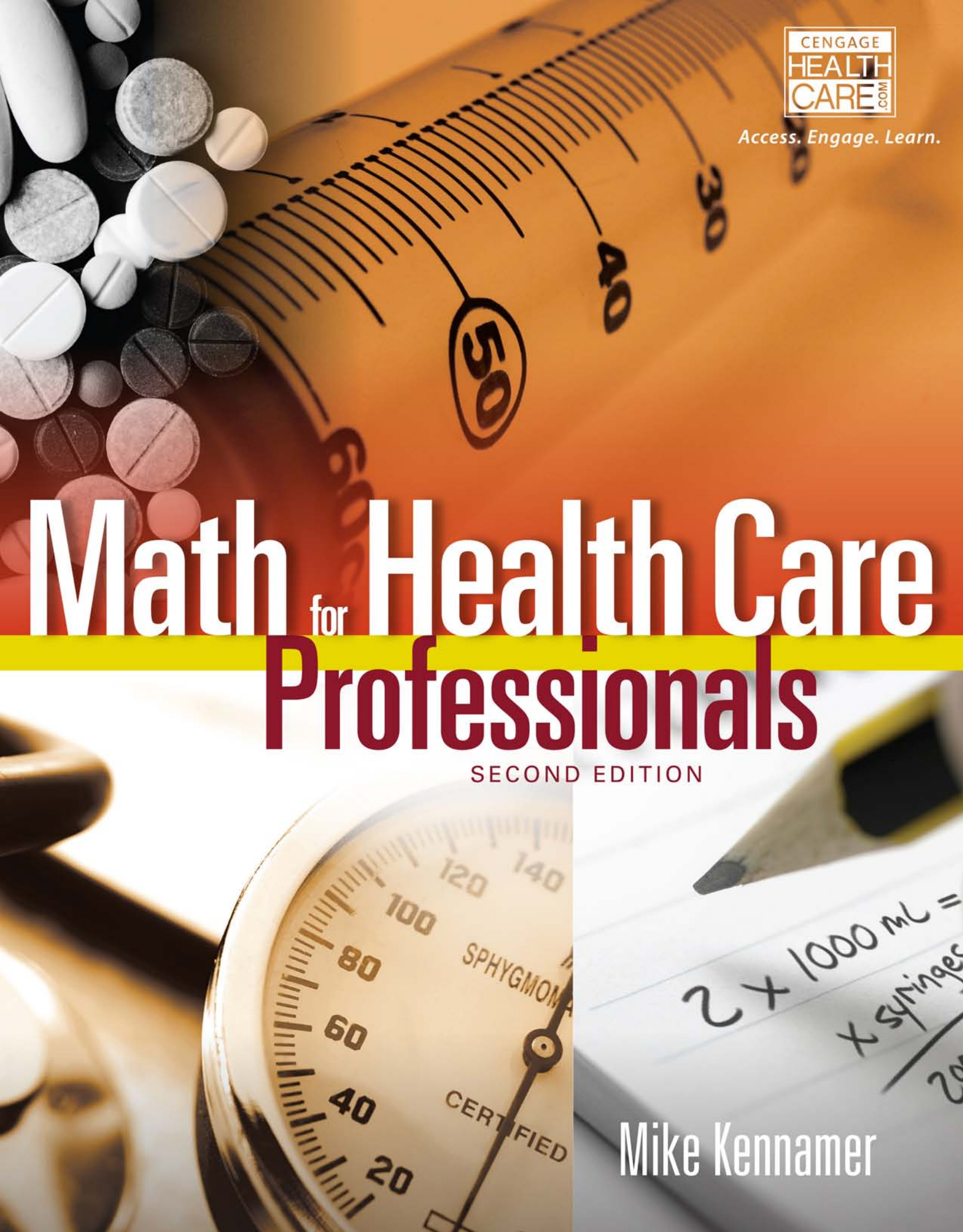
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Math for Health Care Professionals

SECOND EDITION

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To Trisha:

Nobody has ever made me smile as much as you do. Thanks for being my best friend and partner in life.

Contents

Preface

Math for Health Care Professionals provides a comprehensive mathematics text for students enrolled in, or interested in, any of the health care professions. Written at a level appropriate for both secondary and postsecondary students, *Math for Health Care Professionals* uses a unique competency-based approach in which instructors assess individual student abilities and prescribe learning activities that support the learning needs of each student. Whether used in the classroom or for independent study, the organization and structure of this book meets the learning needs of each student.

This book was written with both the instructor and student in mind. Instructors will enjoy the flexibility of selecting only the skills needed for each student from a cafeteria-style format. Instructors can also assign self-assessment pretests for each chapter to assess the knowledge and skills of each student. These assessments will help the instructor focus on the skills most needed by each student.

Students will enjoy the easy-to-read format and will benefit from thorough explanations of each concept presented. Of special interest to students will be the *Math in the Real World* features, where actual health care professionals share their thoughts on the importance of mathematics in everyday life. Other features important to students include self-assessment pretests, multiple opportunities for practice, and an excellent workbook that provides tremendous opportunities for directed practice.

ORGANIZATION

This text is organized in a logical fashion that helps the student move from understanding the basic principles to mastering more complicated operations. The student then uses these principles to perform application-level functions that require technical knowledge and critical-thinking skills.

Unit 1 describes the importance of mathematics as a function of health care professionals. Unit 2 clearly explains the skills that are vitally important for health care professionals, and Unit 3 puts these skills into action with actual health care applications. Unit 4 provides students with a collection of resources that will be helpful throughout their careers.

FEATURES

- **Learning objectives** for each chapter are clear and measurable.
- **Key terms** listed at the beginning of each chapter are shown as bold in the text and defined both in the chapter and in the glossary.
- **Math in the Real World** is a feature of each chapter that highlights a health care professional explaining the importance of mathematical skills for health care professionals.
- A **Self-Assessment Pretest** allows the student to assess competency in each of the skills covered by the chapter learning objectives.
- **Skill Sharpener exercises** are offered after each section to give the student additional practice on each skill.
- **Review and Reflect** sections provide thought-provoking questions to exercise critical-thinking skills.

NEW TO THE SECOND EDITION

- **Mindtap** online student resources
- Three new chapters: Essentials of Pre-Algebra and Geometry, Introduction to Medical Research, and Application of Statistical Principles in Health Care
- New objectives in existing chapters

ALSO AVAILABLE

For the Student

***Workbook to Accompany* Math for Health Care Professionals**

Order number 978-1-305-50979-5

The workbook provides hundreds of questions for practice and mastery of each of the objectives included in the book.

Math for Health Care Professionals Quick Review

Order number 978-1-305-50981-8

This quick review guide is intended for those with prior demonstrated knowledge of basic mathematical principles. It serves as review and, accordingly, does not include the self-assessment pretests found in the core book. It is ideal for those who need a quick refresher of mathematical concepts.

For the Instructor

Instructor's Companion Website to Accompany Math for Health Care Professionals

Order number 978-1-305-50980-1

This handy instructor resource includes answers to all the problems in the book, workbook, and quick review guide. It provides assessment and evaluation tools that will help instructors direct students to areas that require the most attention.

ABOUT THE AUTHOR

Mike Kennamer is a graduate of the paramedic program at Gadsden State Community College in Gadsden, Alabama. He holds a B.S. in public safety administration from Athens State University in Athens, Alabama; an M.P.A. from Jacksonville State University in Jacksonville, Alabama; and an Ed.D. in Higher Education Administration from the University of Alabama.

Dr. Kennamer currently serves as Director of Workforce Development at Northeast Alabama Community College in Rainsville, where he is responsible for economic, workforce, and community development and serves as instructional officer for career and technical education programs. He also serves as president/CEO of Kennamer Media Group, Inc., a boutique content development and content management company that provides writing, editing, designing, and photographic services to select clients.

Kennamer is the author of *Basic Infection Control for Health Care Providers 2nd edition,* also published by Cengage, and he has authored articles, instructor resource manuals, test banks, online course content, and video scripts for other major textbook publishers.

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The author also wishes to recognize the valuable contributions of those individuals who participated the *Math in the Real World* features. Their experience and expertise is of tremendous value to the students who will learn from these professionals. Those who participated include the following:

Retained from first edition

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Dakota Mitchell – subject of photo (Unit 3 title page)

The Cengage Learning team of Laura Stewart (Product Manager), Debbie Bordeaux (Content Developer), and Ken McGrath (Senior Content Product Manager) have been great to work with and transformed my computer-generated manuscript and hand-scribbled drawings into the attractive book you are now holding.

FEEDBACK

The author is interested in hearing from anyone who would like to offer suggestions or constructive criticism for future editions of this book. Also, health care professionals who are interested in participating in the *Math in the Real World* segment in future editions should contact the author through Cengage Learning or directly by email at mike@kennamer.net.

To the Reader

Welcome to the exciting and rewarding field of health care. Regardless of the health care profession you pursue, be assured that your chosen profession will be one that impacts the lives of other people on a daily basis. Your work as a health care professional will be valuable, and your studies in preparing for that career are equally important.

This book is a tool to help you ensure success in your chosen field of study. The skills and abilities you learn through this book include some that you will continue to use in daily life. Please take the time necessary for study to ensure that you have mastered each of the objectives presented.

STUDY TIPS

You may find that this textbook is set up differently from others you have used. Most books present a list of learning objectives and then cover each of the objectives somewhere within the chapter. This book is a little different in that it lists a learning objective and then immediately discusses that objective.

It is important to understand the value of objectives. Objectives are much like goals. In other words, each learning objective listed in this book is like a learning goal. Perhaps you can approach your study with that concept in mind. As you progress to each learning objective, make mastering the knowledge, skill, or ability in that objective your goal for that period in time. Work on that objective until you achieve mastery, and then progress to the next objective.

This book is also set up in such a way that your instructor may tell you to skip one or more objectives. This may be because your instructor has evidence that you have already mastered a specific objective or set of objectives or because a specific objective or group of objectives do not relate to your field of study. Please understand that this represents sound educational theory, but realize that you may, if necessary, work on objectives that are not assigned if you believe you need additional work in a particular area.

The accompanying workbook is very helpful in this regard and offers dozens of questions for you to practice. Please consider using this resource for additional practice that will lead to mastery of your mathematical skills.

CALCULATORS AND APPS

Calculators are valuable tools and are used regularly in health care. However, a good health care professional should understand how to calculate any problem in this book without the aid of a calculator. If your instructor allows you to use a calculator, use it as a valuable tool, but also practice working some of the problems without a calculator so that you will understand how to solve problems when a calculator is not available.

A number of health care apps are available for smartphones that will help you do anything from calculate BMI to figure drug dosages. These apps may prove to be very helpful and should be used when appropriate. However, they do not take the place of the knowledge, skills, and ability to make these calculations by hand.

Many of you will take certification and/or licensure exams as you progress in your health care career. Keep in mind that many of the certification and licensing agencies do not allow the use of a calculator or apps during testing. Learn the requirements for the exam(s) that you will take and practice accordingly.

CONCLUSION

I hope that you find as much enjoyment during your career as a health care professional as I have had as a field paramedic and a paramedic instructor, then later as a community college administrator. Whatever you decide to do—whether you enter a career in health care or not—do what you enjoy.

In the years since I wrote the first edition of this book, my three sons have grown up and entered careers of their own. One is a marketing professional, and the other two followed in my footsteps, entering the exciting world of public safety—one as a firefighter/EMT and the other as a firefighter/Advanced EMT—and both are continuing their education. It is exciting to see them exhibit the same passion for their work that led me to enter the same field more than 30 years ago. That passion is palpable, whether you are a firefighter/EMT running EMS calls or a nursing assistant caring for patients in an extended care facility.

Your patients will be able to tell if you really enjoy your work. Your attitude will reflect on the care you provide and how you interact with co-workers, your patients' families, and others with whom you come in contact. Let your patients know you care and that you are there to give them the best possible care. I wish you the very best in your career!

Unit 1

Introduction

This unit provides evidence that mathematics is a valuable skill used by health care professionals on a daily basis. As a vital health care tool, mathematics helps health care professionals provide the best care to patients.

Although each health care field holds its own unique set of requirements and skill competencies, *every* health care discipline requires competency (at varied levels) in math skills. A strong foundation in mathematics is essential to success in the health care field.

Chapter 1

Math as a Health Care Function

Key Terms

- hard skills
- soft skills

Learning Objectives

After completing this chapter, the reader will be able to:

1.1 List at least three ways math is used in everyday life.
1.2 Recognize mathematics as a vital health care skill.
1.3 List at least three ways math is used in different health care disciplines.
1.4 Recognize the importance of solving word problems.
1.5 Use technology to solve mathematical problems.

Math in the Real World

"Learning to do word problems as a kid is one of the most useful things you'll ever do. It's one of the first things you learn that ends up imitating everyday math skills that everyone needs! They train your brain to think in an organized, problem-solving way."

— Laurie A. Romig, MD, FACEP

Self-Assessment Pretest

1. List three ways you use math in everyday life.

2. Discuss the importance of math in your health care discipline.

INTRODUCTION

Every day, health care providers use the knowledge, skills, and abilities that come together as a skill set needed for a particular occupation. Among these skills are **hard skills**, such as starting intravenous lines and taking an x-ray, as well as **soft skills**, such as communicating with patients and their family members and reading (Figure 1-1). Both types of skills are vitally important to success in a health care career. However, students should have a firm foundation of soft skills upon which to build their hard skills, or technical expertise.

One of the most vital soft skills involves mathematics, which health care providers use daily in both their personal and professional lives. Think of all the ways numbers and mathematics are used on a daily basis. Could you function for even one day without math and numbers?

FIGURE 1-1 Health care professionals must possess both soft skills such as reading, math, and communication skills, and hard skills specifically related to their profession.

Objective 1.1 List at least three ways math is used in everyday life.

People from all walks of life use mathematics every day in a variety of ways. When you wake up to an alarm clock, a numerical system is telling you what time it is. To make coffee in the morning, you use proportions to mix the correct amount of coffee for the amount of water used. When driving to work, you may use fractions to check to see if you need gas in your car. You pay for your lunch with money, which is measured using decimals. The sales tax you pay is figured as a percentage and then added to your total. The soft drink you purchase may be packaged in a bottle measured in liters. As illustrated in Figure 1-2, math, as you may have determined by now, is an important part of your everyday life.

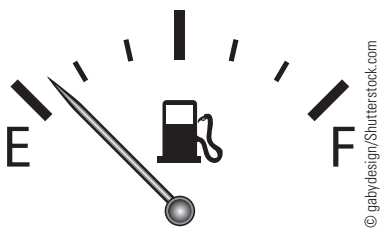

FIGURE 1-2 Just a few ways we use math in everyday life.

Objective 1.2 Recognize mathematics as a vital health care skill.

Health care providers use math as part of daily job skills. Many of the skills health care providers perform depend on mathematical calculations for accuracy. Health care providers use mathematical skills such as proportions and fractions when figuring medication dosages. Decimals are commonly used in medication calculations, and percents are used for many things, from intravenous fluid concentrations to oxygen administration.

Understanding the importance of math is vital to success in any health care discipline. Although different disciplines require varied levels of mathematical knowledge, health care providers at any level need a firm foundation of mathematics that, coupled with other basic soft skills such as written and oral communication, reading, and locating information, will help them to be successful.

Objective 1.3 List at least three ways math is used in different health care disciplines.

Regardless of the health care discipline you choose, you will find that math is an important skill. Figure 1-3 illustrates a variety of mathematical applications used by people in different health care fields.

FIGURE 1-3 Health care professionals use math every day in their jobs.

Objective 1.4 Recognize the importance of solving word problems.

Word problems are helpful in applying mathematical principles to real life situations. This problem-solving model allows the opportunity to analyze the information provided, formulate a plan, determine a solution, justify that solution, and evaluate the reasonableness of the solution. Word problems help the health care professional develop critical thinking and problem-solving skills.

Objective 1.5 Use technology to solve mathematical problems.

As stated in the preface, the health care professional should know how to work mathematical problems using only pencil and paper in the event that a calculator is not available or not allowed. However, calculators may be helpful tools and, when allowed by the instructor, should be used in conjunction with paper and pencil to help solve math problems.

Other technology, including smartphone apps, online apps, and tablet apps, are available and may be useful tools in automating repetitive functions such as calculating drug doses, determining body mass index, and converting between systems. However, it is important to note that, as with any technological device, mistakes in programming and data entry may occur. The health care professional should never solely depend on technology for critical patient care functions.

CONCLUSION

Throughout history, mathematics and numbers have been an important part of everyday life. Today we live in a world where evidence of the importance of math is all around us. Computers, for instance, operate on a numerical system called the binary system, which consists of only two digits—0 and 1.

A strong foundation of mathematical skills is key to success in health care, regardless of the health care discipline you plan to enter. Ratios and proportions, fractions, decimals, and percents are all considered vital in any health care profession.

REVIEW AND REFLECT

1. Other than mathematics, what are some soft skills that a health care professional should have?

_____

_____

_____

_____

_____

2. What are some of the soft skills that everyone in the workforce should have?

3. Which mathematical operations do you believe will be most helpful in your chosen field of study?

4. List at least three hard skills that you will learn in your program of study.

5. Describe why learning to do word problems is important to the health care professional.

6. Discuss how the health care professional may use technology to solve math problems.

7. Do you enjoy math? Why or why not?

Unit 2

Basic Principles

This unit provides a stable foundation of mathematical skills upon which the student may build. Each chapter features a self-assessment pretest that can be used to better understand individual strengths and identify areas where further study and practice are needed.

A thorough understanding of the principles discussed in this unit will help in the successful application of these principles when presented in Unit 3 and in actual practice.

Chapter 2

Numerical Systems

Key Terms

- Hindu-Arabic system
- numerical system
- Roman numerals

Learning Objectives

After completing this chapter, the reader will be able to:

2.1 List the common numerical systems in use today.
2.2 Convert Roman numerals to Hindu-Arabic numerals.
2.3 Convert Hindu-Arabic numerals to Roman numerals.

Math in the Real World

"Basic math is essential to doing the advanced part of math."

–Troy Colvin, Paramedic

Self-Assessment Pretest

Convert the following Roman numerals to Arabic.

1. IV _____
2. XIII _____
3. MCLIV _____
4. VI _____
5. VIII _____
6. XXVI _____
7. XIX _____
8. CXC _____
9. MCMLXXIII _____
10. MCMLXV _____

Convert the following Arabic numerals to Roman.

11. 2,006 _____
12. 18 _____
13. 98 _____
14. 3,466 _____
15. 231 _____
16. 778 _____
17. 465 _____
18. 2 _____
19. 72 _____
20. 102 _____

INTRODUCTION

Numerical systems, or organized systems for counting, are as old as civilization itself. For centuries, people have used numbers to trade with each other and to keep records. Whether they made scratch marks on a rock, or perhaps used pebbles or their fingers to count, people have used numbers throughout history.

Objective 2.1 List the common numerical systems in use today.

We commonly use the **Hindu-Arabic system** of numbers, though **Roman numerals** are still sometimes used. Although health care professionals are not frequently called upon to use Roman numerals, you should be able to convert from Roman to Hindu-Arabic numbers.

ROMAN NUMERALS

Almost 3,000 years ago, the people of ancient Rome developed a numerical system that is still used today, but only on a limited basis. This system has evolved from tick marks on a rock or the ground (as shown in Figure 2-1) into the additive system it is today. Numbers are read by adding and subtracting a series of symbols. The symbols used include the following:

I = 1	C = 100
V = 5	D = 500
X = 10	M = 1,000
L = 50	

FIGURE 2-1 Roman numerals are believed to have evolved from something as simple as tick marks on a rock.

These symbols are combined to create any number. If a symbol for a lower number is placed before another symbol, the lower symbol is subtracted from the other. If the lower symbol follows the larger symbol, the symbols should be added. For example, by placing the I in front of the V, we subtract 1 from 5. By placing the I after the V, we must add 1 to the 5.

I is equal to 1	I
II is equal to 2	I + I
III is equal to 3	I + I + I
IV is equal to 4	V − I
V is equal to 5	V
VI is equal to 6	V + I
VII is equal to 7	V + I + I
VIII is equal to 8	V + I + I + I
IX is equal to 9	X − I
X is equal to 10	X

The same principles apply to larger numbers as illustrated in the following examples.

Example

$$\begin{array}{rrrrrrrrrrrrr} X & + & X & + & V & + & I & + & I & = & XXVII \\ 10 & + & 10 & + & 5 & + & 1 & + & 1 & = & 27 \end{array}$$

Example

MCMXXXIV

$$\begin{array}{rrrrrrrrrrrrr} M & + & (M-C) & + & X & + & X & + & X & + & (V-I) & & \\ 1000 & + & (1000-100) & + & 10 & + & 10 & + & 10 & + & (5-1) & & \\ 1000 & + & 900 & + & 10 & + & 10 & + & 10 & + & 4 & = & 1934 \end{array}$$

HINDU-ARABIC NUMBERS

The numerical system ordinarily used in the United States is called the *Hindu-Arabic system*. This system was developed around 600 A.D. in India by the Hindus and was brought to the Western world by the Arabs about 100 years later. Today, we refer to this system as Hindu-Arabic or simply Arabic.

This system is based on the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. By combining these digits, any number can be represented.

Objective 2.2 Convert Roman numerals to Hindu-Arabic numerals.

To convert Roman numerals to Hindu-Arabic numbers, convert the Roman symbols to Hindu-Arabic symbols, and add or subtract as previously described. For example, to convert XVII to Hindu-Arabic numbers, first convert each of the Roman numerals to Hindu-Arabic as follows:

X = 10
V = 5
I = 1
I = 1

Then add these numbers to find the sum of 17.

$$10 + 5 + 1 + 1 = 17$$

Skill Sharpener

Convert the following Roman numerals to Hindu-Arabic numerals.

1. XXVI _____
2. DCLII _____
3. DCIII _____
4. MCLI _____
5. CXXXVIII _____
6. MCMLXV _____
7. MMI _____
8. MMMDXL _____
9. XXVI _____
10. DCLX _____

Objective 2.3 Convert Hindu-Arabic numerals to Roman numerals.

Convert Hindu-Arabic numerals to Roman numerals by using the same principles as converting Roman to Hindu-Arabic. For example, to convert the Hindu-Arabic number 129 to Roman numerals, first select the largest Roman numeral that equals a portion of this number.

$$C = 100$$

Subtract this number from the original number.

$$129 - 100 = 29$$

Now find the largest number that equals a portion of this number.

$$X = 10$$

Because X is the largest Roman numeral you can use, decide how many Xs are needed by dividing 10 into 29. The 10 will go into 29 twice; therefore, place two Xs to the right of the C.

$$CXX = 120$$

Subtract this number from the original number.

$$129 - 120 = 9$$

Because 9 can be represented as IX, add this to the right of the Roman numeral being created.

$$CXXIX = 129$$

Skill Sharpener 

Convert the following Hindu-Arabic numerals to Roman numerals.

1. 148 _____
2. 3,430 _____
3. 312 _____
4. 459 _____
5. 1,384 _____
6. 1,250 _____
7. 38 _____
8. 365 _____
9. 3,117 _____
10. 333 _____

CONCLUSION

Roman numerals are not commonly used in today's health care system. However, it is important that health care professionals know how to convert between Roman and Hindu-Arabic systems if necessary. The remainder of this book will focus on the Hindu-Arabic system.

REVIEW AND REFLECT

1. Are there numerical systems other than those discussed in this chapter? If so, please list.

_____

_____

_____

_____

_____

2. Other than medicine and health care, in what ways are Roman numerals used?

3. Why is the Roman number system referred to as an additive system?

4. In approximately what year did the Romans develop their numerical system?

5. When was the Hindu-Arabic system brought to the Western world?

Chapter 3

Measurement Systems

Key Terms

- apothecary system
- English system
- household system
- metric system

Learning Objectives

After completing this chapter, the reader will be able to:

3.1 List systems of measurement commonly used in the health care industry.
3.2 List and define key components of the apothecary system.
3.3 List and define key components of the household system.
3.4 List and define key components of the metric system.

Math in the Real World

"I commonly interact with people who routinely do use the metric system, and those who don't. I need to be able to convert numbers into the format that means the most to the individual. Telling a parent how many teaspoons or milliliters or "mLs" of a medicine to give is a great example. For example, I want the parent to give the child 150 mg of a liquid medication that comes in a concentration of 200 mg/mL. How many mL should the parent give the child? How do you convert that to teaspoons or tablespoons?"

— Laurie A. Romig, MD, FACEP

Self-Assessment Pretest

Match the following units of measure with the appropriate system by placing A, B, or C in the blanks.

A Apothecary system
B Household system
C Metric system

_____ **1.** minim
_____ **2.** gram
_____ **3.** hectoliter
_____ **4.** fluidram
_____ **5.** fluidounce
_____ **6.** grain
_____ **7.** tablespoon
_____ **8.** teaspoon
_____ **9.** cup
_____ **10.** pint

INTRODUCTION

Health care providers use a variety of measurement systems, and combinations of those systems, in carrying out tasks such as administering medication, weighing and measuring patients, and measuring intake and output. As a health care provider, you will be called on to use these measurement systems and to convert between systems.

Health care and medicine are as old as civilization itself. Ancient parchments tell of caring for the sick and injured. The measurement systems in use today include a combination of ancient systems, such as the apothecary and household systems, and the more modern metric system. Tradition has played a part in the hodgepodge of systems used today.

This chapter discusses each of the three measurement systems in use today. Although some are much more prevalent than others, it is important to understand the relationships of measurements within each system and how each system relates to each of the others. Conversions between systems will be covered in Chapter 9.

Objective 3.1 List systems of measurement commonly used in the health care industry.

Three systems of measurement are commonly used in the health care industry:

- apothecary system
- household system
- metric system

Although the **apothecary system** is not common today, it is still used in some situations, and health care professionals should be equipped to convert between this and other systems. Measurements such as dram, fluidram, and minim are examples of apothecary system measures.

It is important to be able to convert to the **household system** so that the health care professional can assist patients with converting from metric and apothecary systems to more familiar measures. The household system is also called the **English system** because it originated in England. Examples of household system measurements include teaspoon, tablespoon, cup, and glass.

Although the **metric system** is used on a limited basis in the United States, it is the system most used for medication administration. Milliliters, milligrams, grams, liters, and cubic centimeters are metric system measurements used in the health care profession. Each of these systems will be discussed further within this chapter.

Objective 3.2 List and define key components of the apothecary system.

The apothecary system is an old English system of weight in which whole numbers are represented by Roman numerals, and normal fractions are used to express fractional parts. One-half is sometimes expressed as “ss.” This system is most often used for measuring medication dosages using weight or volume.

APOTHECARY SYSTEM OF WEIGHT

The apothecary system of weight uses the terms and symbols illustrated in Figure 3-1. It is worth noting that in this system, 480 grains equals 1 ounce, and 12 ounces equals 1 pound. In contrast, in the household system, 16 ounces equals 1 pound.

Term	Abbreviation or Symbol
dram	dr or ʒ
grain	gr
ounce	oz or ℥
pound	lb

FIGURE 3-1 Apothecary units of weight

Therefore, you can expect to see medication orders using the apothecary system written as follows:

gr. vii	(7 grains)
℥ iii	(3 ounces)
ʒ ss	(1/2 dram)

Skill Sharpener

Write each of the following measurements using apothecary system symbols.

1. 4 grains _____
2. $\frac{2}{3}$ dram _____
3. 6 ounces _____
4. 4 pounds _____
5. $\frac{1}{200}$ of a grain _____
6. $\frac{1}{2}$ dram _____
7. 13 ounces _____
8. 2 pounds _____
9. 2 pounds and 9 ounces _____
10. $\frac{1}{2}$ grain _____

APOTHECARY SYSTEM OF VOLUME

The apothecary system of volume uses the terms illustrated in Figure 3-2. Though rarely used in today's health care professions, you should be able to convert between these and other systems.

Term	Abbreviation or Symbol
fluidounce	floz
fluidram	fldr or fl ℨ
gallon	gal
minim	m or ♏
pint	pt
quart	qt

FIGURE 3-2 Apothecary units of liquid volume

Skill Sharpener

Write each of the following measurements using apothecary system symbols.

1. 3 minims _____
2. 1 fluidram _____
3. 2 fluidounces _____
4. $\frac{1}{2}$ pint _____
5. 3 quarts _____
6. 3 gallons _____
7. 4 minims _____
8. 8 fluidounces _____
9. 5 fluidrams _____
10. $2\frac{1}{2}$ gallons _____

Objective 3.3 List and define key components of the household system.

The household system of measurement is primarily used when prescribing medication to be taken at home. Although the household system is not as accurate as other systems of measurement, health care providers must be familiar with it to instruct patients in taking correct dosages of their medications at home. Key components of the household system are listed in Figure 3-3.

Term	Abbreviation
drop	gtt
teaspoon	t or tsp
tablespoon	T or tbsp
teacup (6 oz)	tcp
cup or glass (8 oz)	C
pint	pt
quart	qt
gallon	gal
ounce	oz

FIGURE 3-3 Household units of measure

Objective 3.4 **List and define key components of the metric system.**

The metric system is used for many types of measurements in health care. Based on multiples of 10, metric measurements use whole numbers and decimals, rather than fractions, to express fractional parts.

METRIC PREFIXES AND SYMBOLS

The metric system uses prefixes that may be added to units of measure to alter their value. For instance, the prefix *kilo-*, meaning thousand, may be added to *meter* to signify 1,000 meters. In similar fashion, the prefix *milli-*, meaning thousandth, may be added to *meter* to signify one thousandth of a meter. Other metric prefixes and their symbols are shown in Figure 3-4.

Unit	Value	Symbol
mega-	1,000,000	M
kilo-	1,000	k
hecto-	100	h
deka-	10	da
base	1	
deci-	0.1 or 1/10	d
centi-	0.01 or 1/100	c
milli-	0.001 or 1/1000	m
micro-	0.000001 or 1/1,000,000	μ or mc

FIGURE 3-4 Metric prefixes

Skill Sharpener

Write the value that the following prefixes signify.

1. deci- _____
2. milli- _____

3. kilo- _____
4. centi- _____
5. deka- _____
6. hecto- _____
7. micro- _____

METRIC UNITS OF MEASURE

Metric measurements are used by health care providers to measure weight, length, and volume (Figure 3-5). Whether measuring great distances using kilometers or making miniscule measurements using micrometers, the base unit of measure is the same—the meter. Similarly, the liter is the base unit of measure for volume, and gram is the base unit of measurement for weight.

FIGURE 3-5 Though not widely embraced in the United States, the metric system is used for certain purposes, including health care and medicine.

Skill Sharpener 

For each of the following, note whether the term is used to measure volume, weight, or length, and whether the unit listed is a multiple of the base (ten, hundred, or thousand) or a fractional component (tenth, hundredth, thousandth, millionth) of the base.

		Measure of	Multiple or Fractional
1.	millimeter		
2.	milligram		
3.	microliter		
4.	milliliter		
5.	deciliter		
6.	dekaliter		
7.	hectometer		
8.	hectogram		
9.	kilogram		
10.	centimeter		

CONCLUSION

It is important for the health care provider to understand the relationships among each of the measurement systems. Although the apothecary system is rarely used today, it is sometimes seen. The ability to understand each system and its relationship to other systems, as well as how measurements within a single system relate, is important in the overall care of patients.

REVIEW AND REFLECT

1. Why do you suppose there is not just one system of measurement?

2. The metric system is based on multiples of _____.

3. Which measurement system do you think is the most precise? Why?

4. Which measurement system are you the most comfortable with? Why?

5. Which measurement system do you believe to be the best suited to medical care? Why?

Chapter 4

Whole Number Review

Key Terms

- addend
- average
- borrow
- difference
- dividend
- divisor
- factor
- mean
- minuend
- multiplicand
- multiplier
- place value
- product
- quotient
- remainder
- subtrahend
- sum
- whole number

Learning Objectives

After completing this chapter, the reader will be able to:

4.1 Define whole numbers.
4.2 Explain place values of whole numbers.
4.3 Compare whole numbers.
4.4 Order whole numbers.
4.5 Round whole numbers.
4.6 Add whole numbers.
4.7 Subtract whole numbers.
4.8 Multiply whole numbers.
4.9 Divide whole numbers.
4.10 Average whole numbers.

Math in the Real World

"I cannot overestimate the importance of estimation in my everyday life. Because I understand the principle that multiplication is really just another form of addition, and division is just another form of subtraction, I can quickly come up with pretty good estimates of a calculation before anybody else can drag out a calculator!"

— Laurie A. Romig, MD, FACEP

"I use basic math all the time, literally multiple times an hour."

— Kelly Smith, Pharm. D.

Self-Assessment Pretest

Circle the digit found in the ones place.

1. 24
2. 43
3. 68
4. 93
5. 1
6. 32
7. 998
8. 3,292
9. 56,632
10. 750

Circle the digit found in the tens place.

11. 124
12. 366
13. 89,977
14. 4,955
15. 324
16. 10,922
17. 390
18. 12
19. 13,545
20. 10

Circle the digit found in the hundreds place.

21. 123
22. 9,868
23. 13,243
24. 45,888
25. 990
26. 785
27. 78,900
28. 200
29. 43,542
30. 65,400

Circle the digit in the thousands place.

31. 13,390
32. 78,980
33. 32,434
34. 1,200
35. 9,878
36. 45,000
37. 125,000
38. 454,302
39. 500,964
40. 231,493

Circle the digit in the ten thousands place.

41. 14,390
42. 54,372
43. 299,987
44. 298,873
45. 12,098
46. 34,094
47. 150,990
48. 54,000
49. 893,804
50. 434,000

Circle the digit found in the hundred thousands place.

51. 756,321
52. 1,237,434
53. 34,343,665
54. 1,206,900
55. 2,987,655
56. 45,443,345
57. 656,959
58. 2,124,000
59. 456,222
60. 9,040,000

Compare the values of each of the following by inserting the greater than (>), less than (<), or equal (=) sign between the sets of whole numbers.

61. 643 _____ 762

62. 3,232 _____ 23,232

63. 654 _____ 644

64. 89,032 _____ 89,033

65. 76 _____ 67

66. 34,232 _____ 32,343

67. 323 _____ 343

68. 1 + 56 _____ 57

69. 78 − 9 _____ 69

70. 393 _____ 39 + 3

Place the following whole numbers in order beginning with the lowest value.

71. 1,234, 34,323, 54,323, 100 _____

72. 659, 657, 777, 343 _____

73. 656, 7686, 454, 654 _____

74. 112, 121, 111, 222 _____

75. 343, 342, 454, 544 _____

76. 343, 345, 346, 365 _____

77. 878, 873, 394, 493 _____

78. 300, 398, 392, 394 _____

79. 940, 483, 482, 849 _____

80. 984, 493, 345, 433 _____

Round the following numbers to the nearest ten.

81. 456 _____

82. 7,698 _____

83. 879 _____

84. 979 _____

85. 1,293 _____

86. 329 _____

87. 786 _____

88. 898 _____

89. 493 _____

90. 429 _____

Round the following numbers to the nearest hundred.

91. 3,502 _____

92. 54,534 _____

93. 34,610 _____

94. 1,204 _____

95. 78,642 _____

96. 22,032 _____

97. 4,324 _____

98. 55,332 _____

99. 98,932 _____

100. 430,043 _____

Round the following numbers to the nearest thousand.

101. 34,392 _____

102. 94,449 _____

103. 43,453 _____

104. 75,953 _____

105. 99,434 _____

106. 54,642 _____

107. 45,054 _____

108. 78,864 _____

109. 75,003 _____

110. 494,043 _____

Add the following whole numbers.

111. $12 + 2 =$ _____

112. $23 + 75 =$ _____

113. $123 + 876 =$ _____

114. $343 + 967 =$ _____

115. $67{,}909 + 45{,}433 =$ _____

116.
$$\begin{array}{r} 3{,}434{,}974 \\ +\ \ 83{,}332 \\ \hline \end{array}$$

117.
$$\begin{array}{r} 12{,}232 \\ +\ \ 513 \\ \hline \end{array}$$

118.
$$\begin{array}{r} 90{,}980 \\ +\ 353{,}304 \\ \hline \end{array}$$

119.
$$\begin{array}{r} 450{,}032 \\ +\ \ 393 \\ \hline \end{array}$$

120.
$$\begin{array}{r} 1{,}230{,}903 \\ 56{,}767 \\ +\ 45{,}322{,}856 \\ \hline \end{array}$$

Subtract the following whole numbers.

121. $\begin{array}{r} 456 \\ -\ 76 \\ \hline \end{array}$

122. $\begin{array}{r} 343 \\ -\ 98 \\ \hline \end{array}$

123. $\begin{array}{r} 12{,}576 \\ -\ 989 \\ \hline \end{array}$

124. $\begin{array}{r} 23{,}365 \\ -\ 6{,}786 \\ \hline \end{array}$

125. $\begin{array}{r} 34{,}327 \\ -\ 6{,}432 \\ \hline \end{array}$

126. $454{,}454 - 211{,}675 =$ _____

127. $344 - 279 =$ _____

128. $947 - 564 =$ _____

129. $4{,}543 - 3{,}321 =$ _____

130. $65{,}482 - 59{,}431 =$ _____

Multiply the following whole numbers.

131. $2 \times 23 =$ _____

132. $34 \times 241 =$ _____

133. $432 \times 873 =$ _____

134. $1{,}232 \times 530 =$ _____

135. $1{,}659 \times 563 =$ _____

136. $\begin{array}{r} 15{,}329 \\ \times\ 67 \\ \hline \end{array}$

137. $\begin{array}{r} 35{,}432 \\ \times\ 9{,}321 \\ \hline \end{array}$

138. $\begin{array}{r} 459 \\ \times\ 1{,}321 \\ \hline \end{array}$

139. $\begin{array}{r} 500 \\ \times\ 124 \\ \hline \end{array}$

140. $\begin{array}{r} 32 \\ \times\ 783 \\ \hline \end{array}$

Divide the following whole numbers. Show remainders.

141. $9\overline{)45}$ _____

142. $90\overline{)450}$ _____

143. $80\overline{)1{,}239}$ _____

144. $35\overline{)750}$ _____

145. $21\overline{)590}$ _____

146. 76,453 ÷ 293 = _____

147. 65,600 ÷ 25 = _____

148. 75,000 ÷ 370 = _____

149. 32 ÷ 8 = _____

150. 282 ÷ 4 = _____

Average the following whole numbers.

151. 9, 8, 9, 10, 7 _____

152. 12, 21, 19, 15, 20 _____

153. 432, 324, 456, 654, 321 _____

154. 90, 91, 21 _____

155. 900, 989, 780, 211 _____

156. 12,232, 22,213, 3,432, 323, 493 _____

157. 56, 75, 81 _____

158. 32, 31, 43, 34, 33, 33, 31 _____

159. 450, 457, 544, 543, 545 _____

160. 90, 99, 100, 98, 99, 96, 94, 95 _____