

Home-Study Continuing
Pharmacy Education
Modules for
Pharmacy Technicians



Pharmacy | tech topics™

by Illinois Council of Health-System Pharmacists

**Pharmacy
Calculations
Review**

July 2011
Volume 16
Number 3

This module must be successfully
completed by July 31, 2013
to receive CPE Credit.



Pharmacy Tech Topics™ is provided as a free service
to all Pharmacy Technician Members of the
American Society of Health-System Pharmacists.

Pharmacy Tech Topics™
Volume 16 Number 3
July 2011

Pharmacy Calculations Review

AUTHOR: Yolanda M. Hardy, PharmD
EDITOR: Patricia M. Wegner, PharmD, FASHP
DESIGN EDITOR: Stephanie Lammi

Pharmacy Tech Topics™ (USPS No. 014-766) is published quarterly for \$50 per year by the Illinois Council of Health-System Pharmacists, 4055 N. Perryville Road, Loves Park, IL 61111-8653. Phone (815) 227-9292. Periodicals Postage Paid at Rockford, IL and additional mailing offices.

POSTMASTER: Send address changes to:
Pharmacy Tech Topics™, c/o ICHP, 4055 N. Perryville Road, Loves Park, IL 61111-8653

Copyright July 2011

All contents © 2011 Illinois Council of Health-System Pharmacists unless otherwise noted. All rights reserved. Pharmacy Tech Topics™ is a trademark of the Illinois Council of Health-System Pharmacists.

This module is accredited for 2.5 contact hours of continuing pharmacy education and is recognized by the Pharmacy Technician Certification Board (PTCB).

LEARNING OBJECTIVES

Upon completion of this module, the subscriber will be able to:

1. Compute pharmacy problems by using ratio and proportion or dimensional analysis.
2. Compare and convert units among the pharmacy math systems, especially the metric system.
3. Calculate quantity and day supply.
4. Calculate doses based on weight and body surface area.
5. Calculate intravenous (IV) flow rates.
6. Reduce and enlarge compounding formulas.



Accreditation: Pharmacy Tech Topics™ Modules are accredited for Continuing Pharmacy Education (CPE) credits by the Illinois Council of Health-System Pharmacists. The Illinois Council of Health-System Pharmacists is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education. © 2011 Illinois Council of Health-System Pharmacists. Pharmacy Tech Topics™ is a trademark of the Illinois Council of Health-System Pharmacists. The intended audience is pharmacy technicians.

This module will provide 2.5 contact hours of continuing pharmacy education credit for pharmacy technicians.

ACPE Universal Activity Number: 121-000-11-003-H04-T

Type of Activity: Knowledge

Validation Dates: 07/01/11 to 07/31/13



MEET THE AUTHOR

Yolanda M. Hardy, PharmD

Assistant Professor of Pharmacy Practice
Chicago State University College of Pharmacy
Chicago, IL

Dr. Yolanda M. Hardy is an Assistant Professor of Pharmacy Practice at Chicago State University College of Pharmacy. She is also an adjunct professor at South Suburban College, where she teaches pharmacy calculations in the pharmacy technician program. Dr. Hardy holds a Bachelor of Science in Pharmacy degree from the University of Toledo in Toledo, Ohio (1999). She earned a Doctor of Pharmacy degree at The Ohio State University in Columbus, Ohio (2001). Following this, she completed a Pharmacy Practice Residency in Community Care with The Ohio State University School of Pharmacy and the Columbus Neighborhood Health Centers, Inc. in Columbus, Ohio. She served on the faculty of Northeastern University School of Pharmacy in Boston, Massachusetts from 2002-2008.

PHARMACY TECH TOPICS™ JULY 2011 FACULTY DISCLOSURE

It is the policy of the Illinois Council of Health-System Pharmacists (ICHP) to insure balance and objectivity in all its individually or jointly presented continuing pharmacy education programs. All faculty participating in any ICHP continuing pharmacy education programs are expected to disclose any real or apparent conflict(s) of interest that may have any bearing on the subject matter of the continuing pharmacy education program. Disclosure pertains to relationships with any pharmaceutical companies, biomedical device manufacturers, or other corporations whose products or services are related to the subject matter of the topic.

The intent of disclosure is not to prevent the use of faculty with a potential conflict of interest from authoring a publication but to let the readers know about the relationship prior to participation in the continuing pharmacy education activity. It is intended to identify financial interests and affiliations so that, with full disclosure of the facts, the readers may form their own judgments about the content of the learning activity.

Dr. Hardy's submission has been peer reviewed with consideration and knowledge of these potential conflicts and it has been found to be balanced and objective. The author has no real or apparent conflict(s) of interest that may have any bearing on the subject matter of this continuing pharmacy education program.

NOTICE

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The author and the publisher of this work have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication. However, in view of the possibility of human error or changes in medical sciences, neither the author nor the publisher nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from use of such information.

Readers are encouraged to confirm the information contained herein with other sources. For example and in particular, readers are advised to check the product information sheet included in the package of each drug they plan to administer to be certain that the information contained in this module is accurate and that changes have not been made in the recommended dose or in the contraindications for administration. This recommendation is of particular importance in connection with new or infrequently used drugs.

Module Contents

Introduction

Unit 1:
Basic Calculation Foundation:
Ratio and Proportion and
Dimensional Analysis

Unit 2:
Measurement Systems Used
in the Practice of Pharmacy

Unit 3:
Calculation of Quantity and
Day Supply

Unit 4:
Calculation of Doses

Unit 5:
IV Flow Rates

Unit 6:
Reducing and Enlarging
Formulas

Striving for Accuracy in
Pharmacy Calculations

Tips to help minimize calcula-
tions errors

Pharmacy Calculation
Practice Resources

Introduction

Correct pharmacy calculations are imperative to the practice of pharmacy. From the calculation of amounts of components being added to a compounded total parenteral nutrition (TPN) to the drops per minute rate on the label of an intravenous (IV) bag, pharmacy calculations can make a difference of life or death.

Being a pharmacy technician requires a variety of skills and abilities and perhaps most important is the ability to carry out important mathematic calculations. The goal of this module is to provide a basic review of the many types of pharmacy calculations that pharmacy technicians are asked to perform.

Unit 1: Basic Calculation Foundation Ratio and Proportion and Dimensional Analysis¹

Ratio and Proportion

Ratio and proportion calculations are based on the concept that one component is in proportion to another. As a result, many calculations may be solved by setting the problem up as a ratio.

For example: 1 tablet contains 500mg. *“One tablet contains 500mg” is the same as saying “500mg per 1 tablet”.* Thus, this can be written as:

$$\frac{500\text{mg}}{1 \text{ tab}} \text{ or } \frac{1 \text{ tab}}{500\text{mg}}$$

Using proportions we can determine a ratio that is equal to this ratio.

Example 1: If 1 tablet contains 500mg, how many milligrams are in 3 tablets?

$$\frac{500\text{mg}}{1 \text{ tab}} = \frac{X\text{mg}}{3 \text{ tab}}$$

Solving for x, we find that there are 1500mg in 3 tablets. Because we used proportions, we know that the ratio of:

$$\frac{500\text{mg}}{1 \text{ tab}} \text{ is equal to } \frac{1500\text{mg}}{3 \text{ tab}} \quad \text{or} \quad \frac{500\text{mg}}{1 \text{ tab}} = \frac{1500\text{mg}}{3 \text{ tab}}$$

Example 2: If one teaspoonful (5ml) of a solution contains 15mg of medication, how many milligrams are there in 4 teaspoonsful or 20ml?

$$\frac{15\text{mg}}{5\text{ml}} = \frac{X\text{mg}}{20\text{ml}}$$

$$15\text{mg} \times 20\text{ml} = X\text{mg} \times 5\text{ml}$$

$$\frac{15\text{mg} \times 20\text{ml}}{5\text{ml}} = \frac{X\text{mg} \times 5\text{ml}}{5\text{ml}}$$

$$\frac{300\text{mg}}{5} = \frac{X\text{mg}}{1}$$

$$60\text{mg} = X\text{mg}$$

So there are 60mg in 20mls or 4 teaspoons of the solution.

Dimensional Analysis

Dimensional Analysis is another method that may be used to calculate quantities of IV additives or strengths of doses. This method is based on cancelling out the units of measure or labels.

Example 1: If 1 tablet contains 500mg, how many milligrams are in 3 tablets?

Step 1: Find the ratio that is in the problem. In this case, the ratio is:

$$\frac{500\text{mg}}{1 \text{ tab}}$$

Step 2: Set up the problem around the ratio so that the units cancel out. The unit that is left (ie. the unit that does not cancel out with the other units) should correspond to the unit needed for the answer to the problem. In this problem, the unit that we need is 'mg', since the problem asks how many milligrams are in 3 tablets.

$$3 \cancel{\text{ tab}} \times \frac{500\text{mg}}{1 \cancel{\text{ tab}}} = 1500\text{mg}$$

Example 2: A pharmacy technician must fill an order for three 1 liter bags of 5% dextrose in water (D5W) with 12mmols of potassium phosphate for one patient. The potassium phosphate is 3mmol/ml in 5ml vials. How many 5ml vials of potassium phosphate will the technician need to fill the patient's order?

$$3 \cancel{\text{ bags}} \times \frac{12\cancel{\text{ mmols}}}{1 \cancel{\text{ bag}}} \times \frac{1\cancel{\text{ ml}}}{3\cancel{\text{ mmol}}} \times \frac{1\cancel{\text{ vial}}}{5\cancel{\text{ ml}}} = 2.4 \text{ vials}$$

Practice

1. A prescription for a suspension calls for a dose of 250mg to be given twice a day. If the suspension contains 300mg/5ml, how many ml are needed for one dose?
2. A prescription calls for 2000mg of amoxicillin for one dose. If the pharmacy only carries 250mg capsules of amoxicillin, how many capsules will you need to fill this dose?
3. A patient injects 8 units of U-100 insulin each day. What is the volume in milliliters the patient needs to inject? (Hint: U-100 = 100units of insulin/ml)
4. An order is written for 375mg of ampicillin to be given intravenously every 6 hours to a child weighing 15kg. Ampicillin is available in a 1g/50ml concentration. Calculate the volume in milliliters needed for a single 375mg dose.
5. An order is written for 2g of vancomycin to be given IV every 12 hours for an adult. Calculate the volume in milliliters needed for a single dose if vancomycin is available in a 50mg/ml concentration.
6. If there are 400,000 units of penicillin in 250mg of penicillin V potassium, how many units of penicillin will a patient receive in a 125mg dose of penicillin V potassium?
7. A patient injects 0.15 ml of insulin each morning. How many units of insulin are in each dose? (Hint: 100units of insulin/ml)

*A Word About Rounding

Often, it is more practical to round a number to the nearest whole number, tenth, or hundredth decimal place. *When rounding, it is important to follow this rule: If the number to the right of the place for which you are rounding is less than 5, round down. If the number is 5 or greater, round up.* For example, the answer to **Practice Question 1** is actually 4.17 ml. Because it would be very difficult to measure this exact amount in an oral syringe, it is more practical to round the amount to a volume that is more practical to obtain. If we are using an oral syringe that measures to the tenths place, we could round the volume to the nearest tenth. Because the number to the right of the tenths place is greater than 5 (it is 7), we would round up, making the value 4.2ml. If we were to round to the nearest whole number, the value would be 4, since the number to the right of the whole number is less than 5 (it is 1).

Practice Answers

Question 1: 4.2ml*; Question 2: 8 capsules; Question 3: 0.08ml; Question 4: 18.75ml; Question 5: 40ml; Question 6: 200,000 units; Question 7: 15 units

Unit 2: Measurement Systems Used in the Practice of Pharmacy²

The Metric System

The metric system, also known as the International System of Units (SI), is a measurement system that pharmacists and technicians must know. The system uses ‘units’ and ‘prefixes’.

The ‘units’ most commonly used in the practice of pharmacy include:

- Gram (used as a measure of weight or drug strength)
- Meter (used as a measure of distance or area)
- Liter (used as a measure of volume)

These are sometimes referred to as the ‘base unit’.

The ‘prefixes’ most commonly used in the practice of pharmacy include:

- Kilo
- Milli
- Micro
- Nano

In the SI system, a prefix is paired with a base unit to help describe a measurement.

Examples:

Kilo + Gram → Kilogram

Milli + Liter → Milliliter

Metric System: Grams

(Note: Units of measure in bold are most commonly used in pharmacy practice)

| Prefix | Name | Factor | Value |
|--------|------------------------|------------------|------------------|
| Kilo | Kilogram (Kg) | 10 ³ | 1,000 grams |
| Hecto | Hectogram (hg) | 10 ² | 100 grams |
| Deka | Dekagram | 10 ¹ | 10 grams |
| | Gram (g) | | 1 gram |
| Deci | Decigram (dg) | 10 ⁻¹ | 0.1 gram |
| Centi | Centigram | 10 ⁻² | 0.01 gram |
| Milli | Milligram (mg) | 10 ⁻³ | 0.001 gram |
| Micro | Microgram (mcg) | 10 ⁻⁶ | 0.000001 gram |
| Nano | Nanogram (ng) | 10 ⁻⁹ | 0.000000001 gram |

Understanding Factors

Each prefix represents a power of 10 from the base unit.

Metric System: Liters

(Note: Units of measure in bold are most commonly used in pharmacy practice)

| Prefix | Name | Factor | Value |
|--------|------------------------------|------------------|-------------------|
| Kilo | Kiloliter (KL) | 10 ³ | 1,000 liters |
| Hecto | Hectoliter (hL) | 10 ² | 100 liters |
| Deka | Dekaliter | 10 ¹ | 10 liters |
| | Liter (L) | | 1 liter |
| Deci | Deciliter (dL) | 10 ⁻¹ | 0.1 liter |
| Centi | Centiliter | 10 ⁻² | 0.01 liter |
| Milli | Milliliter (mL or ml) | 10 ⁻³ | 0.001 liter |
| Micro | Microliter (mcL) | 10 ⁻⁶ | 0.000001 liter |
| Nano | Nanoliter (nL) | 10 ⁻⁹ | 0.000000001 liter |

Metric System: Meters

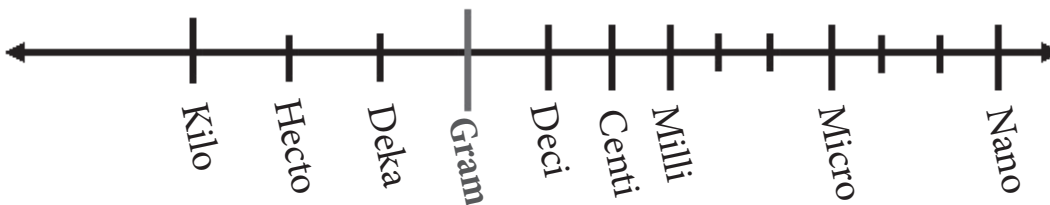
(Note: Units of measure in bold are most commonly used in pharmacy practice)

| Prefix | Name | Factor | Value |
|--------|-------------------------|-----------|-------------------|
| Kilo | Kilometer (Km) | 10^3 | 1,000 meters |
| Hecto | Hectometer (hm) | 10^2 | 100 meters |
| Deka | Dekameter | 10^1 | 10 meters |
| | Meter (m) | | 1 meter |
| Deci | Decimeter(dm) | 10^{-1} | 0.1 meter |
| Centi | Centimeter (cm) | 10^{-2} | 0.01 meter |
| Milli | Millimeter (mm) | 10^{-3} | 0.001 meter |
| Micro | Micrometer (mcm) | 10^{-6} | 0.000001 meter |
| Nano | Nanometer (nm) | 10^{-9} | 0.000000001 meter |

Converting Units within the Metric System

There are a number of ways to convert between units in the metric system. Here are a couple of examples.

Method #1



Metric System Scale

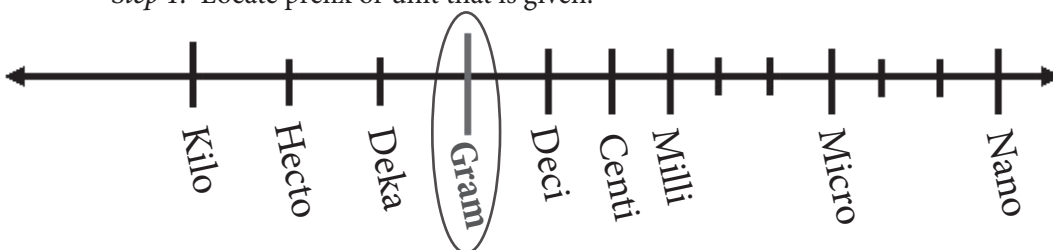
The smaller hash marks represent units that are not typically used in pharmacy. Please do not forget that these hash marks also represent units!

Using the scale above, one can convert between units by following these directions:

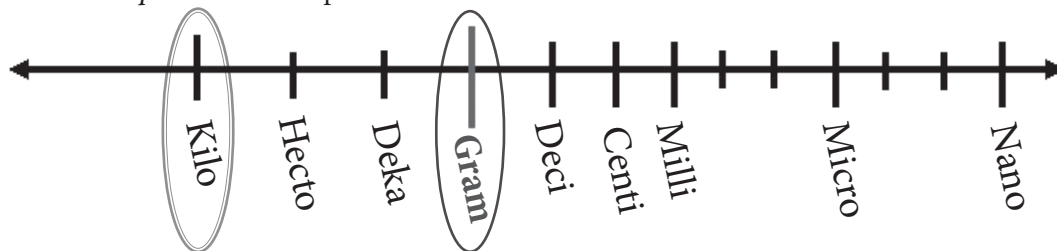
1. Locate the prefix or unit that matches the unit that is given to you.
2. Locate the prefix or unit that matches the unit that is desired.
3. Count the number of units it takes to get to the desired unit, starting from the given unit. Note the direction you have to move to get to the desired unit. This will tell you how many spaces to move the decimal point of the number written before the unit that is given. If you move to the left to get to the desired unit, move the decimal point to the left. If you move to the right to get to the desired unit, move the decimal point to the right. Use zeros "0" as place holders.
4. Add the new unit to the numerical value.

Example: Convert 3g to kg.

Step 1: Locate prefix or unit that is given.



Step 2: Locate the prefix or unit that matches the unit that is desired.



Step 3: Count the number of units between step 1 and step 2.

I have to move 3 units to get to the desired unit. I have to move to the left. Therefore, I move the decimal point to the left.



In pharmacy, it is imperative to include a leading zero, to help reduce medication errors. Therefore, this value is written as:

0.003

Step 4: 3g is equivalent to 0.003kg

Method #2

Remembering the following conversions can also help in converting within the metric system:

- 1kg = 1000g
- 1g = 1000mg
- 1g = 1,000,000mcg
- 1g = 1,000,000,000ng

Keeping this in mind, you can use ratio and proportion or dimensional analysis to convert within the metric system.

Example: Convert 5kg to mg.

Ratio and Proportion

$$\frac{5\text{kg}}{X\text{g}} = \frac{1\text{kg}}{1000\text{g}} \quad \text{Solving for } x: \quad x = 5000\text{g} \quad \text{Then} \quad \frac{5000\text{g}}{X\text{mg}} = \frac{1\text{g}}{1000\text{mg}} \quad \text{Solving for } X: \quad X = 5,000,000\text{mg}$$

Dimensional Analysis

$$5\text{kg} \times \frac{1000\text{g}}{1\text{kg}} \times \frac{1000\text{mg}}{1\text{g}} = 5,000,000\text{mg}$$

Practice

Complete the following conversions:

- 3mg = _____g
- 5.4L = _____ml
- 14mm = _____m
- 30ml = _____L
- 6g = _____ng
- 12,000,000mcg = _____g
- 100mcl = _____ml
- 13g = _____kg
- 26g = _____mg
- 640ml = _____mcl

Practice Answers

Question 1: 0.003g; Question 2: 5400ml; Question 3: 0.014 m; Question 4: 0.03L; Question 5: 6,000,000,000ng; Question 6: 12g; Question 7: 0.1ml; Question 8: 0.013kg; Question 9: 26,000mg; Question 10: 640,000mcl

Apothecary System

Another measurement system used in pharmacy is the apothecary system. The apothecary system can be used for fluid measurements and weight measurements. Converting within the apothecary system may be done using ratio and proportion or dimensional analysis.

Apothecary Conversions:

| Fluid Measures | |
|--------------------------------------|---|
| 60 minims = 1 fluidrachm or fluidram | 8 fluidrams = 480 minims = 1 fluidounce (fl oz) |
| 16 fluidounces = 1 pint (pt) | 2 pints = 32 fluidounces = 1 quart (qt) |
| 4 quarts = 8 pints = 1 gallon (gal) | |

| Weight Measures | |
|-------------------------------------|--|
| 20 grains = 1 scruple | 3 scruples = 60 grains = 1 dram |
| 8 drams = 480 grains = 1 ounce (oz) | 12 ounces = 5760 grains = 1 pound (lb) |

Example: How many fluidounces are in 6 quarts?

Ratio and Proportion

$$\frac{6 \text{ quarts}}{X \text{ pints}} = \frac{4 \text{ quarts}}{8 \text{ pints}} \quad \text{Solving for X:} \quad \text{Then } \frac{12 \text{ pints}}{X \text{ fluidounces}} = \frac{1 \text{ pint}}{16 \text{ fluidounces}}$$

Solving for X:

$$X = 192 \text{ fluidounces}$$

Dimensional Analysis

$$6 \text{ quarts} \times \frac{8 \text{ pints}}{4 \text{ quarts}} \times \frac{16 \text{ fluidounces}}{1 \text{ pint}} = 192 \text{ fluidounces}$$

Avoirdupois System

A third measurement system used in pharmacy is the avoirdupois system. This system is used in measuring weight. Oftentimes, the weight displayed on bulk powders and chemi-

cal packages are listed as an avoirdupois weight. However, many if not all compounding recipes require measurements to be made using the metric system. Converting within the avoirdupois system may be done using ratio and proportion or dimensional analysis.

Avoirdupois conversions:

1kg = 2.2 lb

This conversion is commonly used to convert body weight in pounds to kilograms.

$$1\text{kg} = 2.2\text{ lb}$$

$$1\text{ lb} = 454\text{g}$$

Example: A young child weighs 45 lb. How much does this child weigh in kilograms?

Ratio and Proportion

$$\frac{45\text{ lb}}{X\text{kg}} = \frac{2.2\text{ lb}}{1\text{kg}} \quad \text{Solving for X:}$$

$$X = 20.5\text{ kg}$$

Dimensional Analysis

$$45\text{ lb} \times \frac{1\text{kg}}{2.2\text{ lb}} = 20.5\text{kg}$$

Household System

A fourth system of measure that pharmacists and technicians should be familiar with is the household system. Converting within the household system may be done using ratio and proportion or dimensional analysis.

One must be familiar with the following abbreviations in order to use this system:

- 1 tsp = 5 ml
- 1 tbs = 3 tsp
- 1 cup = 8 oz
- 2 tbs = 1 oz
- 1 oz = 30 ml
- 1 pt = 2 cups
- 16 oz = lb (weight)
- 1 qt = 4 cups = 2pt

Practice

Complete the following conversions:

1. 70kg = _____lb (avoirdupois)
2. 5 fluidounces = _____pint
3. 3 gallons = _____fluidounces
4. 9 tbs = _____oz
5. 12 lb = _____kg
6. 120 minims = _____fluidram
7. 2 lb = _____g (avoirdupois)
8. 2 tbs = _____tsp
9. 3 ounces = _____grains
10. 7 pounds = _____oz (apothecary)

Practice Answers

Question 1: 154 lb; Question 2: 0.3125 pint; Question 3: 384 fluidounces; Question 4: 4.5oz; Question 5: 5.45kg; Question 6: 2 fluid drams; Question 7: 908g; Question 8: 6 tsp; Question 9: 1440 grains; Question 10: 84oz

Unit 3: Calculation of Quantity and Day Supply³

In order to calculate quantity and day supply, it is important to understand unit of measure and Latin abbreviations used on prescriptions. A review of unit of measure abbreviations and Latin abbreviations are beyond the scope of this review. Readers are encouraged to refer to the **Pharmacy Calculation Practice Resources** and **References** (listed on pages 24-25 in this module) or other manuals to review pharmacy abbreviations.

In many instances, the quantity of medication that needs to be dispensed is listed on the prescription. However, there are instances when this is not the case. In these situations, it is important that the pharmacist or technician knows how to calculate this amount. There are a number of scenarios that the pharmacist or technician may find themselves in when dealing with quantity and/or day supply.

Scenario #1: Calculating the quantity of a dose when the dose is given in milligram strength.

Many times, the quantity (or dose) is provided. It may be referred to as the number of tablets or capsules needed, or the amount of milliliters needed. However, there are some times when the dose is listed in milligram strength, and you may need to determine how many tablets, capsules, or milliliters are needed so that the prescription can be properly dispensed.

You may use the following steps to calculate quantity when the dose is given in milligrams (mg):

1. Determine the ratio of milligram of drug per dosage form.
2. Using ratio and proportion or dimensional analysis, calculate the equivalent amount of dosage form needed to equal the milligram strength.

Example: A prescription was written for 750mg dose of drug X. There are 500mg of drug X in 1 tablet. How many tablets are needed to receive the 750mg dose?

Ratio and Proportion

$$\frac{750\text{mg}}{X \text{ tab}} = \frac{500\text{mg}}{1\text{tab}} \quad \text{Solving for X:}$$

$$X = 1.5 \text{ tab}$$

Dimensional Analysis

$$750\text{mg} \times \frac{1\text{tab}}{500\text{mg}} = 1.5 \text{ tab}$$

Scenario #2: Calculating the quantity of drug needed to be dispensed for a stated day supply.

You may use the following steps to calculate the quantity needed to be dispensed for a stated day supply:

1. Determine the amount of agent (ie, tablets, capsules, milliliters, etc) needed per dose.
2. Determine how many doses are given per day based on the dosing schedule.
3. Determine the amount of agent (ie, tablets, capsules, milliliters, etc) needed for one day.
4. Determine how many days the prescription is written for. Then, calculate the amount of agent needed for the amount of days the prescription will be taken.

Example: A prescription was written for 750mg dose of drug X to be taken 3 times a day for 10 days. There are 500mg of drug X in 1 tablet. How many tablets should be dispensed for a 10-day supply?

Ratio and Proportion

Step 1:

$$\frac{750\text{mg}}{X \text{ tab}} = \frac{500\text{mg}}{1\text{tab}} \quad \text{Solving for X:}$$

$$X = 1.5 \text{ tab}$$

Steps 2 and 3: The instructions call for 3 doses per day.

$$\frac{1.5 \text{ tab}}{1 \text{ dose}} = \frac{X \text{ tab}}{3 \text{ doses}} \quad \text{Solving for X:}$$

$$X = 4.5 \text{ tabs}$$

Step 4: The prescription is written for 10 days.

$$\frac{4.5 \text{ tabs}}{1 \text{ day}} = \frac{X \text{ tabs}}{10 \text{ days}} \quad \text{Solving for X:}$$

$$X = 45 \text{ tablets}$$

Dimensional Analysis

Step 1:

$$750 \cancel{\text{mg}} \times \frac{1 \text{ tab}}{500 \cancel{\text{mg}}} = 1.5 \text{ tab}$$

Steps 2 and 3: The instructions call for 3 doses per day.

$$3 \cancel{\text{doses}} \times \frac{1.5 \text{ tab}}{1 \cancel{\text{dose}}} = 4.5 \text{ tabs}$$

Step 4: The prescription is written for 10 days.

$$10 \cancel{\text{days}} \times \frac{4.5 \text{ tabs}}{1 \cancel{\text{day}}} = 45 \text{ tablets}$$

Scenario #3: *Calculating the day supply when the quantity of drug needed to be dispensed, and dosing schedule is stated.*

Making this calculation is oftentimes done automatically through the computer system. However, it is helpful for the pharmacist or technician to know how to do this calculation. You may use the following steps to perform this calculation.

1. Determine how much of the agent (ie. tablet, capsule, milliliters) is needed per dose, if it is not stated.
2. Determine how many doses per day are given.
3. Multiply Step 1 and Step 2 to determine the total amount of agents (ie, tablets, capsules, milliliters) given in one day.
4. Using ratio and proportion or dimensional analysis, calculate the number of days (ie. day supply) the prescription provides. Please note that this problem can also be solved using simple division.

Example: A prescription is written for the patient to take 2 tablets Q 8 hours. The prescription calls for 180 tablets to be dispensed. How long with this prescription last? Calculate the day's supply.

Ratio and Proportion

Step 1: The prescription tells us that one dose consists of 2 tablets.

Step 2: The instructions call for 3 doses per day.

Step 3: 2 tablets x 3 doses = 6 tablets per day

Step 4: $\frac{6 \text{ tabs}}{1 \text{ day}} = \frac{180 \text{ tabs}}{X \text{ days}}$ Solving for X:
X = 30 days

Therefore, this prescription is for a 30 day supply.

Dimensional Analysis

Step 1: The prescription tells us that one dose consists of 2 tablets.

Step 2: The instructions call for 3 doses per day.

Step 3: 2 tablets x 3 doses = 6 tablets per day

Step 4: $180 \cancel{\text{ tab}} \times \frac{1 \cancel{\text{ day}}}{6 \cancel{\text{ tab}}} = 30 \text{ days}$

Therefore, this prescription is for a 30 day supply.

Practice

Complete the following problems.

- How many days will the following prescription last?
Rx: Nitrofurantion 100mg capsules
#28 capsules
Sig: i cap po QID
- A loading dose of 2g is ordered for an antibiotic suspension. If the suspension is available in 250mg/ml, how many milliliters are needed for this dose?
- A prescription is written as follows:

Prednisone 10mg tablets
20mg po BID x 2 days
20mg po once daily x 2 days
10mg po once daily x 2 days

a. How many tablets are needed for each 2 day regimen?
b. How many days does this prescription last?
c. How many tablets need to be dispensed?

Practice Answers

Question 1: 7 days; Question 2: 8ml; Question 3a: First 2 days: 8 tablets, Second 2 days: 4 tablets, Third 2 days: 2 tablets; Question 3b: 6 days; Question 3c: 14 tablets

Unit 4: Calculation of Doses^{3,4}

(Weight Based, Body Surface Area)

Sometimes, a medication is dosed based on a person's weight or body surface area.

Weight based dosing

Weight based doses are most often calculated by using a patient's weight in kilograms (kg). In order to do this, one must know the conversion from pounds (lb) to kilograms (kg). This dosing method is usually done with pediatric dosing.

$$1\text{kg} = 2.2\text{ lb}$$

Another key point to remember with weight based dosing is that the dose is determined based on milligram of drug per kilogram of body weight. One can calculate weight based dosing easily using ratio and proportion or dimensional analysis.

Example: The dose of an antibiotic is 40mg/kg twice daily. How much of the antibiotic per dose should be given to a patient who weighs 80 lb?

Ratio and Proportion

Step 1: Convert weight from pounds to kilograms.

$$\frac{1\text{kg}}{2.2\text{ lb}} = \frac{X\text{kg}}{80\text{ lb}} \quad \text{Solving for X:}$$

$$X = 36\text{ kg}$$

Step 2: Calculate dose.

$$\frac{40\text{mg}}{1\text{kg}} = \frac{X\text{mg}}{36\text{kg}} \quad \text{Solving for X:}$$

$$X = 1440\text{mg}$$

Dimensional Analysis

Steps 1 and 2 can be done together.

$$80\cancel{\text{ lb}} \times \frac{1\cancel{\text{ kg}}}{2.2\cancel{\text{ lb}}} \times \frac{40\text{mg}}{1\cancel{\text{ kg}}} = 1440\text{mg}$$

Dosing Based on Body Surface Area (BSA)

Some medications, such as chemotherapy agents, are dosed based on BSA. In addition, some medications that will be administered to pediatric patients will be dosed based on BSA. Most times, a nomogram is used to calculate the BSA. A review of the BSA equation and/or how to use a nomogram is outside the scope of this review. For the purpose of this review, the BSA will be provided.

One can also calculate doses based on milligram per m². One will still need to know the BSA for this calculation. Calculations using mg/m² can be easily completed using ratio and proportion or dimensional analysis.

Example: The dose for a drug is 5mg/m². Calculate the dose of a drug for a patient with a BSA of 1.25m².

Ratio and Proportion

$$\frac{5\text{mg}}{\text{m}^2} = \frac{X\text{mg}}{1.25\text{m}^2} \quad \text{Solving for X:}$$

$$X = 6.25\text{mg}$$

Dimensional Analysis

$$1.25\cancel{\text{m}^2} \times \frac{5\text{mg}}{\cancel{\text{m}^2}} = 6.25\text{mg}$$

Practice

Complete the following problems.

1. The dose of a pain medication is 5mg/kg. Calculate the dose for a patient that weighs 36kg.
2. An antibiotic is dosed at 80mg/kg/day, divided in 2 doses. Calculate the dose, in milligrams of a single dose for a child weighing 30 lb. What is the total daily dose given?
3. The dose of paclitaxel is 260mg/m². Calculate the dose that should be given to a patient that has a body surface area of 1.51m².

Practice Answers

Question 1: 180mg; Question 2: 545mg, 1090mg; Question 3: 393mg

Unit 5: Intravenous (IV) Flow Rates⁵

In certain instances, it is necessary for medications to be given by intravenous route. These medications are typically added to IV solutions such as normal saline (NS), 5% dextrose in water (D5W), or Lactated Ringers (LR). The medication is then delivered into the vein by using an infusion pump or regulated manually. In order for the solution to be delivered properly, a flow rate has to be determined. Flow rates for infusion pumps are typically written in ml/hr. Manually regulated flow rates are typically written in drops/minute.

Calculating the flow rate

A flow rate can be calculated in multiple ways, depending on which type of information is provided.

Calculating flow rate when a particular volume and assigned time frame is given, when using an infusion pump

Because the flow rate can be described as volume/time, if one is given a standard volume and a standard time, then flow rate can be determined simply by placing the volume, in milliliters, over minutes or hours.

Example: 3L of D5W is to be infused over 24 hours. Calculate the flow rate.

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

Calculating flow rate when using manual flow regulation

Calculating flow rate when the infusion is to be regulated manually can be done by using the following equation:

$$\frac{\text{Volume (ml) X drop factor}}{\text{Time in minutes}} = \text{flow rate}$$

The drop factor is a value that describes how many drops are contained in milliliter of solution. The drop factor is determined by the type of tubing used.

Example: 3L of D5W is to be infused over 24 hours, using an IV set that delivers 15gtt/ml. Calculate the flow rate.

$$\frac{3000 \text{ X } 15\text{gtt/ml}}{1440 \text{ minutes}} = 31.25 \text{ drops/minute or } 31 \text{ drops/minute}$$

In some cases, a flow rate may be written in mg/min. In these situations, one must convert the mg to the amount of volume, in milliliters.

Example: 3000mg of a drug is placed in 600ml of NS, and is ordered to be given at a rate of 10mg/min. Calculate the flow rate in ml/hr.

Step 1: Convert the mg/min to ml/min using ratio and proportion or dimensional analysis.

Step 2: Determine the flow rate in ml/hr

Ratio and Proportion

Step 1: Convert the mg/min to ml/min.

$$\frac{3000\text{mg}}{600\text{ml}} = \frac{10\text{mg}}{\text{X ml}} \quad \text{Solving for X:}$$

$$\text{X} = 2\text{ml}$$

Therefore, 2ml of solution contains 10mg of drug.

Step 2: Determine the flow rate in ml/hr.

Since 2ml contains 10mg, you are essentially giving 2 ml/minute.

$$\frac{2\text{ml}}{\text{min}} = \frac{\text{X ml}}{60\text{min}} \quad \text{Solving for X:}$$

$$\text{X} = 120\text{ml/hr}$$

Dimensional Analysis

Steps 1 and 2 can be done together.

$$\frac{10\text{mg}}{\text{min}} \times \frac{600\text{ml}}{3000\text{mg}} \times \frac{60\text{min}}{1 \text{ hr}} = 120 \text{ ml/hr}$$

Practice

Complete the following problems.

1. 4L of Lactated Ringers is to be infused over 20 hours by infusion pump.
 - a. Calculate the flow rate in ml/hr.
 - b. Calculate the flow rate in gtt/min when infused with an IV set with a drop factor of 12gtt/ml.

2. An order is written for 375ml of D5W to be administered over 6 hours.
 - a. Calculate the flow rate of an infusion given with an IV set that has a drop factor of 20gtt/min.
 - b. Calculate the administration rate in ml/hr.

3. 50 mg of a drug is added to 500ml of 0.45% sodium chloride or NaCl (1/2 NS). Calculate the flow rate in ml/hr needed in order to administer the drug so that it is delivered at a rate of 5mg/hr.

Practice Answers

Question 1a: 200ml/hr; Question 1b: 40gtt/min; Question 2a: 20.8gtt/min or 21gtt/min; Question 2b: 62.5ml/hr or 63ml/hr; Question 3: 50ml/hr

Unit 6: Reducing and Enlarging Formulas⁶

Pharmacists and technicians must use a recipe, or formula, when compounding medications. These recipes, much like recipes found in cookbooks, are designed to make a certain amount of the end product. On occasion, a prescription may call for more or less of the product than what the recipe is written for. In these situations, the recipe or formula, must be enlarged or reduced.

There is a simple equation that can be used when reducing and enlarging formulas:

$$\frac{\text{Quantity of formula specified}}{\text{Quantity of formula desired}} = \frac{\text{Quantity of ingredient specified}}{X}$$

To use this equation, it is important to know that the quantity specified refers to the quantity that is listed in the recipe or formula. The quantity desired is the quantity ordered in the prescription, or in other words, the quantity that you want to make.

Example: The following recipe makes 10 capsules:

- Drug X 2g
- Starch 20mg

How much of Drug X is needed to make 25 capsules?

$$\frac{10 \text{ caps}}{25 \text{ caps}} = \frac{2\text{g}}{X\text{g}} \quad \text{Solving for X:}$$

$$X = 5\text{g}$$

Practice Answers

Question 1: 96 capsules; 7.2 g;
 Question 2: Betamethsone valerate 54.45mg, Alcohol 9ml, Propylene glycol 9ml, Pluronic® F127 9.9g, Purified water qs 45g

Practice

Complete the following problems.

1. A prescription for an oral suspension calls for 240ml to be dispensed. The recipe for the solution is as follows:⁷

| | |
|------------------------|----------|
| Tamiflu® 75mg capsules | 1.5 g |
| Cherry syrup | qs 50 ml |

- a. Calculate the number of Tamiflu® 75mg capsules that will be needed to compound the 240ml of suspension.
- b. Calculate the amount of Tamiflu® in grams needed to make 240ml of the solution.

2. A prescription for a topical ointment calls for 45g to be dispensed. The recipe for the solution is as follows:⁸

| | |
|------------------------|---------|
| Betamethasone valerate | 121mg |
| Alcohol (95%) | 20ml |
| Propylene glycol | 20ml |
| Pluronic® F127 | 22g |
| Purified water | qs 100g |

Calculate the amount of each ingredient needed to make 45g of the solution.

Percent Strength

The term *concentration* is used interchangeably with the term *percent strength*.

Unit 7: Calculation of Percent Strength⁹

Certain medications, when available as a solution or a solid dosage form can be referred to by the percent strength. Percent strength can be thought of as the parts of a drug contained in 100 parts of a product. Percent strength is expressed as:

- Weight/Volume (w/v)
- Weight/Weight (w/w)
- Volume/Volume (v/v)

Weight/Volume (w/v), Volume/Volume (v/v), Weight/Weight (w/w)

Units play a very important role when calculating percent strength. Weight is always measured in grams, and volume is always measured in milliliters.

| Percent Strength | Meaning |
|------------------|---|
| %Weight/Volume | The number of grams in every 100 milliliters of product (or solution) |
| % Weight/Weight | The number of grams in every 100 grams of product |
| % Volume/Volume | The number of milliliters in every 100 milliliters of product (or solution) |

Examples using %w/v:

If the percent strength is known along with the volume of the solution, the amount of drug, in grams, can be determined.

Example: A certain antibiotic solution is available in a 1% (w/v) concentration. Calculate the amount of antibiotic, in grams, present in 50ml of this 1% solution.

Ratio and Proportion

$$\frac{1\text{g antibiotic}}{100\text{ml solution}} = \frac{X}{50\text{ml}} \quad \text{Solve for X}$$

$$X = 0.5\text{g}$$

Dimensional Analysis

$$50\cancel{\text{ml}} \times \frac{1\text{g antibiotic}}{100\cancel{\text{ml}}} = 0.5\text{g}$$

If the drug amount is available along with the volume of the solution, the percent strength can be determined.

Example: Calculate the percent strength of a 400ml solution that contains 6g of a drug.

$$\frac{6\text{g}}{400\text{ml}} \times 100\% = 1.5\% \quad \text{or} \quad \frac{6\text{g}}{400\text{ml}} = \frac{X\%}{100\%} \quad \text{Solve for X}$$

$$X = 1.5\%$$

Examples using %w/w

Example 1: How much hydrocortisone is available in a 60g tube of hydrocortisone cream 2.5%?

Ratio and Proportion

$$\frac{2.5\text{g hydrocortisone}}{100\text{g cream}} = \frac{X}{60\text{g}} \quad \text{Solve for X}$$

$$X = 1.5\text{g}$$

Dimensional Analysis

$$60\cancel{\text{g}} \times \frac{2.5\text{g hydrocortisone}}{100\cancel{\text{g cream}}} = 1.5\text{g}$$

Example 2: Calculate the percent strength of a 15g gel that contains 375mg of drug.

First, you must convert the 375mg to grams. 375mg = 0.375g

$$\frac{0.375\text{g hydrocortisone}}{15\text{g gel}} \times 100\% = 2.5\%$$

or

$$\frac{0.375\text{g hydrocortisone}}{15\text{g gel}} = \frac{X\%}{100\%} \quad \text{Solving for X}$$

$$X = 2.5\%$$

Percent Strength**Calculations**

Remember, percent strength calculations must be done using grams, not milligrams.

Examples using % v/v:

Example 1: Calculate the amount of alcohol in 1L of a 70% solution.

$$\frac{70 \text{ ml alcohol}}{100 \text{ ml solution}} = \frac{X \text{ ml}}{1000 \text{ ml}} \quad \text{Solving for X}$$

$$X = 700 \text{ ml}$$

Example 2: A 30ml of a liquid astringent was mixed with 200ml of lotion. Calculate the percent strength of the mixture.

$$\frac{30 \text{ ml}}{200 \text{ ml}} \times 100\% = 15\%$$

or

$$\frac{30 \text{ ml}}{200 \text{ ml}} = \frac{X\%}{100\%} \quad \text{Solving for X}$$

$$X = 15\%$$

Practice Answers

Question 1: 0.05%; Question
2: 40g; Question 3: 300mg

Practice

Complete the following problems.

1. Calculate the percent strength of a 500ml solution that contains 250 mg of drug.
2. A patient received 800ml of 5% dextrose in water (D5W) over a time span of 24 hours. How many grams of dextrose did this patient receive?
3. How many milligrams of clotrimazole are available in a 30 gram tube of clotrimazole 1% cream?

Striving for Accuracy in Pharmaceutical Calculations

The National Coordinating Council for Medication Error Reporting and Prevention defines a medication error as

A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.¹⁰

Performing accurate calculations can prevent medication errors in the area of medication prescribing, product labeling, product preparation, as well as medication administration and use. The following cases demonstrate how a calculation error in the product preparation resulted in a medication error.

Case 1

An order for caffeine citrate was ordered for a 4 pound neonate in the neonatal intensive care unit (NICU). The order was written as follows:

Caffeine citrate 10mg/ml
20mg/kg bolus x 1, then 5mg/kg/day

The technician compounded an extemporaneous solution of caffeine citrate and then proceeded to fill the prescription. The technician calculated the dose needed for the bolus to be 36 mg, and the maintenance dose to be 9 mg. He then prepared the prescription, drawing up 3.6 ml of the solution in to an oral syringe for the bolus dose, and 0.9 ml in to a second syringe to be placed in the unit dose cart for later delivery. The pharmacist on duty checked the syringes and sent the bolus dose to the NICU. Two hours later, the neonate was found to have tachycardia. Shortly after that, the neonate began to seize. Labs were drawn, in which the neonate was discovered to have a toxic caffeine serum concentration of 80 mg/L. After an investigation, it was determined that there was an error with the caffeine citrate compounded product. Compounding calculations were reviewed, and it was discovered that the caffeine citrate was prepared in a concentration of 100mg/ml, rather than 10mg/ml.

In this example, the technician calculated the correct dose for the patient. However, the error in calculation occurred during the extemporaneous preparation of the caffeine citrate. The recipe for caffeine citrate¹¹ calls for 10 g of caffeine base and 10 g of citric acid to be mixed in 1L of sterile water. Unfortunately, when converting the liter to milliliters, the technician multiplied by a factor of 100, rather than 1000. As a result, the technician dissolved the caffeine and the citric acid in 100ml of sterile water rather than 1000 ml. This error resulted in the final product being 10 times more concentrated, thereby causing the patient to receive too much drug.

Technician's Calculation (incorrect calculation)

1L = 100ml (source of the error) 10g = 10,000mg

| | |
|--|---|
| <i>Actual concentration of preparation</i> | <i>Resultant dose of 3.6ml of preparation</i> |
| $\frac{10,000\text{mg}}{100\text{ml}} = 100\text{mg/ml}$ | $\frac{100\text{mg}}{\text{ml}} = \frac{X\text{mg}}{3.6\text{ml}} \quad x = 360\text{mg of caffeine citrate}$ |

Correct Calculation

1L = 1000ml 10g = 10,000mg

| | |
|--|---|
| <i>Actual concentration of preparation</i> | <i>Resultant dose of 3.6ml of preparation</i> |
| $\frac{10,000\text{mg}}{1000\text{ml}} = 10\text{mg/ml}$ | $\frac{10\text{mg}}{\text{ml}} = \frac{X\text{mg}}{3.6\text{ml}} \quad x = 36\text{mg of caffeine citrate}$ |

Case 2

A prescription is written for 200 mg of an antibiotic to be given by mouth every 8 hours for 10 days. The antibiotic comes in an oral suspension in a concentration of 100mg/5ml, and is available in a 150ml bottle. One bottle of the antibiotic costs \$600. The technician filled the prescription and reconstituted 6 bottles of the antibiotic and prepared the label for the pharmacist to check. The pharmacist, visibly upset, looked at the technician and stated “you’ve just cost us \$2,400 dollars”.

This is an example in which an incorrect medication calculation did not necessarily harm a patient, but was nonetheless an expensive error. In this case, the technician calculated the total bottles needed to be dispensed as if the medication were to be given 8 times a day rather than 3 times a day. Had this calculation been missed, the patient may have thought that the remaining medication should be saved for use at a later date, or may have continued to take the medication until all 6 bottles were taken. If this medication were not covered on the patient’s insurance plan, or if the patient was a cash paying customer, they may have paid for medication that they did not need.

Technician’s Calculation (incorrect calculation)

Dose in milliliters

$$\frac{100\text{mg}}{5\text{ml}} = \frac{200\text{mg}}{X} \quad \text{Solving for X:} \\ X = 10\text{ml per dose}$$

Total volume per day

$$10\text{ml} \times 8 \text{ times a day} = 80\text{ml (source of error)}$$

Total volume for 10 days

$$80 \text{ ml/day} \times 10\text{days} = 800\text{ml}$$

Total bottles to dispense

$$\frac{1 \text{ bottle}}{150 \text{ ml}} = \frac{X \text{ bottles}}{800 \text{ ml}} \quad \text{Solving for X:} \\ X = 5.3 \text{ bottles or 6 bottles}$$

Total cost of 6 bottles

$$\$600 \times 6 \text{ bottles} = \$3600$$

Correct Calculation

Dose in milliliters

$$\frac{100\text{mg}}{5\text{ml}} = \frac{200\text{mg}}{X} \quad \text{Solving for X:} \\ X = 10\text{ml per dose}$$

Total volume per day

$$10\text{ml} \times 3 \text{ times a day} = 30\text{ml}$$

Total volume for 10 days

$$30\text{ml} \times 10\text{days} = 300\text{ml}$$

Total bottles to dispense

$$\frac{1 \text{ bottle}}{150\text{ml}} = \frac{X \text{ bottles}}{300\text{ml}} \quad \text{Solving for X:} \\ X = 2 \text{ bottles}$$

Total cost of 2 bottles

$$\$600 \times 2 \text{ bottles} = \$1200$$

Cost of calculation error

$$\$3600 - \$1200 = \$2400$$

Tips to help minimize calculation errors

Pharmacy technicians play a very important role in the prescription filling process, and play a very important role in ensuring that patients receive not only the correct medication, but also the correct medication *dose*. In order to do this, pharmacy technicians must be able to confidently and accurately calculate doses for prescription orders. Adoption of a few tips such as those listed below can help minimize the chances of making a calculation error.

- 1. Show your work:** While attempting to perform simple calculations in your head, it is important to remember that a simple error can lead to severe medical misadventures and even death. Therefore, even the simplest pharmacy calculation should be completed on paper. There are a number of activities that take place simultaneously in the pharmacy. As a result, the chances of becoming distracted or interrupted while performing a calculation are very high. Doing something such as working a calculation on paper can help you to stay focused. Additionally, if you are interrupted, you have a record of where in the calculation you were before you had to stop.
- 2. Include units in all calculations:** When performing calculations using the dimensional analysis method, including units is imperative. However, including units when using the ratio and proportion method is just as important. Including the units in the calculation can not only help determine if the calculation is set up properly, units can also provide a cursory way to initially double check your answer. For example, if a dose is needed in milliliters, but the answer after calculating the dose is in milligrams, this should be a key sign that the calculation was performed inaccurately.
- 3. Use leading zeros left of the decimal:** Writing a dose or volume without a leading zero can lead to a major dosing error. A dose of “.5mg” can be mistaken as “5mg”, or when written by hand, “1.5mg”. To prevent this error from occurring, technicians should make it a habit to add the leading zero, so that “.5 mg” is written as “0.5mg”.
- 4. Check, check and check again:** After performing the calculation, ask if the answer makes sense, especially if the dosing, day supply, or quantity dispensed seems unusually higher or lower than what is typically seen. For example, if a calculation results in dispensing 10 bottles of an antibiotic to a child, when only one bottle is usually dispensed, there may be an error in calculation due to a misplaced decimal point, incorrect metric conversion, or the addition of an extra zero by mistake.

Summary

Pharmacy technicians, regardless of the practice setting, will have the responsibility of performing pharmacy calculations. Whether calculating the day supply of an oral medication, drawing up an IV dose for a neonate, preparing an IV admixture, or compounding an extemporaneous preparation, performing an accurate calculation is a very important step in the process. The process of performing accurate calculations involves becoming confident in computing calculations. One can develop confidence with practice and periodic review of pharmacy calculation concepts. Incorporating tips to help minimize calculation errors is also important when performing accurate pharmacy calculations.

Pharmacy Calculation Practice Resources

The following texts are great sources to refer to for more practice with calculations as well as for an overview of basic calculation concepts.

ASHP Pharmacy Technician Certification Review and Practice Exam, 3rd Ed

Author: Barbara Lacher

ISBN: 978-1-58528-208-1

This text is designed to help technicians prepare for the certification exam. This text provides a review on calculations. This text comes with a CD that contains additional practice questions to aid in preparing for the certification exam.

Manual for Pharmacy Technicians, 4th Ed

Editor: Bonnie S. Bachenheimer BS, PharmD

ISBN: 978-1-58528-207-4

This text provides an overview of the many functions related to the pharmacy technician. There is one chapter dedicated to pharmacy calculations in this text.

Math Calculations for Pharmacy Technicians

Authors: Robert and Eugenia Fulcher

ISBN: 978-0-7216-0642-2

This text provides an overview of calculations performed in inpatient and outpatient pharmacy. Each chapter provides practice problems, however the answer key only provides answers for the odd numbered problems.

Math for Pharmacy Technicians

Author: Lorraine C. Zentz

ISBN: 978-0-7637-5961-2

This text provides a concise, step by step method of performing pharmacy calculations performed in inpatient and outpatient settings. Each chapter provides practice problems as well as a chapter quiz. The second half of the book provides an answer key. Each answer in the key is worked out, to help the student understand the calculation methods used.

Pharmaceutical Calculations, 13th Ed

Author: Howard Ansel, PhD.

ISBN: 978-1-58255-837-0

This text provides a comprehensive overview of calculations performed in inpatient and outpatient pharmacy. Each chapter provides a multitude of practice problems along with answer keys. Additionally, this text has a web component that provides access to a quiz bank, thus allowing further calculation practice.

Pharmaceutical Calculations for the Pharmacy Technician, 1st Ed

Author: Barbara Lacher

ISBN: 978-0-7817-6310-3

This text provides a comprehensive, yet easy to understand overview of pharmacy calculations performed in inpatient and outpatient pharmacy. Each chapter provides a number of problems, which are review sets and practice problems. An answer key is available for the review sets in the back of the text. This text also comes with a CD that contains more practice problems and a quiz bank, as well as a website that offers more practice problems.

References

1. Lacher B. Fundamentals of Calculations. In: Lacher B. *Pharmaceutical Calculations for the Pharmacy Technician*. Baltimore, MD: Lippincott Williams & Wilkins; 2008:1-36.
2. Lacher B. Systems of Measure. In: Lacher B. *Pharmaceutical Calculations for the Pharmacy Technician*. Baltimore, MD: Lippincott Williams & Wilkins; 2008:37-65.
3. Lacher B. Calculations of Oral Doses. In: Lacher B. *Pharmaceutical Calculations for the Pharmacy Technician*. Baltimore, MD: Lippincott Williams & Wilkins; 2008:117-148.
4. Lacher B. Calculations of Pediatric Dosea. In: Lacher B. *Pharmaceutical Calculations for the Pharmacy Technician*. Baltimore, MD: Lippincott Williams & Wilkins; 2008:149-167.
5. Lacher B. Intravenous Rate of Flow Calculations. In: Lacher B. *Pharmaceutical Calculations for the Pharmacy Technician*. Baltimore, MD: Lippincott Williams & Wilkins; 2008:273-292.
6. Lacher B. Reducing and Enlarging Formulas. In: Lacher B. *Pharmaceutical Calculations for the Pharmacy Technician*. Baltimore, MD: Lippincott Williams & Wilkins; 2008:168-180.
7. Genentech. Directions for the Emergency Compounding of an Oral Suspension From Tamiflu Capsules (Final Concentration = 15 mg/mL). Website. available at: http://www.tamiflu.com/hcp/resources/hcp_resources_pharmacists.jsp. Accessed 11/16/2010.
8. Allen LV. Contemporary Compounding: Betamethasone Valerate 0.1% Topical Gel. *US Pharmacist*. 2008; 33(1):46-47.
9. Lacher B. Percentage, Ratio Strength, and Other Expressions of Concentration. In: Lacher B. *Pharmaceutical Calculations for the Pharmacy Technician*. Baltimore, MD: Lippincott Williams & Wilkins; 2008:181-206.
10. National Coordinating Council for Medication Error Reporting and Prevention. About Medication Errors. At <http://www.nccmerp.org/aboutMedErrors.html> accessed April 26, 2011.
11. Nahata MC, Pai VB, and Hipple TF, *Pediatric Drug Formulations*, 5th ed, Cincinnati, OH: Harvey Whitney Books Co, 2004.
12. Skillman K, Caruthers R, Johnson C. Stability of an extemporaneously prepared clopidogrel oral suspension. *Am J Health-Syst Pharm*. 2010; 67:559-61.
13. Hutchinson D, Johnson C, Klein K. Stability of extemporaneously prepared moxifloxacin oral suspensions. *Am J Health-Syst Pharm*. 2009; 66:665-7.

VOLUME 16 NO. 3
Pharmacy Calculations Review
SELF-ASSESSMENT QUESTIONS 1 — 20

1. A patient is to take 40 units of insulin each day. If there are 100 units in each ml of insulin, how many ml will the patient need to take each day?
 - A. 0.25
 - B. 0.4
 - C. 2.5
 - D. 4
2. The pharmacy has 1ml vials of heparin, each of which contain 5000 units. How many milliliters do you need for a dose of 1100 units?
 - A. 0.22
 - B. 0.55
 - C. 2.2
 - D. 4.54
3. A children's allergy syrup contains 2mg of antihistamine in each 15ml dose. How many milligrams of antihistamine would be contained in a 120ml bottle of the allergy syrup?
 - A. 10
 - B. 16
 - C. 48
 - D. 240
4. A prescription for 600mg of ibuprofen is to be taken every 8 hours. If there are only 200 mg tablets in stock, how many tablets will be needed for a five day supply?
 - A. 5
 - B. 15
 - C. 30
 - D. 45
5. A prescription calls for a total of 88 micrograms of levothyroxine. What is the equivalent amount in milligrams?
 - A. 0.088
 - B. 0.88
 - C. 880
 - D. 88,000
6. If one codeine capsule contains 30mg, how many grams of codeine is in 50 capsules?
 - A. 1.5
 - B. 15
 - C. 150
 - D. 1500
7. A patient has to receive 300 mg of a medication four times a day. If the medication comes in a concentration of 40mg/ml, how many teaspoonsful would be equal to the 300 mg dose?
 - A. $\frac{1}{2}$
 - B. 1
 - C. $1\frac{1}{2}$
 - D. $7\frac{1}{2}$
8. Referring to question 7, if the patient is to take the medication for 10 days, how many ounces of the medication would need to be dispensed?
 - A. 3
 - B. 7
 - C. 10
 - D. 50
9. Instructions call for a patient to take 2 teaspoonsful of an antibiotic on day 1, followed by 1 teaspoonful daily for the next 4 days. How much of the antibiotic, in ounces, should be dispensed?
 - A. 1
 - B. 3
 - C. 15
 - D. 30
10. A patient has to take 750 mg of a medication twice daily for 7 days. How many tablets should be dispensed if the medication is available as 500 mg scored tablets?
 - A. 11
 - B. 21
 - C. 28
 - D. 45

11. How many days will this prescription last?

Metformin 500mg tablets

60 tablets

SIG: 1 gram po BID

- A. 15
- B. 30
- C. 60
- D. 90

12. A child weighs 8 lbs. If the dose for a medication is 100mg/kg, how many milligrams should the child receive per dose?

- A. 364
- B. 400
- C. 800
- D. 1760

13. The recommended dose for a medication is 20mg/m². What is the dose, in milligrams, for a patient with a BSA of 0.85 m²?

- A. 9.8
- B. 12
- C. 17
- D. 23

14. Calculate the flow rate, in ml/hr, for 5 L of D5W that is to be infused over 24 hours.

- A. 52
- B. 69
- C. 83
- D. 208

15. Calculate the flow rate in drops/minute when a 500 ml bag of D5W is infused over 8 hours with a drip set of 10drops/ml.

- A. 1
- B. 10
- C. 63
- D. 625

16. 15g of a drug is ordered in 1500ml of fluid to be run so that 5mg of the drug is given per minute. Calculate the flow rate in ml/min.

- A. 0.5
- B. 5
- C. 10
- D. 300

17. A prescription for an oral suspension calls for 360 ml to be dispensed. The recipe for the suspension is as follows¹²:

Clopidogrel 75mg tablets 300mg

Ora-Plus® 30 ml

Ora-Sweet® 30 ml

To make 60 ml

Calculate the amount of clopidogrel in grams needed to make this prescription.

- A. 0.3
- B. 1.8
- C. 300
- D. 1800

18. A prescription for an oral suspension calls for 180 ml to be dispensed. The recipe for the suspension is as follows¹³:

Moxifloxacin 400mg tablets 1200mg

Ora-Plus® 30 ml

Ora-Sweet® 30 ml

To make 60 ml

Calculate the amount of moxifloxacin in milligrams needed to make this prescription.

- A. 3.6
- B. 36
- C. 360
- D. 3600

19. 450 mg of a drug is added to 500 ml of sterile water. Calculate the percent concentration of the drug.

- A. 0.09
- B. 0.9
- C. 9
- D. 90

20. How much sodium chloride in grams is needed to make 800ml of a ½ NS solution?

- A. 0.036
- B. 3.6
- C. 4
- D. 40

Need Extra Credit Fast? 2010 MODULES ARE STILL AVAILABLE!

Attention 2011 Pharmacy Tech Topics™ subscribers! You may purchase the 2010 modules at a special rate of **\$39.95***, if you haven't already received them. The 2010 modules offer 10 hours of accredited pharmacy continuing education credit for pharmacy technicians.

ONLY 2011 SUBSCRIBERS ARE ELIGIBLE TO RECEIVE THIS OFFER! Single modules are also available at the full price of \$17.95, but the full year for \$39.95 is a deal you can't beat! *Illinois residents must include 7.25% state sales tax. Total \$42.85 for 4-2010 modules.

Personal check made payable to: ICHP
Money Order
Credit Card**
Company P.O.**

PLEASE BILL MY:
 MasterCard Discover VISA American Express

Card#: _____
Expiration Date: _____ CVV2 Security Code #: _____
Signature: _____
Name on Card: _____

**Orders placed with a credit card or purchase order may be faxed to ICHP at (815) 227-9294. All orders must be accompanied by one completed order form for each technician. Refunds will not be issued on any processed subscriptions. Credit card orders will show up as an ICHP charge on your billing statement.

PLEASE PRINT CLEARLY OR TYPE:

TECHNICIAN NAME _____

MAILING ADDRESS _____ APT.# _____

CITY/STATE/ZIP _____

WORK PHONE: (_____) _____ HOME PHONE: (_____) _____

EMAIL: _____

PRIMARY PHARMACY PRACTICE SITE: Community Long-Term Care Pharmaceutical Industry Hospital
 Mail Order Military Home Health Other _____

To complete and receive your Pharmacy Tech Topics™ ONLINE, go to: www.pharmacytechttopics.com

Checks, money orders, and company purchase orders should be made payable to:
Illinois Council of Health-System Pharmacists (ICHP)
4055 N. Perryville Road • Loves Park, Illinois 61111-8653
Phone (815) 227-9292 Fax (815) 227-9294

| |
|---|
| <p>2010 <i>Pharmacy Tech Topics™ Modules</i></p> <ul style="list-style-type: none"> • Volume 15 Number 1: January 2010 Medication Safety From a Regulatory Aspect Expiration Date: January 31, 2012 (2.5 contact hours of law CPE) • Volume 15 Number 2: April 2010 Smoking Cessation Update Expiration Date: April 30, 2012 (2.5 contact hours CPE) • Volume 15 Number 3: July 2010 Alzheimer's Disease and Dementia Expiration Date: July 31, 2012 (2.5 contact hours CPE) • Volume 15 Number 4: October 2010 Peptic Ulcer Disease Expiration Date: October 31, 2012 (2.5 contact hours CPE) |
|---|

**IN ORDER TO RECEIVE A STATEMENT OF CREDIT VIA MAIL,
PLEASE READ THE FOLLOWING SUBSCRIBER REQUIREMENTS ...**

1. We must receive the July 2011 Pharmacy Calculations Review Module's COMPLETED Evaluation Form and Answer Sheet by July 31, 2013. A score of 70% must be achieved in order to receive credit. Answers to the self assessment questions on pages 26-27 should be circled in the space on page 30. Participants scoring below 70% will be notified and permitted to retake the exam two (2) times within the limits of the validation dates. **This course is valid from July 1, 2011 to July 31, 2013.**
2. Subscribers must keep the original examination sheet for your records and send in a **photocopy or fax** to (815) 227-9294.
3. Be sure to complete the entire **EDUCATIONAL EVALUATION FORM AND EXAMINATION ANSWER SHEET FOUND ON PAGE 30**, including the name and address section, especially any change of name, address, email, or phone number. Without a complete name and address on the exam sheet, it will be discarded.
4. Pharmacy Tech Topics™ examination sheets will be graded in the order in which they are received. We do not fax back graded tests or statements of credit. Please allow 4 - 6 weeks for delivery of your statement of credit via mail.
5. Only original Pharmacy Tech Topics™ subscribers are eligible to receive continuing pharmacy education credit for any Pharmacy Tech Topics™ module.
6. After completing the Educational Evaluation Form and Examination Answer Sheet, mail or fax it to:

ICHP (Pharmacy Tech Topics™)

4055 N. Perryville Road

Loves Park, IL 61111-8653

Fax: (815) 227-9294

Phone: 815-227-9292

Update!

If you pass your exam but select any incorrect answers, **we now provide a copy of the test marked with the correct answers.** This information will help you complete the learning process.

In order to receive your CPE Certificate, you **MUST FILL OUT** both the Educational Evaluation Form AND the Answer Sheet below!

EDUCATIONAL EVALUATION FORM

PROVIDER: Illinois Council of Health-System Pharmacists
 TITLE OF MODULE: Pharmacy Calculations Review
 DATE(S): 07/01/11 to 07/31/13
 ACPE Universal Activity Number: 121-000-11-003-H04-T Type of Activity: Knowledge

COMPLETE THIS EVALUATION FORM USING THE RATING SCALE BELOW

Use the following rating scale and circle the appropriate number:

- | | |
|------------------|---------------------------------------|
| 5 AGREE STRONGLY | 3 NO OPINION, NEUTRAL, DOES NOT APPLY |
| 4 AGREE | 2 DISAGREE |
| | 1 DISAGREE STRONGLY |

As a result of this module, I feel I have achieved the following objectives:

- | | |
|---|-----------|
| 1. Compute pharmacy problems by using ratio and proportion or dimensional analysis. | 5 4 3 2 1 |
| 2. Compare and convert units among the pharmacy math systems, especially the metric system. | 5 4 3 2 1 |
| 3. Calculate quantity and day supply. | 5 4 3 2 1 |
| 4. Calculate doses based on weight and body surface area. | 5 4 3 2 1 |
| 5. Calculate intravenous (IV) flow rates. | 5 4 3 2 1 |
| 6. Reduce and enlarge compounding formulas. | 5 4 3 2 1 |

Please use the rating scale above to answer the questions below:

- | | |
|---|-----------|
| • Rate the relationship of the objectives to the overall purpose or goal of the module. | 5 4 3 2 1 |
| • The information presented will be useful in my work. | 5 4 3 2 1 |
| • This program presented information in a balanced and unbiased manner. | 5 4 3 2 1 |

RATE THE EXPERTISE OF THE AUTHOR

| <i>AUTHOR</i> | Demonstrates knowledge of subject matter | Uses appropriate teaching strategies |
|--------------------------|--|--------------------------------------|
| Yolanda M. Hardy, PharmD | 5 4 3 2 1 | 5 4 3 2 1 |

CONTINUING PHARMACY EDUCATION CREDIT REQUEST FORM

Pharmacy Calculations Review

JULY 2011 VOLUME 16 NO. 3 ACPE Universal Activity Number: 121-000-11-003-H04-T

PLEASE CIRCLE ONE LETTER FOR EACH QUESTION FROM THE EXAMINATION SHEET:

| | | | |
|------------|-------------|-------------|-------------|
| 1. A B C D | 6. A B C D | 11. A B C D | 16. A B C D |
| 2. A B C D | 7. A B C D | 12. A B C D | 17. A B C D |
| 3. A B C D | 8. A B C D | 13. A B C D | 18. A B C D |
| 4. A B C D | 9. A B C D | 14. A B C D | 19. A B C D |
| 5. A B C D | 10. A B C D | 15. A B C D | 20. A B C D |

NAME _____

ADDRESS _____ APT NO. _____

CITY/STATE/ZIP _____

DAYTIME PHONE (_____) _____ E-MAIL ADDRESS _____

THIS IS A CHANGE IN MY: LAST NAME ADDRESS PHONE, OR E-MAIL.

MAIL FORMS TO: PTT; 4055 N Perryville Road; Loves Park, IL 61111 • FAX TO: 815-227-9294

FUTURE PHARMACY TECH TOPICS™ SURVEY

What do you find most beneficial from subscribing to Pharmacy Tech Topics™?

What changes or suggestions do you have for future Pharmacy Tech Topics™ modules?

What other topics would you like to see in future issues of Pharmacy Tech Topics™?

Please photo copy and return this completed survey with your answer sheet to help us improve Pharmacy Tech Topics™.

Fax: 815-227-9294

Pharmacy | tech topics™

by Illinois Council of Health-System Pharmacists

July 2011 VOLUME 16 NUMBER 3
Pharmacy Calculations Review
Expiration Date: July 31, 2013