CHAPTER 15
Dosage Calculation Using the Formula Method

Objectives
After reviewing this chapter, you should be able to:
1. Identify the information from a calculation problem to place into the formula given
2. Calculate medication dosages using the formula \( \frac{D}{H} \times Q = x \)
3. Calculate the number of tablets or capsules to administer
4. Calculate the volume to administer for medications in solution

This chapter shows how to use a formula method for dosage calculation to calculate the amount to administer. Using a formula method to calculate requires determining the components of the formula from the problem, and substituting the information from the problem into the formula.

Total reliance on a formula without thinking and asking yourself whether an answer is reasonable can result in errors in calculation and an administration error.

When using a formula always use it consistently and in its entirety to avoid calculation errors. Always ask, “Is the answer obtained reasonable?”

You will learn, for example, that the maximum number of tablets or capsules for a single dosage is usually three. Anything exceeding that should be a red flag to you, even if the answer is obtained from the use of a formula. Use formulas to validate the dosage you think is reasonable, not the reverse. Think before you calculate. Always estimate before applying a formula. Thinking first will allow you to detect errors and alert you to try again and question the results you obtained.

SAFETY ALERT!
Avoid Dosage Calculation Errors
Do not rely solely on formulas when calculating dosages to be administered. Use critical thinking skills such as considering what the answer should be, reasoning, problem solving, and finding rational justification for your answer. Formulas should be used as tools for validating the dosage you THINK should be given.

Formula for Calculating Dosages
The formula presented in this chapter can be used when calculating dosages in the same system of measurement. When the dosage desired and the dosage on hand are in different systems, convert them to the same system before using the formula, using one of the methods learned for conversion. It is important to learn and memorize the following formula and its components:

\( \frac{D}{H} \times Q = x \)
Let’s examine the terms in the formula before using it.

\[ \frac{D}{H} \times Q = x \]

- **D** = The dosage desired, or what the prescriber has ordered, including the units of measurement. Examples: mg, g, etc.
- **H** = The dosage strength available, what is on hand, or the weight of the medication on the label, including the unit of measurement. Examples: mg, g, etc.
- **Q** = The quantity or the unit of measure that contains the dosage that is available, in other words, the number of tablets, capsules, milliliters, etc. that contains the available dosage. “Q” is labeled accordingly as tablet, capsule, milliliter, etc.
- **x** = The unknown, the dosage you are looking for, the dosage you are going to administer, how many milliliters, tablets, etc. you will give.

Always get into the habit of inserting the quantity value for “Q” into the formula, even though when solving problems that involve solid forms of medication (tabs, caps), “Q” is always 1. This will prevent errors when calculating dosages for medications in solution (oral liquids or injectables) in which the solution quantity can be more or less than 1. (such as per 10 mL). When solving problems for medications in solution, the amount for “Q” varies and must always be included.

The available dosage on the label for medications in solution may indicate the quantity of medication per 1 milliliter or per multiple milliliters of solution, such as 80 mg per 2 mL, 125 mg per 5 mL. Some liquid medications may also express the quantity in amounts less than a milliliter, such as 2 mg per 0.5 mL.

When setting up the formula, notice that “D,” which is the dosage desired, is in the numerator, and “H,” which is the dosage strength available, is placed in the denominator of the fraction.

All terms of the formula, including “x,” must be labeled to ensure accuracy.

**SAFETY ALERT!**

Omission of the amount for “Q” can render an error in dosage calculation. Labeling of all terms of the formula, including “x,” is a safeguard to prevent errors in calculation. Always think first, what is a reasonable amount to administer, and calculate the dosage using the formula.

### Steps for Use of the Formula

Now that we have reviewed the terms in the formula, let’s review the steps for using the formula (Box 15-1) before beginning to calculate dosages using the formula.

**BOX 15-1 Steps for Using the Formula**

1. Memorize the formula, or verify the formula from a resource.
2. Place the information from the problem into the formula in the correct position, with all terms in the formula labeled correctly, including “x.”
3. Make sure that all measures are in the same units and system of measure; if not, a conversion must be done before calculating the dosage.
4. Think logically, and consider what a reasonable amount to administer would be.
5. Calculate your answer, using the formula \( \frac{D}{H} \times Q = x \).
6. Label all answers—tabs, caps, mL, etc.

Now we will look at sample problems illustrating the use of the formula.

**Example 1:** Order: 0.375 mg p.o. of a medication.

Available: Tablets labeled 0.25 mg

**Solution:** The dosage 0.375 mg is desired; the dosage strength available is 0.25 mg per tablet. No conversion is necessary. What is desired is in the same system and unit of measure as what you have on hand.
The desired (D) is 0.375 mg. You have on hand (H) 0.25 mg per (Q) 1 tablet. The label on x is tablet. Notice that the label on x is always the same as Q.

\[
\frac{D}{H} \times Q = x
\]

Therefore \( x = 1.5 \) tabs, or \( 1\frac{1}{2} \) tabs. (Because 0.375 mg is larger than 0.25 mg, you will need more than 1 tab to administer 0.375 mg.) Note: Although 1.5 tabs is the same as \( 1\frac{1}{2} \) tabs, for administration purposes, it would be best to state it as \( 1\frac{1}{2} \) tabs.

Example 2: Order: 7,000 units IM of a medication.
Available: 10,000 units in 2 mL

Solution:

\[
\frac{D}{H} \times Q = x
\]

Therefore \( x = 1.4 \) mL. (Because 0.375 mg is larger than 0.25 mg, you will need more than 1 mL to administer 7,000 units.) Note: Although 1.4 mL is the same as \( 1\frac{1}{2} \) mL, for administration purposes, it would be best to state it as \( 1\frac{1}{2} \) mL.

Remember that despite The Joint Commission (TJC) recommendation to discontinue the use of the apothecary system, you may still see these measures indicated on medication labels. A common medication seen with apothecary measures is Nitrostat (Nitroglycerine); however, the metric equivalent is also indicated on the label. Always look carefully for the metric dosage strength and use it to calculate dosages.
The metric system is the principal system used in measurement for medications. When converting is required before calculating a dosage, convert measures to their metric equivalent when possible to decrease the chance of error in calculation.

Example 3: Order: 0.1 mg p.o. of a medication daily

Available: Tablets labeled 50 mcg

Solution: Convert 0.1 mg to mcg. The equivalent to use is 1 mg = 1,000 mcg. Therefore, 0.1 mg = 100 mcg

Now that you have everything in the same system and units of measure, use the formula presented to calculate the dosage to be administered.

\[
(D) \frac{100 \text{ mcg}}{1 \text{ tab}} \times (Q) 1 \text{ tab} = x \text{ tab}
\]

\[
x = \frac{100}{50} \times 1
\]

\[
x = \frac{100}{50}
\]

\[
x = 2 \text{ tabs}
\]

Therefore, x = 2 tabs. (Because 100 mcg is a larger dosage than 50 mcg, it will take more than 1 tab to administer the desired dosage.)

Example 4: Order: 0.2 g p.o. of a liquid medication.

Available: 125 mg per 5 mL.

Solution: Convert 0.2 g to mg. The equivalent to use is 1,000 mg = 1 g. Therefore, 0.2 g = 200 mg.

Now that everything is in the same system and units of measure, use the formula presented to calculate the dosage to be administered.

\[
(D) \frac{200 \text{ mg}}{1 \text{ mL}} \times (Q) 5 \text{ mL} = x \text{ mL}
\]

\[
x = \frac{200 \times 5}{125}
\]

\[
x = \frac{1,000}{125}
\]

\[
x = 8 \text{ mL}
\]

Therefore, x = 8 mL (Because 200 mg is a larger dose than 125 mg, it will take more than 5 mL to administer the desired dosage.)

Example 5: Order: 10 mg subcutaneous of a medication.

Available: 30 mg per mL (Express the answer to the nearest tenth.)
Solution: No conversion is required; the dosage ordered is in the same system and unit of measurement as the available.

\[
\frac{(D)}{10 \text{ mg}} \times \frac{(Q)}{1 \text{ mL}} = \frac{x}{\text{ mL}}
\]

\[
x = \frac{10}{30} \times 1
\]

\[
x = \frac{10}{30}
\]

\[
x = \frac{1}{3} = 0.33 = 0.3 \text{ mL}
\]

Therefore, \(x = 0.33 = 0.3 \text{ mL}\) rounded to the nearest tenth. (Because 30 mg is larger than 10 mg, it will take less than 1 mL to administer the required dosage.)

CRITICAL THINKING

Always think critically, even when using a formula. It is an essential step in estimating what is reasonable and logical in terms of a dosage. This will help prevent errors in calculation caused by setting up the problem incorrectly or careless math and will remind you to double-check your calculation and identify any error.

Remember to memorize the formula presented and follow the steps sequentially. Check FIRST to see if a conversion is required; if so, convert so that everything is in the same units and system of measure, set up terms into the formula, THINK critically as to a reasonable answer, and calculate the dosage using the formula to validate the dosage you anticipated was reasonable.

SAFETY ALERT!

Always double-check your math. Errors can be made in simple calculations because of lack of caution. Always ask yourself whether the answer you have obtained is reasonable and correct.

POINTS TO REMEMBER

- The formula \(\frac{D}{H} \times Q = x\) can be used to calculate the dosage to be administered.
- The \(Q\) is always 1 for solid forms of medications (tabs, caps, etc.) but varies when medications are in liquid form. Do not omit “\(Q\)” even when 1.
- Before the dosage to be given is calculated, the dosage desired must be in the same units and system of measure as the dosage available or a conversion is necessary.
- Set up the terms in the formula labeled with the units of measure, including “\(x\).”
- Think about what a reasonable answer would be.
- Calculate the dosage to administer using the formula to validate your answer as to what was reasonable.
- Double-check all your math, and think logically about the answer obtained.
- Label all answers obtained (e.g., tabs, caps, mL).
- The use of a formula does not eliminate the need to think critically.
- Always systematically follow these steps: Convert if necessary, set up the terms in the formula, THINK about what would be a reasonable answer, Calculate the dosage to administer using the formula.

PRACTICE PROBLEMS

Calculate the following problems using the formula presented in this chapter. Label answers correctly: tabs, caps.

1. Order: 0.4 mg p.o.
   Available: Tablets labeled 0.2 mg