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- Master measurement system conversions
- Calculate basic IV flow rates and infusion times for IV therapy
- Grasp pediatric dosage calculations

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# *Medical Dosage Calculations*

FOR

# DUMMIES®

**by Dr. Richard W. Snyder, DO, and  
Barry Schoenborn**



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In addition to maintaining a full time clinical practice at Lehigh Valley Nephrology Associates, he has authored and coauthored several articles in peer-reviewed journals, including the *American Journal of Kidney Disease* and *Kidney International*. He has also presented at national meetings, including the National Kidney Foundation's Annual Meeting. In addition to being a coauthor of *Medical Dosage Calculations For Dummies*, he has written the book *What You Must Know About Kidney Disease: A Practical Guide to Conventional and Complementary Treatments*. He's also been interviewed regionally and nationally on both radio and television about integrative medicine and kidney disease. Beginning in January 2011, he can be heard weekly on his show, *Improve Your Kidney Health*, on VoiceAmerica Radio Health and Wellness Channel.

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# *Dedications*

## **Rich Snyder**

This book I dedicate to my mother, Nancy Snyder, herself a registered nurse and constant source of inspiration and encouragement.

I also dedicate this book to every nurse, every healthcare provider, and every caregiver out there. You are the unsung heroes and the ones that inspire hope and healing.

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## **Barry Schoenborn**

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# Introduction

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**W**hether you're currently working in a healthcare profession or studying in school, you've probably discovered that most healthcare jobs require some math — which is likely why you picked up this book.

Don't panic if you're intimidated by the mere mention of *math*. Most dosing math calculations are simple. At first glance, some dosing problems may seem pretty hard, but look closer. After you read them a few times, you'll see that most seemingly complex problems are really just a combination of simple calculations. After you read through the basics we cover in this book, you'll hit your forehead with the heel of your palm whenever you come up against a challenging-on-the-surface problem and say, "Yes! Of course! I sorta knew that all along, but now I really get it!"

## About This Book

This book puts a lot of medical dosing math into just a few chapters and in a very compact form. It's different from other medical dosage math books in four main ways.

- ✔ **It's all about dosing in the context of real medical conditions.** Our focus is giving you the right math for real-life situations, not just presenting math problems. We bring up dosing scenarios you just might deal with every day in a medical-surgical unit or in a rehab or homecare setting.
- ✔ **It's comprehensive.** It covers *all* the major areas in which you need to do dosing calculations. Other math books often don't give you the broad coverage you need.
- ✔ **It offers a great review of math basics and then explains the three main dosing calculation methods.** We begin by looking briefly at numbers, arithmetic, fractions, units, and conversions and then delve deeper into the more dosing-specific math you need to know to be a successful healthcare professional. We also offer many examples of solving dosing problems so you get plenty of practice.
- ✔ **It isn't dull (we hope!), as other math books tend to be.** Because it's a *For Dummies* book, you can be sure it's easy to read and includes just enough humor to keep you entertained.

As you start reading, remember: This book is a reference. You can start anywhere you like and jump around as your interest and needs change. But it's also a repair manual; it can help fill voids in your math background.

Some of the chapters are based on an aspect of medicine with particular dosing requirements (for example, pregnancy, insulin, and critical care), while others are based on particular methods of medication administration (for example, oral, injection, and intravenous). Some chapters also cover useful techniques, such as mixing insulin, splitting tablets, and managing an IV line. Regardless of the chapter's particular focus, though, you get plenty of practical, real-life examples to help you hone your dosage calculation skills.

**Note:** Unlike many *For Dummies* books, this one doesn't have a lot of light, humorous moments because so much in medical dosage calculations is critical. When patients' lives are on the line, we're certainly not going to make any jokes about the topics at hand.

## Conventions Used in This Book

We designed this book to be user-friendly, maybe even user-affectionate. The trouble is, we can't come to your school, hospital, or home and do the math for you. If we could, we'd drive right over and bring coffee and donuts!

To make things as user-friendly as possible, we've used the following conventions throughout the book:

- ✔ We *italicize* new terms in each chapter; these terms include technical names, slang names, and abbreviations. We follow each one with a short, plain English definition, and we sometimes give you pronunciation cues and word origins when helpful.
- ✔ Variables appear as *italics* in formulas (for example,  $3a + 4b = 10$ ).
- ✔ Drug names appear with their generic names first, followed by their commercial brand names (where they apply) in parentheses. For example, we say "hydrocodone (Vicodin)" to show you both the generic name and the brand name. In some cases, we use only the generic name. On subsequent references in a given example or section of text, we use only the generic name.
- ✔ We abbreviate units of measurement, just as you'll see them every day in your career. For example, we say *g*, not *gram*, and *mL*, not *milliliter*, wherever possible. (See Chapter 4 for more on units of measurement and Chapter 5 for more on appropriate abbreviations.)
- ✔ Web addresses appear in `monofont` to help them stand out. They're usually very short and shouldn't break across two lines of text. But if

they do, know that we haven't added any extra characters to indicate the break. Just type what you see into your Web browser.

- ✔ We usually begin the first few calculation examples in each chapter with the basic structure of the calculation. That way, you review the basic structure throughout the book and not just in Chapter 4 where we introduce the different methods.
- ✔ We usually show the results of a math example to several decimal places. However, we then round the results up or down, using the standard math convention “5 up/4 down.” We do this so the dose you give is consistent with the accuracy of the device you use to give it.

## *What You're Not to Read*

We'd love for you to read all the words in this book in the order they appear, but life is short. You don't have to read chapters that don't interest you. This is a reference book, and we've designed it so that you can read only the parts you need. If you get stuck in a chapter, you can go back to a chapter you skipped to get some help.

As you read, rest easy that you can skip the following text without losing anything crucial to the dosage-calculations discussion:

- ✔ **Text marked with a Technical Stuff icon:** We've included this text to give you a little history, the origin of a principle, or maybe a formal definition, but this text doesn't provide vital dosage-related info.
- ✔ **Text marked with a Did You Know? icon:** This text offers up a little pop culture, a bizarre fact, or maybe some humor, but it's not critical to your understanding of dosage calculations.
- ✔ **Text set up in a sidebar:** *Sidebars* are blocks of text that have a gray background. They're interesting (we think), but they aren't critical to your understanding of the main text.

## *Foolish Assumptions*

As we wrote this book, we made the following assumptions about you:

- ✔ We assume that you're in a two-year or four-year nursing program. But we also like the idea that you may be a working nurse or a concerned parent or caregiver.
- ✔ We assume (or should we say, “hope”?) you learned some basic math in middle and/or high school.

But even if you missed some math concepts in school, you can find the ones you need for medical dosing in the review section of this book (Chapters 1 through 4). It's amazing how little you need to review (multiplying fractions and conversion math) to be caught up on the math you need to do dosing calculations.

- ✔ We assume that you'll skip concepts you're already comfortable with. That's perfectly okay because this is a reference book, not a novel.
- ✔ We assume that you have access to a computer and the Internet. It's not essential, but it's very handy. Use a good search engine to find out more about any topic in this book — in the worlds of pharmacology, mathematics, and nursing practice.

## *How This Book Is Organized*

This book has five main sections, called *parts*, with about the same number of chapters in the first four sections.

### *Part I: Getting Up to Speed: Reviewing Math Basics*

Part I starts with the math basics that make calculating dosages possible. Go to these chapters if you need to catch up on some math you missed in the past. Chapter 1 gives you the basic concepts covered in this book and describes the need for medical dosage calculations. Chapter 2 is a review of numbers and fundamental arithmetic.

When you get to Chapters 3 and 4, the medical dosing fun begins. Chapter 3 covers the basics of fraction math, which is a core part of the calculations you do in all the other chapters. Chapter 4 reviews the major systems of measurement and shows you how to convert units.

### *Part II: Minding Your Meds: Administration and Calculation Methods*

When you get past Part I (either because you read it or because you already know basic math), you enter Part II, the world of dosage administration and calculation methods. Chapter 5 reviews the basic elements of a prescription, while Chapter 6 focuses on drug labels and patient safety. Chapter 7 deals with the MAR (the very important Medication Administration Record)



and explains what you need to know about proper medical documentation. Finally, Chapter 8 walks you through the three classic calculation methods for working up correct dosages. Even if you skip the rest of this part, it's a good idea to review Chapter 8 before moving on to Part III.

## ***Part III: Calculations for Different Routes of Administration***

Part III contains “serious math” for dosing calculations. Sounds complicated, but the examples aren't hard to work through. We cover simple oral dosing calculations in Chapter 9 and calculations related to parenteral medication administration (injections, in other words) in Chapter 10. Then we show you how to calculate intravenous dosing in Chapter 11 and reconstitution in Chapter 12. Don't start panicking just yet! The math is simple after you practice it.

## ***Part IV: Dosing in Special Situations***

The field of medicine is full of special situations, which is what Part IV is all about. Chapter 13 gives you a rundown on insulin. Chapter 14 is all about administering drugs during pregnancy (the patient's, not yours), and Chapter 15 takes a look at dosing for children. Chapter 16 deals with making dosing changes for patients with different medical conditions (like high or low blood pressure) and shows you how to do multiple calculations for real-life dosage problems. Chapter 17 offers dosing considerations you need to take when dealing with critical care patients, and Chapter 18 covers dosing for enteral and parenteral nutrition.

## ***Part V: The Part of Tens***

Part V is the world-famous Part of Tens that appears in all *For Dummies* books. The chapters in this part are very compact and contain handy information. Chapter 19 summarizes the ten most common dosage calculations you're likely to do. Chapter 20 describes ten dosing mistakes and shows you how to avoid them.

## ***Icons Used in This Book***

We use several icons in this book to call out special kinds of information.



This icon represents information you definitely don't want to skip over. It'll come in handy as you do the medical dosage calculations throughout this book and in your career as a healthcare professional.



This icon highlights medical dosing problems that appear throughout each chapter. Each example describes a particular situation, asks one or two dosing questions, and then shows you the steps you need to take to get the answers.



This icon points out suggestions or recommendations. Don't skip over the text marked with this icon if you want to know the quick and easy way to get things done.



A warning icon describes a situation where you should exercise care and seek additional advice or instruction. Some dosage situations can be critical to the well-being of the patient, and you need to be aware of them.



The paragraphs next to this icon contain information that's interesting and useful but not vital to your understanding of the topic at hand. This info may include a brief history of a principle, the earliest practitioners, or the origin of a word. This icon also showcases technical points. You can read the text marked with this icon or skip over it. Either is fine.



This is our "interesting trivia" icon. The text here usually contains odd facts, pieces of pop culture, bits of history, bizarre terms, or strange findings. You can read the info marked with this icon or skip over it.

## Where to Go from Here

You can go to any chapter from here. The book isn't linear, so you can start anywhere.

First, check the table of contents, where you find the names of the parts and the chapters. Then pick any chapter you're interested in.

- ✓ If you can't make a choice, begin with Chapter 1. It highlights the broad concepts covered in the book.
- ✓ If you have a particular dosing problem you want to work on, find a chapter in the table of contents that deals with it, and go straight to it. You can always check out the index at the back of the book, too.

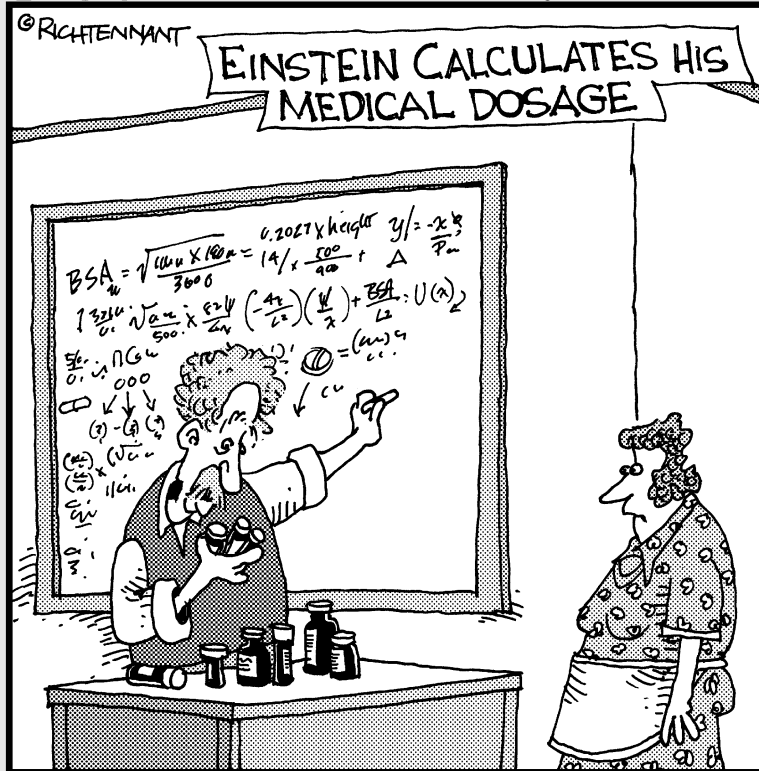
If, at any time, you get stuck on a concept, look for a cross-reference that tells you which chapter covers that particular topic. Then stop what you're reading, and go visit that chapter.

# Part I

# Getting Up to Speed: Reviewing Math Basics

The 5<sup>th</sup> Wave

By Rich Tennant



"I'm not sure I calculated my dosage correctly, but I think I'm close to making a breakthrough in time travel."

## *In this part . . .*

**P**art I is a review of math basics, just in case you missed a concept or two during your education. Chapter 1 stresses the importance of dosage calculations in all healthcare professions. Chapter 2 is a fun and simple review of numbers and arithmetic. In Chapters 3 and 4, you get important basics for medical math — fractions, systems of measurement, and unit conversions.

## Chapter 1

# Brushing Up on Your Math Skills and Entering the Healthcare Field

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### *In This Chapter*

- ▶ Looking at the basics of medical math and dosage calculations
  - ▶ Taking a look at healthcare careers and the need for math
  - ▶ Remembering the importance of compassion, empathy, and other important skills
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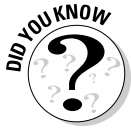
**I**f you're a healthcare professional (or planning to be one), you're in one of the most important careers around today. In essence, you help healthy people stay healthy, you help sick people get well, and you help people with critical health conditions live.

Of course, nursing and all health professions involve more than just calculating and administering medications. They're vocations for comforting the sick and injured — clearly they involve much more than just “pushing meds.”

However, being a successful healthcare provider means being an able mathematician. After all, the field of medicine relies extensively on administering medications, and you must be able to calculate meds correctly before you dispense them.

In any healthcare education program, medical dosage calculations come up in practically every course (or they should). In addition, most schools of nursing have one course devoted entirely to medical dosage calculations.

In this chapter, we introduce you to the math you need to know to perform basic and complex medical dosage calculations. We also provide an overview of the different careers available in the healthcare field (and show you how they all utilize medical math). Finally, we go beyond math and focus on the other essential components of being a good healthcare provider.



Florence Nightingale had a great gift for mathematics. She was a pioneer in presenting information visually — especially health statistics. She has been recognized for developing a form of the pie chart now known as the polar area diagram.

## *Knowing What Math You Need to Know in Healthcare*

In healthcare, you need to know the following three kinds of dosing math:

- ✓ **School math:** The math you learn in order to pass tests while getting an education
- ✓ **NCLEX (National Council Licensure Examination) math:** The math you learn to get your license
- ✓ **Real-world math:** The math you use to handle your job

It's true; you'll sometimes find questions on tests in school or in practicing for the NCLEX that may never come up in real life, but you still need to be prepared for those questions. Similarly, real life will surely present you with math problems that you never practiced in school. In this section, we cover the math concepts and calculation methods you need to know to be prepared for just about any scenario in healthcare.



Never despair about medical dosage calculations. Each principle in this book is easy if you look at it the right way. Medical dosing math isn't harder than you think; it's actually easier!

## *Nailing down basic arithmetic*

Nursing and related professions require basic math skills, but don't worry if math hasn't always been your favorite subject in school. The best part about medical math is that it's easy to identify just how much math you need to know.

Basic math is essentially just arithmetic — addition, subtraction, multiplication, and division. And you mostly use multiplication and division in your dosage calculations. But don't forget that counting is math, too. For example, when you count out 4 tablets, you're doing addition ( $1 + 1 + 1 + 1 = 4$ ).

In case you missed some of what you need to know math-wise in school, we cover the most important principles in Chapters 2 through 4.