg}}{\text{dose}}$

Step 2 Since the drug protocol (5 mg/kg/dose) is based on *kilograms* (kg), let's convert from *pounds* to *kilograms*. Use the equivalency, 1 kilogram = 2.2 pounds.

$$\frac{160 \cancel{\text{lb}}}{1} \times \frac{1 \text{ kg}}{2.2 \cancel{\text{lb}}}$$

Goal: $\dfrac{\text{mg}}{\text{dose}}$

Step 3 The drug protocol will allow us to move away from dealing with patient weight and move towards introducing the quantity of drug.

There are <u>three units of measure</u> in the protocol (5 mg/kg/dose).

Since we want to get rid of *kilograms*, 1 kg must be written in the denominator to force cancelation. The quantity of drug, 5 mg, will go in the numerator. The last unit of measure (dose) is related to time and it is placed in the denominator. A raised dot, which indicates multiplication, is placed in order to separate 1 kg and 1 dose.

$$\frac{160 \cancel{\text{lb}}}{1} \times \frac{1 \cancel{\text{kg}}}{2.2 \cancel{\text{lb}}} \times \frac{5 \text{ mg}}{1 \cancel{\text{kg}} \cdot 1 \text{ dose}}$$

Goal: $\dfrac{\text{mg}}{\text{dose}}$

Step 4 Since our setup has only *milligrams* (mg) and *dose* remaining, we have reached our goal. Multiply the numerators together and then multiply the denominators. Divide those results to finish the problem.

$$\frac{160 \cancel{\text{lb}}}{1} \times \frac{1 \cancel{\text{kg}}}{2.2 \cancel{\text{lb}}} \times \frac{5 \text{ mg}}{1 \cancel{\text{kg}} \cdot 1 \text{ dose}} = \frac{800 \text{ mg}}{2.2 \text{ dose}} = \mathbf{364 \text{ mg per dose (nearest whole number)}}$$

Example 1.12.3

An order is written for a 20 pound child to receive morphine sulfate 0.3 mg/kg/dose PO every 4 hours. The concentration of the morphine sulfate is 10mg/5ml.

How many ***milliliters per dose*** will be administered? Round to the nearest tenth.

Goal: Determine how many milliliters (mL) are required for a single dose.

Goal: $\frac{\text{mL}}{\text{dose}}$

Step 1 We will start the problem with the **patient's weight**.

$$\frac{20 \text{ lb}}{1}$$

Goal: $\frac{\text{mL}}{\text{dose}}$

Step 2 Since the drug protocol (0.3 mg/kg/dose) is based on *kilograms* (kg), let's convert from *pounds* to *kilograms*. Use the equivalency, 1 kilogram = 2.2 pounds.

$$\frac{20 \cancel{\text{lb}}}{1} \times \frac{1 \text{ kg}}{2.2 \cancel{\text{lb}}}$$

Goal: $\frac{\text{mL}}{\text{dose}}$

Step 3 The drug protocol will help us switch from patient weight to the quantity of drug.

There are <u>three units of measure</u> in the protocol (0.3 mg/kg/dose).

Since we want to get rid of *kilograms*, 1 kg must be written in the denominator to force cancelation. The quantity of drug, 0.3 mg, belongs in the numerator. The last unit of measure (dose) is related to time and it is placed in the denominator. A raised dot, which indicates multiplication, is placed in order to separate 1 kg and 1 dose.

$$\frac{20 \cancel{\text{lb}}}{1} \times \frac{1 \cancel{\text{kg}}}{2.2 \cancel{\text{lb}}} \times \frac{0.3 \text{ mg}}{1 \cancel{\text{kg}} \cdot 1 \text{ dose}}$$

Goal: $\frac{\text{mL}}{\text{dose}}$

Step 4 We have introduced *milligrams* (mg) into our setup, but we need *milliliters* (mL). Use the drug concentration of 10 mg/5 mL to get *milliliters* (mL).

$$\frac{20 \cancel{\text{lb}}}{1} \times \frac{1 \cancel{\text{kg}}}{2.2 \cancel{\text{lb}}} \times \frac{0.3 \cancel{\text{mg}}}{1 \cancel{\text{kg}} \cdot 1 \text{ dose}} \times \frac{5 \text{ mL}}{10 \cancel{\text{mg}}}$$

Goal: $\frac{\text{mL}}{\text{dose}}$

Step 5 Since our setup has only *milliliters* (mL) and *dose* remaining, we have met the required goal. Multiply the numerators together and then multiply the denominators. Divide those results to finish the problem.

$$\frac{20 \cancel{\text{lb}}}{1} \times \frac{1 \cancel{\text{kg}}}{2.2 \cancel{\text{lb}}} \times \frac{0.3 \cancel{\text{mg}}}{1 \cancel{\text{kg}} \cdot 1 \text{ dose}} \times \frac{5 \text{ mL}}{10 \cancel{\text{mg}}} = \frac{30 \text{ mL}}{22 \text{ doses}} = \mathbf{1.4\ mL\ per\ dose} \text{ (nearest tenth)}$$

Practice Problems

Directions – For each problem, use <u>dimensional analysis</u> to determine the quantity of drug required for the patient. Before you start, write your *goal* in the space provided (the first one has been done for you). Your answers should include the appropriate units of measure. Round all answers to the ***nearest tenth***.

1.) A 14 pound infant is prescribed Rocephin at 30 mg/kg/dose every 8 hours. Determine the milligrams per dose required for this patient.

<u>Goal:</u> $\frac{\mathbf{mg}}{\mathbf{dose}}$

2.) For treatment of chicken pox, Acyclovir is prescribed at 20 mg/kg/dose QID. How many milligrams per dose should be given to a 19.5 kg patient?

<u>Goal:</u>

3.) Heparin with a concentration of 5000 units/100 mL is prescribed for a 15.5 pound infant at a rate 25 units/kg/hour. How many milliliters should the patient receive per hour?

<u>Goal:</u>

4.) An outpatient is prescribed Lovenox, available in a 300 mg/3 mL multi-use vial. The recommended FDA protocol is 1.5 mg/kg/day. How many milliliters should a 132 pound patient receive per day?

<u>Goal:</u>

5.) Clindamycin is prescribed to treat a serious infection for a young patient weighing 18 kilograms. Available is Clindamycin 75 mg/5 mL. The reference guide indicates 4 mg/kg/dose, every 4 hours is appropriate. How many milliliters per dose should this patient receive?

<u>Goal:</u>

6.) For pharyngitis, Cephalexin is prescribed at the IDSA recommended rate of 20 mg/kg/dose, two time per day. Available is Cephalexin, 125 mg/mL. How many milliliters per dose should a 98 pound patient receive?

<u>Goal:</u>

Solutions to Practice Problems

1.) A 14 pound infant is prescribed Rocephin at 30 mg/kg/dose every 8 hours. Determine the milligrams per dose required for this patient.

Goal: $\frac{\textbf{mg}}{\textbf{dose}}$

$$\frac{14\ \cancel{\text{lb}}}{1} \times \frac{1\ \cancel{\text{kg}}}{2.2\ \cancel{\text{lb}}} \times \frac{30\ \text{mg}}{1\ \cancel{\text{kg}} \cdot 1\ \text{dose}} = \frac{420\ \text{mg}}{2.2\ \text{doses}} = \mathbf{190.9\ mg/dose}$$

2.) For treatment of chicken pox, Acyclovir is prescribed at 20 mg/kg/dose QID. How many milligrams per dose should be given to a 19.5 kg patient?

Goal: $\frac{\textbf{mg}}{\textbf{dose}}$

$$\frac{19.5\ \cancel{\text{kg}}}{1} \times \frac{20\ \text{mg}}{1\ \cancel{\text{kg}} \cdot 1\ \text{dose}} = \frac{390\ \text{mg}}{1\ \text{dose}} = \mathbf{390\ mg\ per\ dose}$$

3.) Heparin with a concentration of 5000 units/100 mL is prescribed for a 15.5 pound infant at a rate 25 units/kg/hour. How many milliliters should the patient receive per hour?

Goal: $\frac{\textbf{mL}}{\textbf{hour}}$

$$\frac{15.5\ \cancel{\text{lb}}}{1} \times \frac{1\ \cancel{\text{kg}}}{2.2\ \cancel{\text{lb}}} \times \frac{25\ \cancel{\text{units}}}{1\ \cancel{\text{kg}} \cdot 1\ \text{hour}} \times \frac{100\ \text{mL}}{5000\ \cancel{\text{units}}} = \frac{38{,}750\ \text{mL}}{11{,}000\ \text{hours}} = \mathbf{3.5\ mL\ per\ hour}$$

4.) An outpatient is prescribed Lovenox, available in a 300 mg/3 mL multi-use vial. The recommended FDA protocol is 1.5 mg/kg/day. How many milliliters should a 132 pound patient receive per day?

Goal: $\frac{\boldsymbol{mL}}{\boldsymbol{day}}$

$$\frac{132\ \cancel{\text{lb}}}{1} \times \frac{1\ \cancel{\text{kg}}}{2.2\ \cancel{\text{lb}}} \times \frac{1.5\ \cancel{\text{mg}}}{1\ \cancel{\text{kg}} \cdot 1\ \text{day}} \times \frac{3\ \text{mL}}{300\ \cancel{\text{mg}}} = \frac{594\ \text{mL}}{660\ \text{days}} = \mathbf{0.9\ mL\ per\ day}$$

5.) Clindamycin is prescribed to treat a serious infection for a young patient weighing 18 kilograms. Available is Clindamycin 75 mg/5 mL. The reference guide indicates 4 mg/kg/dose, every 4 hours is appropriate. How many milliliters per dose should this patient receive?

Goal: $\frac{\textbf{mL}}{\textbf{dose}}$

$$\frac{18\ \cancel{\text{kg}}}{1} \times \frac{4\ \cancel{\text{mg}}}{1\ \cancel{\text{kg}} \cdot \text{dose}} \times \frac{5\ \text{mL}}{75\ \cancel{\text{mg}}} = \frac{360\ \text{mL}}{75\ \text{doses}} = \mathbf{4.8\ mL\ per\ dose}$$

Solutions to Practice Problems (continued)

6.) For pharyngitis, Cephalexin is prescribed at the IDSA-recommended rate of 20 mg/kg/dose, two time per day. Available is Cephalexin, 125 mg/mL. How many milliliters per dose should a 98 pound patient receive?

<u>Goal:</u> $\dfrac{\mathbf{mL}}{\mathbf{dose}}$

$$\frac{98\ \cancel{\text{lb}}}{1}\times\frac{1\ \cancel{\text{kg}}}{2.2\ \cancel{\text{lb}}}\times\frac{20\ \cancel{\text{mg}}}{1\ \cancel{\text{kg}}\cdot 1\ \text{dose}}\times\frac{1\ \text{mL}}{125\ \cancel{\text{mg}}}=\frac{1960\ \text{mL}}{275\ \text{doses}}=\mathbf{7.1\ mL\ per\ dose}$$