

PHARMACOLOGY - PRINCIPLES AND APPLICATION FOR MEDICAL ASSISTANTS



Anna Jannak
Moraine Valley Community College

Pharmacology - Principles and Application for Medical Assistants

by Anna Jannak RN APN MSN AHI(AMT)

This text is disseminated via the Open Education Resource (OER) LibreTexts Project (<https://LibreTexts.org>) and like the thousands of other texts available within this powerful platform, it is freely available for reading, printing, and "consuming."

The LibreTexts mission is to bring together students, faculty, and scholars in a collaborative effort to provide an accessible, and comprehensive platform that empowers our community to develop, curate, adapt, and adopt openly licensed resources and technologies; through these efforts we can reduce the financial burden born from traditional educational resource costs, ensuring education is more accessible for students and communities worldwide.

Most, but not all, pages in the library have licenses that may allow individuals to make changes, save, and print this book. Carefully consult the applicable license(s) before pursuing such effects. Instructors can adopt existing LibreTexts texts or Remix them to quickly build course-specific resources to meet the needs of their students. Unlike traditional textbooks, LibreTexts' web based origins allow powerful integration of advanced features and new technologies to support learning.



LibreTexts is the adaptable, user-friendly non-profit open education resource platform that educators trust for creating, customizing, and sharing accessible, interactive textbooks, adaptive homework, and ancillary materials. We collaborate with individuals and organizations to champion open education initiatives, support institutional publishing programs, drive curriculum development projects, and more.

The LibreTexts libraries are Powered by [NICE CXone Expert](#) and was supported by the Department of Education Open Textbook Pilot Project, the California Education Learning Lab, the UC Davis Office of the Provost, the UC Davis Library, the California State University Affordable Learning Solutions Program, and Merlot. This material is based upon work supported by the National Science Foundation under Grant No. 1246120, 1525057, and 1413739.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation nor the US Department of Education.

Have questions or comments? For information about adoptions or adaptations contact info@LibreTexts.org or visit our main website at <https://LibreTexts.org>.

This text was compiled on 06/07/2026

Preface

The Creation of this Open Educational Resource (OER)

This textbook and ancillary materials were created as part of the Illinois Support for the Creation of Open Educational Resources (SCOERs) project, facilitated by the [Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#) and funded by a \$2 million [Open Textbooks Pilot Program grant from the Department of Education](#) and the [Fund for the Improvement of Post-Secondary Education](#).^[1]

Illinois SCOERs is a true statewide enterprise fundamentally changing the open educational resources landscape in Illinois by providing a new holistic support model that promotes student success through OER awareness, implementation, growth, and adoption. This project features a collaboration between educational systems in Illinois, the library community, and workforce representatives. Developed OER course materials will be released under a license that permits their free use, reuse, modification, and sharing with others., the library community, and workforce representatives. Developed OER course materials will be released under a license that permits their free use, reuse, modification, and sharing with others.

About this Book

This book and its ancillary materials were made possible through an Illinois SCOERs Subgrant awarded to Terra Jacobson at Moraine Valley Community College. The materials created for Pharmacology Principles and Applications for Medical Assistants (course name), a high enrollment course for undergraduate students.

Editors

Ellen Lawrence

Developing Authors

Anna Jannak RN APN MSN AHI(AMT)

Developing authors remix existing OER and create content from evidence-based sources that are aligned with the Illinois Board of Higher Education.

Contributors

Contributors to the development of this OER textbook and ancillary materials include educators, librarians, and staff from: Moraine Valley Community College

Illinois SCOERs Project Staff

The Illinois SCOERs Project Staff helped coordinate the management of the Open Textbook Pilot grant that made this OER possible. Topical experts shared their knowledge on open educational resources, incorporating technologies including 3D printing, accessibility, author rights, instructional design, publishing, and participated with the review and proofreading processes.

- Anne Craig, Principal Investigator, CARLI Senior Director
- Michele Leigh, Project Director, CARLI Senior Coordinator Open Illinois
- Margaret Chambers, CARLI Director and Advisor, Membership and Communications
- Michelle Haake, CARLI Senior Coordinator Membership and Communications
- Diane Day, CARLI Fiscal Officer
- Elizabeth Clarage, CARLI Director, Collections Services and OER Committee Liaison
- Nicole Swanson, CARLI Senior Coordinator, Library Services and Outreach and OER Committee Liaison
- Sara Benson, Copyright Training Coordinator, Assistant Professor, Copyright Librarian, University of Illinois Urbana-Champaign
- Emily Boles, Instructional Design Coordinator and Trainer, eLearning Specialist, University of Illinois Springfield
- Elisandro (Alex) Cabada, 3D Printing Coordinator Trainer, Assistant Professor and Medical & Bioengineering Librarian, University of Illinois Urbana-Champaign
- Ann Fredricksen, Disability Specialist, Coordinator of Accessible Media Services, University of Illinois Urbana-Champaign, Disability Resources and Educational Services (DRES)
- Kathleen Ricker, Proofreader, ProofreadingPal.com Editing Services

Advisory Committee

The Illinois SCOERs Advisory Committee provided input on the subgrant applications, and the materials produced and contains industry members, librarians, graduate students, and representatives from our project partners:

- Illinois Community College Board
- Illinois Board of Higher Education
- Illinois Department of Commerce & Economic Opportunity
- Illinois Heartland Library System
- Reaching Across Illinois Library System
- Illinois State Library
- Illinois Library Association
- Health Sciences Librarians of Illinois
- University of Illinois Urbana-Champaign's Division of Disability Resources and Educational Services
- Laurie Brown, Executive Director, Hickory Point Christian Village (assisted living) and Illinois Workforce Investment Board Local 1949 Chair
- Lisa Jones, DCEO, Manager, Office of Employment & Training (state workforce agency)
- Suzanne Kinsey, Executive Director, Fox Valley Community Services, (in-home service agency) in DeKalb, LaSalle, Kendall, and Kane Counties
- Danna Williamson, Nursing Education Specialist, Carle Foundation Hospital Clinical Education

Peer Review

The Peer Reviewer process was completed by the following reviewers:

Request to Those Using This Resource: Usage Survey

We would love to hear if you have integrated some, or all of this resource into your course. Please submit usage information every semester for grant reporting purposes using this short [survey](#). Your personal information will be kept private and only the usage data will be shared with the Department of Education.

Customization/Terms of Use

This textbook is licensed under a Creative Commons Attribution 4.0 International (CC-BY) license unless otherwise indicated, which means that you are free to:

- SHARE – copy and redistribute the material in any medium or format
- ADAPT – remix, transform, and build upon the material for any purpose

Licensing Terms

The licensor cannot revoke these freedoms as long as you follow the license terms.

- Attribution: You must give appropriate credit, provide a link to the license, and indicate if any changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
- No Additional Restrictions: You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.
- Notice: You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable United States copyright exception or limitation.
- No Warranties are Given: The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material.

Attribution

Anna Jannak RN APN MSN AHI(AMT). (2023). Illinois SCOERs *Pharmacology Principles and Applications for Medical Assistants* by [Consortium of Academic and Research Libraries in Illinois](#) licensed under [CC BY 4.0\(opens in new window\)](#)

References

This Preface chapter is a derivative of Ernstmeyer, K., & Christman, E. (Eds.). (2022). [Nursing Mental Health and Community Concepts\(opens in new window\)](#) by [Chippewa Valley Technical College\(opens in new window\)](#) is licensed under [CC BY 4.0\(opens in new window\)](#)

[1] The contents of this publication were developed under a grant from the Fund for the Improvement of Postsecondary Education, (FIPSE), U.S. Department of Education. However, those contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government.

TABLE OF CONTENTS

Preface

Licensing

Chapter 1: Introduction to clinical pharmacology for the medical assistant

- 1.1: Main Terms
- 1.2: Chapter Goals
- 1.3: Introduction
 - 1.3.1: What are Drugs?
 - 1.3.2: History of Drugs
 - 1.3.3: Pharmacognosy- The Sources of Drugs
 - 1.3.3.1: Plants
 - 1.3.3.2: Animals
 - 1.3.3.3: Minerals
 - 1.3.3.4: Microbiologic
 - 1.3.3.5: Synthetic and Biosynthetic
- 1.4: Uses of Drugs and Terminology
 - 1.4.1: Prevention
 - 1.4.2: Treatment
 - 1.4.3: Diagnosis
 - 1.4.4: Curative
 - 1.4.5: Palliative
 - 1.4.6: Replacement
 - 1.4.7: Health maintenance
- 1.5: Drug Legislation
 - 1.5.1: Food and Drug Administration
 - 1.5.2: Drug Enforcement Agency
 - 1.5.3: Controlled Substances Act
- 1.6: Drug References
 - 1.6.1: Prescriber's Desk Reference
 - 1.6.2: Package inserts
 - 1.6.3: Nursing Drug References Books and Websites
- 1.7: Drug Names
 - 1.7.1: Generic name
 - 1.7.2: Trade or Brand Name
- 1.8: Drug Classifications
 - 1.8.1: Therapeutic Classification
 - 1.8.2: Pharmaceutical Classification
 - 1.8.3: Body System Classification
 - 1.8.4: Other Classifications
 - 1.8.4.1: Prescription Drugs
 - 1.8.4.2: Over the Counter Drugs
 - 1.8.4.3: Herbal and Vitamin Supplements
- 1.9: Drug Forms
 - 1.9.1: Liquids

- 1.9.2: Powders
- 1.9.3: Oral Drug Forms
 - 1.9.3.1: Enteric-coated Tablets
 - 1.9.3.2: Scored Tablets
 - 1.9.3.3: Sublingual and Buccal Tablets
 - 1.9.3.4: Chewable Tablets
 - 1.9.3.5: Effervescent Tablets
 - 1.9.3.6: Capsules
 - 1.9.3.7: Lozenges (Troches)
 - 1.9.3.8: Dissolving Film
- 1.9.4: Other Forms of Drugs
 - 1.9.4.1: Topical Preparations
 - 1.9.4.2: Transdermal Preparations
 - 1.9.4.3: Suppositories
- 1.10: Chapter 1 References

Chapter 2: Drug Safety and Pharmacology Principles

- 2.1: Main Terms
- 2.2: Chapter Goals
- 2.3: Drug Safety
- 2.4: Drug Errors Classifications
- 2.5: Factors that Can Influence Drug Errors
- 2.6: Strategies to Reduce Drug Errors
- 2.7: The Nine Rights of Drug Administration
 - 2.7.1: The right drug
 - 2.7.2: The right dose
 - 2.7.3: The right route
 - 2.7.4: The right time
 - 2.7.5: The right patient
 - 2.7.6: The right education
 - 2.7.7: The right to refuse
 - 2.7.8: The right technique
 - 2.7.9: The right documentation
- 2.8: Steps to Take for Drug Errors
- 2.9: Drug Terminology
 - 2.9.1: Drug Actions
 - 2.9.1.1: Indications for Use
 - 2.9.1.2: Desired Effects
 - 2.9.1.3: Side Effects
 - 2.9.1.4: Adverse Effects
 - 2.9.1.5: Systemic and Local Effects
 - 2.9.1.6: Drug-Drug Interactions
 - 2.9.1.7: Potentiation
 - 2.9.1.8: Synergism
 - 2.9.1.9: Agonist
 - 2.9.1.10: Antagonists
 - 2.9.1.11: Drug-Food Interactions
 - 2.9.2: Other Factors Influencing Drug Actions
 - 2.9.2.1: Age – Elderly
 - 2.9.2.2: Age- Infants and Children

- 2.9.2.3: Sex
- 2.9.2.4: Genetics
- 2.9.2.5: Comorbidities and Polypharmacy
- 2.9.2.6: Diet
- 2.9.2.7: Mental State
- 2.9.2.8: Drug Biologic Half-Life
- 2.9.2.9: Drug Blood Levels
- 2.9.2.10: Loading Doses
- 2.9.2.11: Maintenance Doses
- 2.9.2.12: Pharmacokinetics
 - 2.9.2.12.1: Absorption
 - 2.9.2.12.2: Distribution
 - 2.9.2.12.3: Metabolism
 - 2.9.2.12.4: Excretion
- 2.10: Chapter 2 References

Chapter 3: Prescriptions, Orders, and Documentation

- 3.1: Main Terms
- 3.2: Chapter Goals
- 3.3: Prescriptions
 - 3.3.1: Parts of a Prescription
 - 3.3.2: Electronic Prescriptions
- 3.4: Medical Assistant's Role in Prescriptions
 - 3.4.1: Patient Education
 - 3.4.2: Refill Requests
 - 3.4.3: Medication Reconciliation
 - 3.4.4: Documentation in the Medical Record
- 3.5: Other Types of Drug Orders
 - 3.5.1: Routine Order
 - 3.5.2: Standing Order
 - 3.5.3: PRN Order
 - 3.5.4: Single Order
 - 3.5.5: STAT Order
 - 3.5.6: Verbal Order
- 3.6: Chapter 3 References

Chapter 4: Pharmacology Math

- 4.1: Main Terms
- 4.2: Chapter Goals
- 4.3: Drug Labels
 - 4.3.1: Drug Form
 - 4.3.2: Drug Strength
 - 4.3.3: Measurement Systems
 - 4.3.3.1: Metric system
 - 4.3.3.2: Household System
 - 4.3.3.3: Conversions between Metric and Household
- 4.4: Equivalencies and Conversions
- 4.5: Healthcare Rules when Writing Numbers
- 4.6: The Formula Method

- 4.7: Medications and Pediatrics Doses
- 4.8: Legal and Ethical Issues
- 4.9: Chapter 4 References

Chapter 5: The Gastrointestinal System and Administering Enteral Drugs

- 5.1: Main Terms
- 5.2: Chapter Goals
- 5.3: Anatomy Review of the Gastrointestinal System
 - 5.3.1: Pharynx
 - 5.3.2: Esophagus
 - 5.3.3: Stomach
 - 5.3.4: Small Intestine
 - 5.3.5: Large Intestine
 - 5.3.6: Rectum and Anus
- 5.4: Review of Gastrointestinal System Pathology
 - 5.4.1: Conditions of the Mouth and Pharynx
 - 5.4.2: Conditions of the Esophagus
 - 5.4.3: Conditions of the Stomach
 - 5.4.4: Conditions of the Large and Small Intestines
 - 5.4.5: Conditions of the Rectum and Anus
- 5.5: Gastrointestinal System Drugs
- 5.6: Enteral Routes of Administration
 - 5.6.1: Oral Route
 - 5.6.2: Sublingual and Buccal Route
 - 5.6.3: Rectal Route
- 5.7: Chapter 5 References

Chapter 6: Integumentary System and Other Sense Organs

- 6.1: Main Terms
- 6.2: Chapter Goals
- 6.3: Anatomy review of the integumentary system
 - 6.3.1: Skin
 - 6.3.2: Associated Structures of the Skin
 - 6.3.3: Hair and Hair Follicles
 - 6.3.4: Nails
- 6.4: Anatomy review of the ears and eyes
 - 6.4.1: Ears
 - 6.4.2: Eyes
- 6.5: Review of Skin Disorders
 - 6.5.1: Skin Lesions
 - 6.5.2: Impetigo
 - 6.5.3: Fungal Infections of the Skin
 - 6.5.4: Dermatitis
- 6.6: Review of Ear and Eye Disorders
 - 6.6.1: Otitis Externa
 - 6.6.2: Otitis Media
 - 6.6.3: Impacted Cerumen
 - 6.6.4: Meniere's Disease
 - 6.6.5: Glaucoma

- 6.6.6: Cataracts
- 6.6.7: Infections of the Eyes
- 6.7: Drugs to Treat Skin, Ear, and Eye Disorders
- 6.8: Routes of Administration
 - 6.8.1: Topical Route
 - 6.8.2: Otic route
 - 6.8.3: Ophthalmic route
- 6.9: Chapter 6 References

Chapter 7: Parenteral Routes- Intradermal and Subcutaneous

- 7.1: Main Terms
- 7.2: Chapter Goals
- 7.3: Parenteral Supplies
 - 7.3.1: Needles and Syringes
 - 7.3.2: Vials
 - 7.3.3: Ampules
 - 7.3.4: Prefilled Syringes
 - 7.3.5: Reconstituting Powders
- 7.4: Intradermal Route
- 7.5: Subcutaneous Route
- 7.6: Chapter 7 References

Chapter 8: Parenteral Routes- Intramuscular

- 8.1: Main Terms
- 8.2: Chapter Goals
- 8.3: Intramuscular Route
 - 8.3.1: Aspiration
- 8.4: Intramuscular Injection Sites
 - 8.4.1: Deltoid Site
 - 8.4.2: Vastus Lateralis Site
 - 8.4.3: Ventrogluteal Site
- 8.5: Airlock and Z-Track Techniques
- 8.6: Chapter 8 References

Chapter 9: Immune System, Allergies, and Vaccines

- 9.1: Main Terms
- 9.2: Chapter Goals
- 9.3: Review of the Anatomy of the Immune System
 - 9.3.1: Antigens and Antibodies
 - 9.3.2: Innate and Adaptive Immunity
 - 9.3.3: White Blood Cells (Leukocytes)
 - 9.3.4: Lymphatic System
 - 9.3.4.1: Immunological Memory
 - 9.3.4.1.1: Primary and Secondary Responses
 - 9.3.4.1.2: Memory Cell Formation
 - 9.3.4.1.3: Rapid and Robust Secondary Response
 - 9.3.4.1.4: Long-lasting Protection
 - 9.3.4.1.5: Vaccination

- 9.3.4.2: Allergies
 - 9.3.4.2.1: Anaphylactic Shock
- 9.3.4.3: Autoimmune Disorders
- 9.3.5: Vaccines
 - 9.3.5.1: Centers for Disease Control and Prevention (CDC)
 - 9.3.5.2: Vaccine Schedules
 - 9.3.5.3: Vaccine Information Statement (VIS)
 - 9.3.5.4: CDC Pink Book
 - 9.3.5.5: Vaccine Administration Documentation
 - 9.3.5.6: Immunization Information Systems
 - 9.3.5.7: The Vaccine Adverse Event Reporting System (VAERS)
- 9.4: Chapter 9 References

Chapter 10: Infections and Drugs to Treat Infections

- 10.1: Main Terms
- 10.2: Chapter Goals
- 10.3: Infectious Agents and Infections
 - 10.3.1: Common Pathogens
- 10.4: Infections and Healthcare
- 10.5: Antibiotic Resistance
- 10.6: Sepsis
- 10.7: Drugs for Infectious Diseases
 - 10.7.1: Bacterial Infections
 - 10.7.2: Viral Infections
 - 10.7.3: Fungal Infections
 - 10.7.4: Parasitic Infections
- 10.8: Antibiotic Patient Teaching
 - 10.8.1: Most Prescribed Antibiotics
- 10.9: Antiviral Drugs Patient Teaching
- 10.10: Chapter 10 References

[Index](#)

[Glossary](#)

[Detailed Licensing](#)

Licensing

A detailed breakdown of this resource's licensing can be found in [Back Matter/Detailed Licensing](#).

CHAPTER OVERVIEW

Chapter 1: Introduction to clinical pharmacology for the medical assistant

- 1.1: Main Terms
- 1.2: Chapter Goals
- 1.3: Introduction
 - 1.3.1: What are Drugs?
 - 1.3.2: History of Drugs
 - 1.3.3: Pharmacognosy- The Sources of Drugs
 - 1.3.3.1: Plants
 - 1.3.3.2: Animals
 - 1.3.3.3: Minerals
 - 1.3.3.4: Microbiologic
 - 1.3.3.5: Synthetic and Biosynthetic
- 1.4: Uses of Drugs and Terminology
 - 1.4.1: Prevention
 - 1.4.2: Treatment
 - 1.4.3: Diagnosis
 - 1.4.4: Curative
 - 1.4.5: Palliative
 - 1.4.6: Replacement
 - 1.4.7: Health maintenance
- 1.5: Drug Legislation
 - 1.5.1: Food and Drug Administration
 - 1.5.2: Drug Enforcement Agency
 - 1.5.3: Controlled Substances Act
- 1.6: Drug References
 - 1.6.1: Prescriber's Desk Reference
 - 1.6.2: Package inserts
 - 1.6.3: Nursing Drug References Books and Websites
- 1.7: Drug Names
 - 1.7.1: Generic name
 - 1.7.2: Trade or Brand Name
- 1.8: Drug Classifications
 - 1.8.1: Therapeutic Classification
 - 1.8.2: Pharmaceutical Classification
 - 1.8.3: Body System Classification
 - 1.8.4: Other Classifications
 - 1.8.4.1: Prescription Drugs
 - 1.8.4.2: Over the Counter Drugs
 - 1.8.4.3: Herbal and Vitamin Supplements
- 1.9: Drug Forms
 - 1.9.1: Liquids
 - 1.9.2: Powders

1.9.3: Oral Drug Forms

1.9.3.1: Enteric-coated Tablets

1.9.3.2: Scored Tablets

1.9.3.3: Sublingual and Buccal Tablets

1.9.3.4: Chewable Tablets

1.9.3.5: Effervescent Tablets

1.9.3.6: Capsules

1.9.3.7: Lozenges (Troches)

1.9.3.8: Dissolving Film

1.9.4: Other Forms of Drugs

1.9.4.1: Topical Preparations

1.9.4.2: Transdermal Preparations

1.9.4.3: Suppositories

1.10: Chapter 1 References

This page titled [Chapter 1: Introduction to clinical pharmacology for the medical assistant](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#) .

1.1: Main Terms

Brand name – trade name, a proprietary name owned by a pharmaceutical manufacturer

Curative – when a drug cures a disease or condition

DEA – Drug Enforcement Agency

Diagnosis – the disease or condition for which the patient is being treated

Efficacy – the ability of a drug to induce the intended result

FDA – Food and Drug Administration

Formulary – a list of available drugs

Generic name – the name of a drug assigned by the United States Adopted Names Program

Indication – the purpose or reason for using a drug

OTC – over the counter

Palliative – treatment aimed at patient comfort, not curative

Parenteral route – intravenous or intermuscular injection of drugs

Pharmacodynamics – the study of how drugs work to produce a therapeutic effect

Pharmacognosy – sources of drugs

Pharmacology – the study of drugs

Pharmacotherapeutics – the study of how drugs are used to treat disease

Prescription – an order created by a provider for the pharmacist to dispense drug

PDR – Prescriber Desk Reference

Prevention – when a drug prevents a disease or condition

Replacement – when a drug replaces a substance normally present in the human body

Trade name – brand name, a proprietary name owned by a pharmaceutical manufacturer

Treatment – medical care provided to a patient

Toxicology – the study of poisonous effects of drugs

This page titled [1.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.2: Chapter Goals

- Explain the history of drugs
 - Identify sources and classifications of drugs
 - Discuss the uses of drugs
 - Identify safe and reliable sources for drug information
 - Distinguish between trade names and generic names for drugs
 - Identify common drug forms used for patient treatment
-

This page titled [1.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.3: Introduction

The Occupational Outlook Handbook from the U.S. Bureau of Labor Statistics states that medical assistants (MA) administer drugs, including injections, as permitted by state law (Bureau of Labor Statistics, n.d.). To safely administer any drug, the MA must have a current working knowledge of drugs, administration techniques and routes, and other patient safety issues that will be discussed in this text.

This page titled [1.3: Introduction](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.3.1: What are Drugs?

The U.S. Food and Drug Administration (FDA) defines drugs as any substance, other than food, that is used to diagnose, cure, mitigate, treat, or prevent disease. In the U.S., all drugs available for prescription are listed in the United States Pharmacopeia (USP) and the National Formulary (NF, uspnf.com). A formulary is a list of available drugs and is used by organizations and institutions to indicate which drugs are available. Insurance companies use a formulary for the prescription drugs that are covered by their plans. Hospitals and clinics use a formulary to list the drugs that are on hand for administration (U.S. Food and Drug Administration, 2017).

This page titled [1.3.1: What are Drugs?](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.3.2: History of Drugs

The history of using plants to treat diseases is thought to date back to prehistoric times (Kelly et al., 2003). The world's oldest known prescriptions were recorded on a clay tablet in Mesopotamia (modern-day Iraq), ca. 2400 BC. (Jerry H. Hodge School of Pharmacy, 2023). The poppy plant has been in use since 3400 BC as opium, which is a powerful narcotic and pain reliever (DEA Museum, n.d.). Many herbs used by Indigenous Americans have led to the development of many modern drugs. One statistic says that “more than 120 drugs prescribed by physicians today were first made from plant extracts, and 75 percent of these were derived from examining plants used in traditional indigenous medicine” (Keoke & Porterfield, 2003, as cited in Smith, 2017).

In more modern history, Apothecary shops were established during the 1700s in Philadelphia. Despite an attempt to provide a centralized location to treat patients, there was no oversight, and drug safety was not regulated. (Center for the History of Medicine, n.d.). Federal regulation of drugs emerged as early as 1848 under a law that addressed only imported drugs. In 1905, the American Medical Association launched a private, voluntary means of controlling a substantial part of the drug marketplace, a system that remained in place for over a half-century. FDA drug regulations have evolved considerably since President Theodore Roosevelt signed the 1906 Pure Food and Drugs Act. (U. S. Food and Drug Administration, 2018c). Today, the FDA is responsible for protecting public health by utilizing oversight systems that assure drug safety, efficacy, and security (U.S. Food and Drug Administration, n.d.).

This page titled [1.3.2: History of Drugs](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.3.3: Pharmacognosy- The Sources of Drugs

This page titled [1.3.3: Pharmacognosy- The Sources of Drugs](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

1.3.3.1: Plants

Plants are our oldest sources of drugs. Drugs are made from leaves, flowers, roots, stems, seeds, and bark of various plants. Examples of drugs derived from plants include aspirin, derived from the bark of willow trees, and digoxin (a cardiac drug), derived from the foxglove flower.

This page titled [1.3.3.1: Plants](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.3.3.2: Animals

Animals are another source of drugs. Insulin, used to treat diabetes, was developed in the 1920s from the pancreas of cows and pigs. In 1978, we started genetically engineering insulin from bacteria, which produces fewer side effects than bovine or porcine insulin. Genetically engineered insulin is also acceptable for patients whose culture or religion restricts the consumption of certain animal products (American Diabetes Association, 2019). Heparin has been used since 1935 to treat patients with blood clotting disorders. Most of the world's heparin supply is manufactured using mast cells from pig intestines (Thacker et al., 2021). Synthetic heparin is available, but its availability is limited by the high cost associated with the manufacturing process (Baytas & Linhardt, 2020).

This page titled [1.3.3.2: Animals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.3.3.3: Minerals

Minerals such as calcium, potassium, sodium, and magnesium are vital for many body functions and good health. Mineral supplements can be prescribed or found over the counter (Natural Medicines Comprehensive Database Consumer Version [NMCDCV], 2022a). Calcium, found in animal bones, shells, and rocks, is used by the human body to create strong bones. Calcium also plays an important role in cardiac function (Bers, 2002). Sodium, found in salt, helps the body maintain homeostasis, aids in controlling fluid balance, and plays a role in blood pressure regulation (Strazzullo & Leclercq, 2014).

This page titled [1.3.3.3: Minerals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.3.3.4: Microbiologic

In addition to insulin, other drugs are derived from bacteria and other microbes. Penicillin was discovered by Alexander Fleming from mold growing in a petri dish in 1928 and is still used today as an effective antibiotic (Demain & Sanchez, 2009). Neomycin was discovered in 1948 and is another antibiotic derived from bacteria that is effective against a broad spectrum of infectious bacteria (National Center for Biotechnology Information, 2023).

This page titled [1.3.3.4: Microbiologic](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.3.3.5: Synthetic and Biosynthetic

The development of synthetic and biosynthetic drugs is always evolving. Many drugs are manufactured by synthesizing chemicals to create a desired compound. Biosynthetic drugs are manufactured using biological substances. Some vaccines have been developed using biosynthetic or genetically engineered technology. These vaccines contain proteins that mimic the structure of a virus or bacteria to produce an immune response in the body (National Institute of Allergy and Infection Diseases, n.d.).

This page titled [1.3.3.5: Synthetic and Biosynthetic](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

1.4: Uses of Drugs and Terminology

Drugs are developed and used for specific purposes. Drugs are used to prevent, treat, diagnose, and cure diseases. The study of how drugs are used to treat disease is pharmacotherapeutics. Indication is the reason a drug is used, and efficacy is when a drug does what it is intended to do. Toxicology is the study of the poisonous effects of drugs.

1.4.1: Prevention

1.4.2: Treatment

1.4.3: Diagnosis

1.4.4: Curative

1.4.5: Palliative

1.4.6: Replacement

1.4.7: Health maintenance

This page titled [1.4: Uses of Drugs and Terminology](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.4.1: Prevention

The goal of preventative drugs is to prevent the patient from developing disease. Examples of drugs used for prevention include anticoagulants to prevent blood clots and vaccines to prevent infectious diseases (U. S. Food and Drug Administration, 2023; Warnock & Huang, 2022).

This page titled [1.4.1: Prevention](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.4.2: Treatment

Drugs are often used to treat the symptoms associated with disease. Examples of these types of drugs include ibuprofen, used to relieve pain and fever associated with infections, and atenolol, used to lower blood pressure for patients diagnosed with hypertension (American Heart Association, 2023; Ngo & Bajaj, 2023).

This page titled [1.4.2: Treatment](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.4.3: Diagnosis

The process of diagnosing a disease sometimes includes the use of diagnostic drugs. For example, radiopaque dye administered during X-rays and CT scans aids in diagnosing organ dysfunction or injuries (Kocak, 2022).

This page titled [1.4.3: Diagnosis](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.4.4: Curative

Drugs are used to cure diseases and help the patient return to a healthy state. Amoxicillin is a good example of a curative drug. It can be used to cure otitis media (middle ear infections) or other bacterial infections in the respiratory tract (NMCDCV, 2022b).

This page titled [1.4.4: Curative](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.4.5: Palliative

Palliative care is not curative but is used to improve quality of life for patients diagnosed with terminal illnesses. Morphine can be used as palliative care to treat pain caused by certain cancers (NMCDCV, 2023).

This page titled [1.4.5: Palliative](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.4.6: Replacement

Sometimes, patients require the replacement of substances that naturally occur in the body. For example, patients with hypothyroidism have sluggish thyroid glands that do not produce enough thyroid hormones. Levothyroxine is a synthetic replacement thyroid hormone often prescribed for these patients (NMCDV, 2019).

This page titled [1.4.6: Replacement](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.4.7: Health maintenance

Vitamins and minerals are often prescribed or purchased over the counter to maintain good health. Multivitamins, calcium supplements, and iron supplements are a few examples of many supplements available for prescription or over the counter.

This page titled [1.4.7: Health maintenance](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

1.5: Drug Legislation

To ensure the public's safety, the U.S. government has enacted laws that control, regulate, and oversee the manufacture, sale, and distribution of drugs.

1.5.1: Food and Drug Administration

1.5.2: Drug Enforcement Agency

1.5.3: Controlled Substances Act

This page titled [1.5: Drug Legislation](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.5.1: Food and Drug Administration

The Food, Drug, and Cosmetics Act of 1938 created the Food and Drug Administration (FDA) under the Department of Health and Human Services. The FDA is responsible for the safety, effectiveness, security, and quality of drugs, cosmetics, and food. To ensure public safety, the FDA approves and monitors the safety of products released to the public (U. S. Food and Drug Administration, 2018a). The FDA has created the Federal Adverse Event Reporting System (FAERS), a public database that dispenses information related to adverse events caused by drugs and biologic products. Healthcare professionals, consumers, and manufacturers may submit voluntary reports to FAERS related to drug safety concerns. These concerns are collected in a database that is available to the public (U.S. Food and Drug Administration, 2021a).

This page titled [1.5.1: Food and Drug Administration](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

1.5.2: Drug Enforcement Agency

The Drug Enforcement Agency (DEA) was established in 1973 as the federal organization in charge of enforcing the controlled substances laws of the United States. We will discuss more information about this in a later chapter.

This page titled [1.5.2: Drug Enforcement Agency](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.5.3: Controlled Substances Act

The Controlled Substances Act (CSA) places all substances regulated under existing federal law in some manner into one of five schedules. This placement is based on the substance's medical use, potential for abuse, and safety or risk of dependence (DEA, n.d.).

This page titled [1.5.3: Controlled Substances Act](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

1.6: Drug References

The Medical Assistant is required to have a working knowledge of drugs that the providers they work with prescribe most frequently. Having access to reliable and current drug information is vital for patient safety. The Medical Assistant does not prescribe drugs, nor does the Medical Assistant offer medical advice to patients. However, the Medical Assistant should be prepared to answer questions, identify side effects and adverse effects of drugs, and recognize indications for drugs within the Medical Assistant's scope of practice and policies and procedures in the clinic. The MA should rely on reputable sources for drug safety. The following are high-quality, reliable sources of drug information.

1.6.1: Prescriber's Desk Reference

1.6.2: Package inserts

1.6.3: Nursing Drug References Books and Websites

This page titled [1.6: Drug References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.6.1: Prescriber's Desk Reference

The Prescriber's (Physician's) Desk Reference (PDR) is a source of drug information widely used by providers, clinical staff, and patients. Product information includes chemical formulation, action of drug, indications, contraindications, side effects, and adverse effects. The PDR website is updated as drug changes occur. To search or browse the PDR, visit [Prescribers' Digital Reference](#) [www.pdr.net].

This page titled [1.6.1: Prescriber's Desk Reference](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.6.2: Package inserts

Product information can be found from the drug manufacturer inside drug packages. These documents contain important information; however, patients may have difficulty interpreting the medical jargon used in these texts. The MA should be prepared to help the patient identify and understand important concepts on package inserts.

This page titled [1.6.2: Package inserts](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.6.3: Nursing Drug References Books and Websites

Quite a few reliable, annually updated nursing drug reference books and websites are available for the MA to use to provide safe care. The MA can ask a nurse or a provider to help choose the best book for their area of practice.

This page titled [1.6.3: Nursing Drug References Books and Websites](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

1.7: Drug Names

Drug references may list the drug by its generic name, trade name, or both.

~~(U. S. Food and Drug Administration, 2021b). The MA should be proficient in identifying drugs by different names.~~

1.7.1: Generic name

1.7.2: Trade or Brand Name

This page titled [1.7: Drug Names](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.7.1: Generic name

The generic name is the name assigned by the U.S. Adopted Names Council. All drugs have a generic name. An example of a generic name is acetaminophen.

This page titled [1.7.1: Generic name](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.7.2: Trade or Brand Name

A trade or brand name is a proprietary name for a drug owned by a pharmaceutical manufacturer. Trade names begin with an upper-case letter and are often followed by a trademark symbol. An example is Tylenol, a trade name for acetaminophen.

This page titled [1.7.2: Trade or Brand Name](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

1.8: Drug Classifications

Drugs are classified or categories by how they work, what they treat, the body system they affect, and/or their chemical structure. Some drugs will be grouped into several different categories based on their intended use.

1.8.1: Therapeutic Classification

1.8.2: Pharmaceutical Classification

1.8.3: Body System Classification

1.8.4: Other Classifications

1.8.4.1: Prescription Drugs

1.8.4.2: Over the Counter Drugs

1.8.4.3: Herbal and Vitamin Supplements

This page titled [1.8: Drug Classifications](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.8.1: Therapeutic Classification

This classification describes drug actions on the body. Examples of therapeutic classifications include antihypertensives, which lower blood pressure, and antacids, which reduce stomach acid. The study of how drugs produce a therapeutic effect in the body is called pharmacodynamics.

This page titled [1.8.1: Therapeutic Classification](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.8.2: Pharmaceutical Classification

The pharmaceutical classification groups drugs based on the mechanism of action at the molecular level. One example is a group of drugs called beta blockers. Beta blockers affect certain cell receptors to block adrenaline and lower heart rate and blood pressure.

This page titled [1.8.2: Pharmaceutical Classification](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.8.3: Body System Classification

Body system classification groups drugs into the body systems that they affect. Cardiac drugs, gastrointestinal drugs, and endocrine drugs are a few examples of these categories.

This page titled [1.8.3: Body System Classification](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.8.4: Other Classifications

This page titled [1.8.4: Other Classifications](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.8.4.1: Prescription Drugs

Drugs that require a valid prescription from a provider are called prescription drugs. Prescription drugs should only be taken by the person for whom they were prescribed, and directions for taking the drug should be followed. Prescription drugs are usually dispensed by a pharmacist.

This page titled [1.8.4.1: Prescription Drugs](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.8.4.2: Over the Counter Drugs

Over-the-counter drugs (OTC) are available for purchase without a prescription. These drugs are monitored by the FDA and may affect the efficacy of prescription drugs. It is important that the MA ask the patient about all drugs they are taking, including OTC drugs, so that the provider can prescribe safely.

This page titled [1.8.4.2: Over the Counter Drugs](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.8.4.3: Herbal and Vitamin Supplements

Herbal and vitamin supplements are available for purchase without a prescription. These are not monitored by the FDA as drugs but are monitored as food products. Vitamins and herbs may also affect the efficacy of prescription drugs, so it is important that the MA includes questions about vitamins and supplements during the patient intake process.

This page titled [1.8.4.3: Herbal and Vitamin Supplements](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

1.9: Drug Forms

Drugs come in many different forms. Commonly available forms include liquids, powders, tablets, capsules, suppositories, inhalers, and others.

1.9.1: Liquids

1.9.2: Powders

1.9.3: Oral Drug Forms

1.9.3.1: Enteric-coated Tablets

1.9.3.2: Scored Tablets

1.9.3.3: Sublingual and Buccal Tablets

1.9.3.4: Chewable Tablets

1.9.3.5: Effervescent Tablets

1.9.3.6: Capsules

1.9.3.7: Lozenges (Troches)

1.9.3.8: Dissolving Film

1.9.4: Other Forms of Drugs

1.9.4.1: Topical Preparations

1.9.4.2: Transdermal Preparations

1.9.4.3: Suppositories

This page titled [1.9: Drug Forms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.9.1: Liquids

Liquid drug forms include solutions, syrups, elixirs, and suspensions. A solution is a liquid in which the drug has been dissolved. A syrup is a a thick, viscous solution. An elixir is a type of solution in which the drug is dissolved in alcohol. In a suspension, the drug is not completely dissolved but remains intact and is suspended in the liquid. Suspensions must always be mixed or shaken before administration. Certain liquids can be administered by injection or parenteral administration.

This page titled [1.9.1: Liquids](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.9.2: Powders

Drugs that are manufactured in powdered form can be inhaled, used topically, or reconstituted into solution or suspension, depending on the manufacturing instructions.

This page titled [1.9.2: Powders](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.9.3: Oral Drug Forms

This page titled [1.9.3: Oral Drug Forms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.3.1: Enteric-coated Tablets

Enteric coated tablets are covered with a waxy substance that prohibits the drug from being dissolved in the stomach. This coating prevents irritation to the stomach. Enteric coated tablets should never be split or crushed (Maderuelo et al., 2019).

This page titled [1.9.3.1: Enteric-coated Tablets](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.3.2: Scored Tablets

Scored tablets have a score line or an indentation through the center of the tablet. The score line makes it easy to split the tablet in half. This practice may allow for easier swallowing, more flexible dosage, and reduced drug costs (Chaudhri et al., 2019).

This page titled [1.9.3.2: Scored Tablets](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.3.3: Sublingual and Buccal Tablets

Sublingual tablets are placed under the tongue and absorbed through the mucous membranes of the mouth. Buccal tablets are placed between the cheek and gum and are also absorbed through the mucous membranes of the mouth. Blood vessels are located close to the surface in mucous membranes, so sublingual and buccal administration routes allow for rapid absorption into the blood stream (Hua, 2019).

This page titled [1.9.3.3: Sublingual and Buccal Tablets](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.9.3.4: Chewable Tablets

Chewable tablets should be chewed by the patient and contain flavors to make them more palatable (U.S. Food and Drug Administration, 2018b).

This page titled [1.9.3.4: Chewable Tablets](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.3.5: Effervescent Tablets

Effervescent tablets are placed in water and must be fully dissolved before consumption.

This page titled [1.9.3.5: Effervescent Tablets](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.3.6: Capsules

Capsules are solid drugs enclosed in a soluble container, usually made from gelatin. When a capsule is clear, it is easy to see the solid medication inside.

This page titled [1.9.3.6: Capsules](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

1.9.3.7: Lozenges (Troches)

Lozenges or troches are hard discs placed in the mouth, where they dissolve slowly. A cough drop is an example of a troche or lozenge.

This page titled [1.9.3.7: Lozenges \(Troches\)](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.3.8: Dissolving Film

Dissolving films are placed on the tongue and dissolve quickly. This type of drug form is often a good choice for children or patients who have trouble swallowing pills. Dissolving films do not require water for swallowing, have a good mouth feel, and reduce the risk of choking during administration (Dahmash et al., 2021).

This page titled [1.9.3.8: Dissolving Film](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.4: Other Forms of Drugs

This page titled [1.9.4: Other Forms of Drugs](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.4.1: Topical Preparations

Topical drugs are applied directly to the skin. These include creams, lotions, ointments, gels, and pastes. Topical drugs usually have a local effect, which means the drug's action occurs only where it is applied. For example, applying an ointment directly to a rash helps relieve the rash.

This page titled [1.9.4.1: Topical Preparations](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.4.2: Transdermal Preparations

Transdermal drugs are usually manufactured as patches that are applied to the skin. The drug is absorbed through the skin and reaches the bloodstream for a systemic effect. An example is a nicotine patch that a patient would apply to help them quit smoking.

This page titled [1.9.4.2: Transdermal Preparations](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

1.9.4.3: Suppositories

Suppositories are solid drugs usually manufactured in a glycerin base in a cylindrical shape to allow for ease of administration into the rectum or vagina. The glycerin base melts at body temperature, so it is important to limit handling of the suppository until just before insertion.

This page titled [1.9.4.3: Suppositories](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

1.10: Chapter 1 References

- American Diabetes Association. (2019, July 1). *The history of a wonderful thing we call insulin*. <https://www2.diabetes.org/blog/histo...e-call-insulin>
- American Heart Association (2023). *Types of blood pressure medication*. Retrieved September 23, 2023, from <https://www.heart.org/en/health-topi...re-medications>
- Baytas, S. N., & Linhardt, R. J. (2020). Advances in the preparation and synthesis of heparin and related products. *Drug Discovery Today*, 25(12), 2095–2109. <https://doi.org/10.1016/j.drudis.2020.09.011>
- Bers, D. M. (2002). Calcium and cardiac rhythms: physiological and pathophysiological. *Circulation Research*, 90(1), 14–17. <https://doi.org/10.1161/res.90.1.14>
- Bureau of Labor Statistics. (2023, September 6). *Occupational outlook handbook: Medical assistants*. U.S. Department of Labor. <https://www.bls.gov/ooh/healthcare/m...assistants.htm>
- Center for the History of Medicine. (n.d.). Apothecaries from the eighteenth century onward: USA. Harvard Countway Library. Retrieved September 23, 2023, from <https://collections.countway.harvard...th-century-usa>
- Chaudhri, K., Kearney, M., Di Tanna, G. L., Day, R. O., Rodgers, A., & Atkins, E. R. (2019, October 18). Does splitting a tablet obtain the accurate dose?: A systematic review protocol. *Medicine*, 98(42), e17189. <https://doi.org/10.1097/MD.00000000000017189>
- Dahmash, E. Z., Iyire, A., & Alyami, H. S. (2021, May 1). Development of orally dissolving films for pediatric-centric administration of anti-epileptic drug topiramate—A design of experiments (DoE) study. *Saudi Pharmaceutical Journal*, 29(7), 635–647. <https://doi.org/10.1016/j.jps.2021.04.025>
- Drug Enforcement Administration. (n.d.) *The Controlled Substances Act*. U.S. Department of Justice. <https://www.dea.gov/drug-information/csa>
- DEA Museum. (n.d.). *Opium poppy*. U.S. Department of Justice. Retrieved September 6, 2023, from <https://museum.dea.gov/exhibits/onli...ts/opium-poppy>
- Demain, A. L., & Sanchez, S. (2009). Microbial drug discovery: 80 years of progress. *The Journal of Antibiotics*, 62(1), 5–16. <https://doi.org/10.1038/ja.2008.16>
- Hua S. (2019, November 5). Advances in nanoparticulate drug delivery approaches for sublingual and buccal administration. *Frontiers in Pharmacology*, 10, 1328. <https://doi.org/10.3389/fphar.2019.01328>
- Jerry H. Hodge School of Pharmacy. (n.d.). *The history of pharmacy*. Texas Tech University Health Sciences Center. Retrieved September 6, 2023, from <https://www.ttuhsc.edu/pharmacy/muse...y.history.aspx>
- Kelly, N., Rees, & Shuter, P. (2003). *Medicine through time*. Heinemann.
- Kocak, M. (2022). Radiographic contrast agents. In *Merck Manual, Consumer Version*. Merck & Co., Inc. Retrieved June 10, 2023, from <https://www.merckmanuals.com/home/sp...ontrast-agents>
- Maderuelo, C., Lanao, J. M., & Zarzuelo, A. (2019, October 1). Enteric coating of oral solid dosage forms as a tool to improve drug bioavailability. *European Journal of Pharmaceutical Sciences*, 138, 105019. <https://doi.org/10.1016/j.ejps.2019.105019>
- Mathur, S., & Hoskins, C. (2017, May 9). Drug development: Lessons from nature. *Biomedical Reports*, 6(6), 612–614. <https://doi.org/10.3892/br.2017.909>
- National Center for Biotechnology Information (2023). *PubChem compound summary for neomycin*. Retrieved September 23, 2023, from <https://pubchem.ncbi.nlm.nih.gov/compound/Neomycin>.
- National Institute of Allergy and Infection Diseases (n.d.). *Vaccine types*. Retrieved September 23, 2023, from <https://www.niaid.nih.gov/research/vaccine-types>

- Natural Medicines Comprehensive Database, Consumer Version [Internet]. *Amoxicillin* [updated 2022b January 15]. Retrieved June 10, 2023, from <https://medlineplus.gov/druginfo/meds/a685001.html>
- Natural Medicines Comprehensive Database, Consumer Version [Internet]. *Definition of health terms: Minerals* [updated 2022a March 2]. Retrieved September 23, 2023, from <https://medlineplus.gov/definitions/...finitions.html>
- Natural Medicines Comprehensive Database, Consumer Version [Internet]. *Levothyroxine* [updated 2019, February 15]. Retrieved June 10, 2023, from <https://medlineplus.gov/druginfo/meds/a682461.html>
- Natural Medicines Comprehensive Database, Consumer Version [Internet]. *Morphine* [updated 2023 May 15]. Retrieved June 10, 2023, from <https://medlineplus.gov/druginfo/meds/a682133.html>
- Ngo, V.T.H & Bajaj, T. (2023, May 29). *Heparin*. In StatPearls [Internet]. StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK542299/>
- Thacker, B., Glass, C., & Sharfstein, S. (2021). Advancing to recombinant heparin. *American Pharmaceutical Review*, 24(5). <https://www.americanpharmaceuticalre...inant-Heparin/>
- Smith, C. (2017, January 10). Native American history: A tale of medicine. *The Differential*. <https://www.thedifferentialdx.com/native-american-history-a-tale-of-medicine/>
- Strazzullo, P., & Leclercq, C. (2014). Sodium. *Advances in Nutrition*, 5(2), 188–190. <https://doi.org/10.3945/an.113.005215>
- U. S. Food and Drug Administration. (2017, November 14). *Drugs@FDA glossary of terms*. <https://www.fda.gov/drugs/drug-appro...glossary-terms>
- U. S. Food and Drug Administration. (2021a, October 22). *FDA adverse event reporting system (FAERS) public dashboard*. <https://www.fda.gov/drugs/questions-...blic-dashboard>
- U. S. Food and Drug Administration. (2021b, October 22). *Generic drugs: Questions & answers*. <https://www.fda.gov/drugs/frequently...stions-answers>
- U. S. Food and Drug Administration. (2018a, November 27). *Part II: 1938, Food, Drug, Cosmetic Act*. <https://www.fda.gov/about-fda/change...g-cosmetic-act>
- U.S. Food and Drug Administration. (2018b, August). Quality attribute considerations for chewable tablets guidance for industry. (Docket Number FDA-2016-D-1490). Center for Drug Evaluation and Research. <https://www.fda.gov/media/98598/download>
- U. S. Food and Drug Administration. (2018c, January 1). *The history of drug regulation*. <https://www.fda.gov/about-fda/fda-hi...rug-regulation>
- U.S. Food and Drug Administration (n.d.) Retrieved September 23, 2023, from <https://www.usa.gov/agencies/food-an...administration>
- U. S. Food and Drug Administration. (2023, February 8). *Vaccines*. <https://www.fda.gov/vaccines-blood-biologics/vaccines>
- Warnock, L. B. & Huang, D. (2022, July 12). *Ibuprofen*. In StatPearls [Internet]. StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK538247>

This page titled [1.10: Chapter 1 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

CHAPTER OVERVIEW

Chapter 2: Drug Safety and Pharmacology Principles

- 2.1: Main Terms
- 2.2: Chapter Goals
- 2.3: Drug Safety
- 2.4: Drug Errors Classifications
- 2.5: Factors that Can Influence Drug Errors
- 2.6: Strategies to Reduce Drug Errors
- 2.7: The Nine Rights of Drug Administration
 - 2.7.1: The right drug
 - 2.7.2: The right dose
 - 2.7.3: The right route
 - 2.7.4: The right time
 - 2.7.5: The right patient
 - 2.7.6: The right education
 - 2.7.7: The right to refuse
 - 2.7.8: The right technique
 - 2.7.9: The right documentation
- 2.8: Steps to Take for Drug Errors
- 2.9: Drug Terminology
 - 2.9.1: Drug Actions
 - 2.9.1.1: Indications for Use
 - 2.9.1.2: Desired Effects
 - 2.9.1.3: Side Effects
 - 2.9.1.4: Adverse Effects
 - 2.9.1.5: Systemic and Local Effects
 - 2.9.1.6: Drug-Drug Interactions
 - 2.9.1.7: Potentiation
 - 2.9.1.8: Synergism
 - 2.9.1.9: Agonist
 - 2.9.1.10: Antagonists
 - 2.9.1.11: Drug-Food Interactions
 - 2.9.2: Other Factors Influencing Drug Actions
 - 2.9.2.1: Age – Elderly
 - 2.9.2.2: Age- Infants and Children
 - 2.9.2.3: Sex
 - 2.9.2.4: Genetics
 - 2.9.2.5: Comorbidities and Polypharmacy
 - 2.9.2.6: Diet
 - 2.9.2.7: Mental State
 - 2.9.2.8: Drug Biologic Half-Life
 - 2.9.2.9: Drug Blood Levels
 - 2.9.2.10: Loading Doses
 - 2.9.2.11: Maintenance Doses

[2.9.2.12: Pharmacokinetics](#)

[2.9.2.12.1: Absorption](#)

[2.9.2.12.2: Distribution](#)

[2.9.2.12.3: Metabolism](#)

[2.9.2.12.4: Excretion](#)

[2.10: Chapter 2 References](#)

This page titled [Chapter 2: Drug Safety and Pharmacology Principles](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

2.1: Main Terms

Absorption – the process by which drugs are absorbed into the blood stream

Adverse effects – harmful results from a drug

Agonist – a drug that causes a cell action

Antagonist – a drug that prohibits a cell action

Blood level – the amount of drug in the blood at the time of the test

Comorbidity – the state of being diagnosed with more than one disease or condition

Desired effect – the ability of a drug to achieve what is expected

Distribution – the process of drug circulation through the bloodstream

Excretion – the process of drug elimination from the body

Half-life – the time it takes for the body to break down one-half of the drug administered

Indication – the desired purpose of a drug

Interactions – a reaction between two or more drugs or between a drug and food

Loading dose – the amount of drug needed to quickly increase blood level

Local effects – when a drug affects a small area of the body

Maintenance dose – the amount of drug needed to maintain therapeutic drug levels

Metabolism – the process of a drug being broken down

Pharmacokinetics – the study of how drugs move throughout the body

Polypharmacy – when patients take more than one drug

Potential – the phenomenon in which one drug increases the effectiveness of another drug

Right documentation – a step of the nine rights of medication administration

Right dose – a step of the nine rights of medication administration

Right education – a step of the nine rights of medication administration

Right medication – a step of the nine rights of medication administration

Right patient – a step of the nine rights of medication administration

Right technique – a step of the nine rights of medication administration

Right time – a step of the nine rights of medication administration

Right to refuse – a step of the nine rights of medication administration

Side effects – unpleasant effects of drugs

Synergism – the phenomenon whereby the combined effect of two or more drugs is greater than the sum of the effects of the drugs if given alone

Systemic effects – effects that a drug has on the entire body

This page titled [2.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#) .

2.2: Chapter Goals

- Explain drug safety and steps the MA can take to reduce drug errors.
 - Describe the nine rights of drug administration.
 - Identify drug classifications, including indications for use, desired effects, side effects, and adverse effects.
 - Discuss terminology used in pharmacy, including drug blood levels, half-life, loading dose, and maintenance dose.
 - Identify the phases of pharmacokinetics, including absorption, distribution, metabolism, and excretion.
-

This page titled [2.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

2.3: Drug Safety

Every patient deserves safe, high-quality care, and the medical assistant plays an important role in ensuring patient safety. Errors in care can lead to life-altering or life-threatening circumstances for the patient. Thus, avoiding these mistakes is very important. The World Health Organization estimates that 50% of healthcare errors that cause patient harm are due to drug errors. Importantly, drug errors are preventable: safety measures should be in place to decrease errors in patient care.

The National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP) defines a medication error as follows:

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 (2023).

The role of the MA in drug errors may occur while administering the drug, when performing drug calculations, when transcribing prescription orders, or during patient teaching. Drug errors are not intentional. However, when an error occurs, it is vital to determine the cause or breakdown in the system to prevent future errors. Every organization or institution should have a drug error reporting system in place and processes to mitigate errors and prevent future mistakes. (Academy of Managed Care Pharmacy, 2019; Rodziewicz et al., 2023; World Health Organization, 2023).

This page titled [2.3: Drug Safety](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

2.4: Drug Errors Classifications

Errors may occur during any stage of the drug use process. These include prescribing, transcribing, dispensing, administration, or monitoring. Types of errors related to drug administration include the wrong patient, the wrong medication, the wrong frequency, or the wrong route. Drug errors can be the result of knowledge-based mistakes, rule-based mistakes, memory lapses, or errors in execution of appropriate planned actions.

This page titled [2.4: Drug Errors Classifications](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.5: Factors that Can Influence Drug Errors

Mistakes made by the MA can be the result of any of the following:

- Lack of training
- Inadequate knowledge of and experience with the drug
- Inadequate knowledge of the patient
- Inadequate perception of the risks associated with the drug
- Overworked or fatigued MAs
- MAs who have physical and/or emotional issues
- A breakdown in communication between the provider, the MA, and the patient

The work environment may have faults or breakdowns that may cause drug errors. These include an environment where the workload and time pressures do not allow for the MA to carefully perform each step during drug preparation and administration. Distractions and interruptions while the MA is preparing or administering drugs may produce errors. Insufficient resources or a lack of standardized protocols may also lead to drug errors.

The Institute for Safe Medication Practice (ISMP) publishes a List of High-Alert Medications in Community/Ambulatory Care Settings that are associated with a high risk of causing significant patient harm when they are used in error. A few of the drugs listed include metformin, heparin, and warfarin, which will be discussed later in this text.

This page titled [2.5: Factors that Can Influence Drug Errors](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

SECTION OVERVIEW

2.6: Strategies to Reduce Drug Errors

Strategies to reduce risks of drug errors include using high-alert labels and automated alerts for high-risk drugs, improving employee education about these drugs, and providing mandatory patient education. MAs can safeguard patients from drug errors by only administering those medications that they have personally prepared, taking a thorough drug history from the patient, ensuring that patient allergies are documented, and watching for potential drug–drug and drug–food interactions. The MA should never administer a drug if the provider’s order is confusing or if the dose does not match the recommended dose range found in the drug reference utilized. Always ask for clarification before administering any confusing order. Another best practice for MAs is to perform the nine rights with every drug administration. (Institute for Safe Medication Practices, 2021).

This page titled [2.6: Strategies to Reduce Drug Errors](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

2.7: The Nine Rights of Drug Administration

The Rights of Drug Administration have been updated through the years. Some healthcare disciplines may utilize different “rights” of drug administration. The following are the 9 rights of drug administration that best serve the medical assistant in ambulatory care settings.

2.7.1: The right drug

2.7.2: The right dose

2.7.3: The right route

2.7.4: The right time

2.7.5: The right patient

2.7.6: The right education

2.7.7: The right to refuse

2.7.8: The right technique

2.7.9: The right documentation

This page titled [2.7: The Nine Rights of Drug Administration](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by Anna Jannak (Consortium of Academic and Research Libraries in Illinois (CARLI)).

SECTION OVERVIEW

2.7.1: The right drug

Choosing the right drug to administer includes utilizing the Three Befores or three checks to ensure the correct drug has been chosen. Check before taking the drug out of the supply area, check the drug before preparing it, and check the drug before putting it back in storage (or before disposing of the packaging).

1. Check the drug against the provider order before taking it out of the supply area. The MA checks the correct concentration, spelling, and form of the drug that has been ordered.
2. Check the drug against the provider order before preparing the drug. After gathering supplies, check the drug again before preparing the drug for administration.
3. Check the drug against the provider order before putting the container back in the storage area or disposing of the packaging.

This page titled [2.7.1: The right drug](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.7.2: The right dose

The MA should have a working knowledge of all medications they administer, including the acceptable dose ranges. The MA should double-check drug calculations and never administer a drug if they are not certain their calculations are correct. The MA should also use the proper device to obtain the most accurate measurement. For example, the MA would choose a 3mL syringe to administer a 1.5mL injection. It is difficult to measure an accurate dose with a larger syringe, such as a 5mL or a 10mL syringe.

This page titled [2.7.2: The right dose](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.7.3: The right route

The MA should match the route with the provider order. For example, some medications are given by mouth, by injection, or topically.

This page titled [2.7.3: The right route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.7.4: The right time

The MA should check the timing of the drug against the provider order. The provider may want a drug to be administered in time intervals to keep blood levels of the drug at therapeutic levels. Examples of timing include immediately, as soon as possible, after meals, at bedtime, or every 6 hours.

This page titled [2.7.4: The right time](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.7.5: The right patient

The MA should verify the patient's name by asking the patient for their name and date of birth. If the patient is wearing an identification bracelet, this should also be checked. The MA should make sure the patient's name is the same as the name on the provider's order. It is acceptable for the MA to ask the parent or guardian to identify young children.

This page titled [2.7.5: The right patient](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.7.6: The right education

Before administering the drug, the MA should provide the patient with the name of the drug, the drug's intended effect of the drug, who ordered the drug, and the drug's common adverse and side effects. The MA must also check for any food or drug allergies the patient may have. Checking for allergies at this point is very important, even if it appears that the patient's allergies have been documented in the patient's medical record. Sometimes, patients forget about allergies and remember them later during the administration process.

This page titled [2.7.6: The right education](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.7.7: The right to refuse

Patients always have a right to refuse any medication or treatment ordered by the provider or offered by the medical assistant. Ask the patient why they are refusing the drug. There may be a logical reason for their refusal: they may have taken the drug already, they may be allergic to the drug, or they may not feel safe taking the drug. Do not pressure the patient to take any drug, but notify the provider about the patient's refusal and the reason for the refusal. Document in the patient's medical record the patient's refusal, the reason for the refusal, and the provider who was notified about the refusal.

This page titled [2.7.7: The right to refuse](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.7.8: The right technique

▶ The MA should always use aseptic technique to avoid infection. If the MA is injecting a drug, an appropriate site should be chosen, and the delivery technique should be appropriate for the injection site. Some medications require monitoring or measuring before drug administration. The MA may be required to measure and document vital signs, pain level, or other details before administering some drugs. ◀

This page titled [2.7.8: The right technique](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.7.9: The right documentation

The MA must document all drug administration in the patient's medical record. Most practice management software systems populate fields appropriate for this task. However, these items are important to document:

- Date and time of administration
- The provider who ordered the drug
- Any assessments completed (pain level or vital signs)
- Patient drug or food allergies
- Patient education provided
- Name of the medication
- Dose of the medication
- Route the medication was administered
- Lot number, expiration date, and manufacturer for some drugs (vaccines)
- The patient's response to the drug
- Side effects or adverse effects experienced by the patient
- Any further actions taken regarding patient response, side effects, or adverse effects
- Any pertinent additional information such as patient refusal, patient position, patient comments
- The MA's signature with credentials such as CMA or RMA

When documenting the drug dose, it is important to document the weight administered (e.g., grams, milligrams, or micrograms). The number of pills, milliliters, or other volume measurements are not as important as the actual amount of the drug administered.

This is an example of good documentation in a patient's medical record:

1/1/20xx 13:00. The patient's heart rate is 84bpm. Patient states that she has no drug or food allergies. Dr. Penter order for metoprolol explained to patient and patient instructed to check heart rate before taking drug. If the patient notices that their heart rate is below 60bpm, do not take the metoprolol. Metoprolol 50mg administered by mouth, patient tolerated procedure well. No side effects or adverse effects. Patient verbalized understanding of instructions. -----

-----M: Rodriguez CMA-----

This page titled [2.7.9: The right documentation](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.8: Steps to Take for Drug Errors

The clinic or organization should have policies and procedures in place if a drug error occurs. The MA should be familiar with these. If an error is made, the MA must first assess the patient, then take any emergency measures needed and permitted by the policies and procedures. Notify the provider about the drug error and proceed with any provider instructions or orders. The occurrence should be documented, and an incident report should be completed. After the event, the occurrence should be investigated to determine what part of the drug administration system broke down. Steps should be taken to avoid future errors (Hanson & Haddad, 2022).

This page titled [2.8: Steps to Take for Drug Errors](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9: Drug Terminology

It is important for the MA to understand drug terminology to ensure patient safety and provide the patient with adequate education regarding their prescriptions and over-the-counter drugs. The MA should be familiar with terms related to drug actions, factors that influence drug actions and pharmacokinetics.

This page titled [2.9: Drug Terminology](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9.1: Drug Actions

Providers consider many factors when deciding to prescribe a drug for a patient. After determining the patient's diagnosis, they review a prospective drug's indications for use, desired effects, side effects, adverse effects, interactions, and contraindications. Providers also review drug pharmacokinetics, onset, peak, duration, and biologic half-life.

This page titled [2.9.1: Drug Actions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.1: Indications for Use

The indication for use is defined as the purpose for the patient taking a certain medication. For example, a patient with hypertension would take an antihypertensive drug. The purpose of the antihypertensive drug is to reduce blood pressure. Therefore, antihypertensive drugs are indicated when a patient has high blood pressure (Khalil & Zeltser, 2023).

This page titled [2.9.1.1: Indications for Use](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.2: Desired Effects

The desired effects of a drug are what the prescriber expects the drug to do to the patient. For example, the desired effect of an antihypertensive drug is to lower blood pressure.

This page titled [2.9.1.2: Desired Effects](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.3: Side Effects

Side effects are effects caused by the medication that are usually expected and unpleasant. When a patient experiences side effects, the prescriber may or may not discontinue the medication, depending on how unpleasant the effects are. For example, diarrhea is a very common side effect for patients who take antibiotics, who are usually told to expect a certain amount of flatulence and diarrhea. A prescriber may ask a patient to continue the antibiotic unless the patient has become severely dehydrated (Leheny, 2017).

This page titled [2.9.1.3: Side Effects](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.4: Adverse Effects

Adverse effects are effects that are potentially life threatening. For example, a patient reports a rash, swelling, and difficulty breathing after taking a medication. This is a potentially life-threatening condition, and the medication should be discontinued immediately. The patient should also seek immediate medical care.

This page titled [2.9.1.4: Adverse Effects](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.5: Systemic and Local Effects

Medications can have effects across the entire body or in a small area. For example, an antihypertensive medication will reduce blood pressure everywhere in the body, which is a systemic effect. On the other hand, hydrocortisone cream will only affect the area where it is applied, which is a local effect.

This page titled [2.9.1.5: Systemic and Local Effects](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.6: Drug-Drug Interactions

When two or more drugs are given together, they can affect each other in many ways. It is important for the medical assistant to be aware of these interactions.

This page titled [2.9.1.6: Drug-Drug Interactions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.7: Potentiation

Potentiation is defined as one medication increasing the effectiveness of another medication. An example of potentiation is the risk of taking an opioid drug and a benzodiazepine drug. Opioids are commonly prescribed for pain relief and benzodiazepines are often prescribed for anxiety. When these are taken together, the patient can experience extreme sedation and respiratory depression that can lead to death.

This page titled [2.9.1.7: Potentiation](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9.1.8: Synergism

Synergism is a type of drug interaction in which the combined effect of two or more drugs is greater than the sum of the effect of each drug given separately. For example, when aspirin and acetaminophen are given together, the combined effect reduces pain more than if each were given separately (National Cancer Institute, n.d.).

This page titled [2.9.1.8: Synergism](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.9: Agonist

An agonist medication is one that binds to a receptor site either in or on a cell and causes a cell action to begin. Our bodies have opioid receptors in the central and peripheral nervous system that are responsible for reducing the feeling of pain. Morphine, a potent pain reliever, acts as an agonist by binding to the opioid receptors in the cells of our nervous system. This agonist effect of morphine then reduces the patient's perception of pain, providing pain relief (Murphy et al., 2023).

This page titled [2.9.1.9: Agonist](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9.1.10: Antagonists

A medication that is considered an antagonist binds to receptor sites either in or on the cells and stops the cell from producing a response. The human heart has beta receptors in its cells that respond to the sympathetic nervous system by increasing heart rate and blood pressure. A beta blocker medication blocks the beta receptors that are sensitive to adrenaline. Beta blockers are considered antihypertensive medications (Alhayek & Preuss, 2022).

This page titled [2.9.1.10: Antagonists](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.1.11: Drug-Food Interactions

Drug–food interactions are reactions between a medication and a food or beverage. A common example of a drug–food interaction is the consumption of dairy products while taking antibiotics. Dairy products can block the absorption of antibiotics in the stomach when taken together (Choi & Ko, 2017).

This page titled [2.9.1.11: Drug-Food Interactions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.2: Other Factors Influencing Drug Actions

Other factors that may influence drug actions include age, sex, genetics, co-morbidities, polypharmacy, diet, and mental state.

This page titled [2.9.2: Other Factors Influencing Drug Actions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

2.9.2.1: Age – Elderly

Most people experience a decline of function in the organs responsible for medication pharmacokinetics. The liver, kidneys, lungs, and gastrointestinal system all decline in function as we age. This means that most older people cannot absorb, metabolize, or excrete medications as well as they could when they were younger. Therefore, the Medical Assistant needs to be aware that older patients may require smaller amounts of medications to be effective and safe.

The Therapeutic Research Center publishes a list of medications that are potentially harmful for patients over the age of 65 years. Many providers reference The Beers List when prescribing for their elderly patients (Therapeutic Research Center, 2019).

This page titled [2.9.2.1: Age – Elderly](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9.2.2: Age- Infants and Children

In infants, immature organs, such as the liver, may affect the metabolism of medications. Most medications for infants and children are prescribed based on their weight. We call these weight-based medications. In most cases, weight-based medications are calculated based on the patient's weight in kilograms, not pounds. The MA needs to be able to correctly calculate these medications to ensure patient safety. We will learn more about that in Chapter 4 (Delgado et al., 2022).

This page titled [2.9.2.2: Age- Infants and Children](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9.2.3: Sex

Men and women can experience physiologic differences to many medications. For example, women who have delayed gastric emptying may be required to take certain medications less frequently than men (U.S. Food and Drug Administration, 2019a).

This page titled [2.9.2.3: Sex](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9.2.4: Genetics

In choosing a drug for a patient, a prescriber often considers genetics or pharmacogenomics. Drugs do not have the same effectiveness or potential for allergic reactions for all people. For example, most people can take coumadin to prevent blood clots, but it may cause a severe allergic reaction in some people. Researchers are taking advantage of this phenomenon and are working to create medications specifically developed for a person's genetic makeup. This work is called pharmacogenomics and is expected to have a significant impact on healthcare and medications (MedlinePlus, 2022).

This page titled [2.9.2.4: Genetics](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9.2.5: Comorbidities and Polypharmacy

Comorbidity is defined as the presence of two or more chronic diseases. This is common for elderly patients and often results in patients taking more than one medication. Polypharmacy occurs when patients take several prescribed medications. Polypharmacy may lead to an increased risk of drug–drug interactions, drug–disease interactions, and adverse reactions. It is important for the medical assistant to document all patient medications and disease processes to reduce the risk of these potentially life-threatening effects (Kurt et al., 2019).

This page titled [2.9.2.5: Comorbidities and Polypharmacy](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

2.9.2.6: Diet

Certain medications should be taken on an empty stomach, and some should be taken with a meal, before a meal, or after a meal. If not taken properly, the medication may not be absorbed properly in the gastrointestinal tract. Some medications come with instructions not to consume certain foods while taking the drug. For example, leafy, green vegetables should not be consumed while taking warfarin because warfarin is an anticoagulant, and green leafy vegetables contain vitamin K, which promotes blood clotting. Therefore, eating a salad with green leafy vegetables would counteract any warfarin the patient takes. Medical assistants should be aware of these types of interactions and include them in patient teaching (National Institutes of Health, 2021; Patel et al., 2023).

This page titled [2.9.2.6: Diet](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

2.9.2.7: Mental State

Research has shown that patients who have a positive attitude regarding their disease process and prescribed medications are more likely to comply with their medication therapy (Bassett et al., 2019).

This page titled [2.9.2.7: Mental State](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.2.8: Drug Biologic Half-Life

Drug half-life is defined as the amount of time it takes for the liver to metabolize or break down medication. For example, if a medication has a half life of six hours, and a patient takes 1000 milligrams of this medication at 12:00 p.m., the liver will metabolize or break down 500 milligrams of this medication by 6:00 p.m. (Hallare & Gerriets, 2022).

This page titled [2.9.2.8: Drug Biologic Half-Life](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.2.9: Drug Blood Levels

Drug blood level is defined as the amount of the medication in the patient's blood. Drug blood levels are determined by blood tests. Some medications require blood level monitoring to be most effective (MedlinePlus, 2021).

This page titled [2.9.2.9: Drug Blood Levels](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.2.10: Loading Doses

A loading dose is defined as a large amount of medication that is taken to quickly increase blood levels to a therapeutic range (Miniaci & Gupta, 2022).

This page titled [2.9.2.10: Loading Doses](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.2.11: Maintenance Doses

A maintenance dose is the amount of medication the patient must take to maintain therapeutic blood levels. Maintenance doses are determined by drug blood levels, which are affected by a patient's age, weight, ethnic differences, disease, pharmacogenomics, and pharmacokinetics

(World Health Organization, 2023).

This page titled [2.9.2.11: Maintenance Doses](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

2.9.2.12: Pharmacokinetics

Pharmacokinetics is an important process for the medical assistant to understand. It is the study of how the body reacts to medications from administration through excretion. Pharmacokinetics comprises four phases: absorption, distribution, metabolism, and excretion. When choosing a drug, the provider must consider the health or disease of the organs responsible for each phase (Grogan & Preuss, 2022).

This page titled [2.9.2.12: Pharmacokinetics](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.9.2.12.1: Absorption

Absorption is the method by which the medication is absorbed into the bloodstream. Oral medications are absorbed through the gastrointestinal tract, injectable medications are absorbed through skin layers or muscle, and transdermal medications are absorbed through the skin.

This page titled [2.9.2.12.1: Absorption](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.9.2.12.2: Distribution

Distribution is the process whereby the medication is transported through the bloodstream to the target tissues or organs.

This page titled [2.9.2.12.2: Distribution](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.9.2.12.3: Metabolism

Metabolism is the process by which the liver breaks down the medication. Patients with liver disease will metabolize drugs slowly and are therefore susceptible to toxic effects from drugs.

This page titled [2.9.2.12.3: Metabolism](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.9.2.12.4: Excretion

Excretion is the process of eliminating medication from the body. Excretion occurs via the kidney, the gastrointestinal tract, the respiratory system, and the skin. Patients with altered kidney function may excrete drugs slowly, which the provider must consider when prescribing drugs.

This page titled [2.9.2.12.4: Excretion](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

2.10: Chapter 2 References

- Academy of Managed Care Pharmacy. (2019, July 18). *Medication errors*. <https://www.amcp.org/about/managed-care-pharmacy-101/concepts-managed-care-pharmacy/medication-errors>
- Alhayek, S. & Preuss, C. V. (2022, August 8). Beta 1 receptors. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK532904/>
- Bassett, S. M., Schuette, S. A., O'Dwyer, L. C., & Moskowitz, J. T. (2019, August 1). Positive affect and medication adherence in chronic conditions: A systematic review. *Health Psychology*, 38(11), 960–974. <https://doi.org/10.1037/hea0000778>
- Choi, J. H., & Ko, C. M. (2017, January 31). Food and drug interactions. *Journal of Lifestyle Medicine*, 7(1), 1–9. <https://doi.org/10.15280/jlm.2017.7.1.1>
- Delgado, B. J., Safadi, A. O., & Bajaj, T. (2022, July 5). Clark's Rule. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK541104/>
- Grogan, S. & Preuss, C. (2022, June 23). Pharmacokinetics. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK557744/>
- Hallare, J. & Gerriets, V. (2022, June 23). Half life. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK554498/>
- Hanson A., Haddad L.M. (2022, September 5). Nursing rights of medication administration. *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK560654/>
- Institute for Safe Medication Practices. (2021, September 30). *High-alert medications in community/ambulatory settings*. <https://www.ismp.org/recommendations/high-alert-medications-community-ambulatory-list>
- Khalil, H. & Zeltser, R. (2023, May 8). Antihypertensive medications. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK554579>
- Kurt, M., Akdeniz, M., & Kavukcu, E. (2019, September 6). Assessment of comorbidity and use of prescription and nonprescription drugs in patients above 65 years attending family medicine outpatient clinics. *Gerontology & Geriatric Medicine*, 5, 2333721419874274. <https://doi.org/10.1177/2333721419874274>
- Leheny, S. (2017, February 22). "Adverse event" not the same as "side effect." *Pharmacy Times*. <https://www.pharmacytimes.com/view/adverse-event-not-the-same-as-side-effect>
- MedlinePlus (2021, September 16). *Therapeutic drug monitoring*. Available from: <https://medlineplus.gov/lab-tests/therapeutic-drug-monitoring/>
- MedlinePlus (2022, March 22). *What is pharmacogenomics?* Available from: <https://medlineplus.gov/genetics/understanding/genomicresearch/pharmacogenomics/>
- Miniaci, A. & Gupta, V. (2022, June 23). Loading dose. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK557418/>
- Murphy, P. B., Bechmann, S., & Barrett, M. J. (2023, May 22). Morphine. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK526115/>
- National Cancer Institute. (n.d.). Synergistic. In *NIC dictionaries—Dictionary of cancer terms*. Retrieved June 10, 2023, <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/synergistic>
- National Coordinating Council for Medication Error Reporting and Prevention (2023). *About medication errors*. Retrieved September 25, 2023, from <https://www.nccmerp.org/about-medication-errors>
- National Institutes of Health. (2021, March 29). *Vitamin K: Fact sheet for health professionals*. Office of Dietary Supplements. <https://ods.od.nih.gov/factsheets/VitaminK-HealthProfessional/>
- Pan, S. D., Zhu, L. L., Chen, M., Xia, P., & Zhou, Q. (2016). Weight-based dosing in medication use: What should we know? *Patient Preference and Adherence*, 10, 549–560. <https://doi.org/10.2147/PPA.S103156>
- Patel, S., Singh, R., Preuss, C. V., Patel, N. (2023, March 24). Warfarin. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK470313/>

- Rodziewicz T.L., Houseman B., Hipkind J.E. (2023, May 2). *Medical error reduction and prevention*. In: StatPearls. <https://www.ncbi.nlm.nih.gov/books/NBK499956/>
- Therapeutic Research Center (2019). *Potentially harmful drugs in the elderly: Beers list* [Clinical Resource #350301]. <https://www.pharmacyquality.com/wp-content/uploads/2019/05/Beers-List-350301.pdf>
- U. S. Food and Drug Administration. (2019a, April 12). *Understanding sex differences at FDA*. <https://www.fda.gov/science-research/womens-health-research/understanding-sex-differences-fda>
- World Health Organization. (2023). *ATC-DDD Toolkit: Defined daily dose*. <https://www.who.int/tools/atc-ddd-toolkit/about-ddd>
- World Health Organization. (2023, September 11). *Patient safety*. <https://www.who.int/news-room/fact-sheets/detail/patient-safety>

This page titled [2.10: Chapter 2 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

CHAPTER OVERVIEW

Chapter 3: Prescriptions, Orders, and Documentation

3.1: Main Terms

3.2: Chapter Goals

3.3: Prescriptions

3.3.1: Parts of a Prescription

3.3.2: Electronic Prescriptions

3.4: Medical Assistant's Role in Prescriptions

3.4.1: Patient Education

3.4.2: Refill Requests

3.4.3: Medication Reconciliation

3.4.4: Documentation in the Medical Record

3.5: Other Types of Drug Orders

3.5.1: Routine Order

3.5.2: Standing Order

3.5.3: PRN Order

3.5.4: Single Order

3.5.5: STAT Order

3.5.6: Verbal Order

3.6: Chapter 3 References

This page titled [Chapter 3: Prescriptions, Orders, and Documentation](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

3.1: Main Terms

Electronic prescription – a prescription that is transmitted electronically to the pharmacy

Medication reconciliation – the process of comparing the drugs the patient is currently taking to the drugs documented in the patient's medical record

Prescription – a legal document that contains instructions for a pharmacist to dispense drugs to a patient

PRN order – directions to administer drugs as needed

Routine order – directions for a drug to be administered at regular intervals

Single order – directions for a drug to be administered one time

Standing order – directions for a drug to be administered to patients who meet criteria

STAT order – directions for a drug to be administered one time immediately

Verbal order – verbal directions to administer a drug immediately during an emergency

This page titled [3.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

3.2: Chapter Goals

- Explain parts of a prescription and the medical assistant's role in preparing prescriptions
 - Compare electronic prescription with written prescriptions
 - Describe the medication reconciliation process and its role in patient safety
 - Demonstrate complete and accurate documentation regarding drug orders, administration, and prescriptions
 - Identify types of provider orders for drug administration
-

This page titled [3.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

3.3: Prescriptions

Prescriptions are legal documents, and care must be taken when preparing, documenting, and archiving prescriptions. In this chapter, we will discuss the parts of a prescription, the MA's role in patient prescriptions, other types of provider orders, and documentation in the patient's medical record. Medication reconciliation is an important task for the MA. The provider relies on the MA to provide an accurate and complete list of drugs the patient is currently taking to safely prescribe new drugs.

This page titled [3.3: Prescriptions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

3.3.1: Parts of a Prescription

A valid prescription must contain specific information for it to be legally filled and dispensed by a pharmacist. When assisting the provider with prescriptions, the MA must verify that the following information is accurate and complete:

- Date the prescription is issued
- Patient's name and address
- Patient's date of birth
- Provider name and business address
- Drug name
- Drug strength
- Drug form
- Quantity to be dispensed by the pharmacist
- Directions for use
- Number of refills
- Signature of provider
- Provider's DEA number (for narcotic prescriptions)

(Kenny & Preuss, 2022)

The image below shows an example of a blank prescription from a pre-printed prescription pad. These forms are not used for e-prescribing but are delivered in person by a patient to a pharmacist. Prescription forms are available through specialty printers and must be printed on prescription security paper. Prescription pads are considered a high-theft item and must never be left unattended or used for scratch paper. Prescription pads, when not in use, should be stored in a locked desk or cabinet.

Typically, the provider's name, address, and contact information are printed at the top of the prescription form, and areas are provided for the patient's name, address, and date of birth. The middle of the form contains a space for drug information, including the name, strength, form, and quantity of the drug to be dispensed by the pharmacist. The directions for use and number of refills permitted are also written in this space by the provider or MA. Some prescription forms include information to indicate that the pharmacist can dispense a generic drug instead of a brand-name drug. The provider's signature and National Provider Identification Number are located at the bottom of the form. The MA can assist the provider in preparing the prescription, however, the MA is not permitted to sign the prescription. Prescriptions, whether on paper or electronic, must be documented in the patient's record.

Happy Town Family Medical Clinic 1234 Happy Street, Happy Town, Happy State, 12345 Phone: 123-123-1234 Fax: 123-123-5678 Radwa Mansur, NP, Family Nurse Practitioner	
Patient	DOB:
Address:	Date:
Rx Refills: _____ ☐ Generics Permitted Radwa Mansur, FNP NPI#: 1234567891 DEA # 123456789	

Image created by Anna Jannak

This page titled [3.3.1: Parts of a Prescription](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.3.2: Electronic Prescriptions

Electronic prescriptions contain the same information as printed prescriptions. However, instead of the patient delivering the prescription in person, the prescription is electronically transmitted to the pharmacy. The benefits of electronic prescribing include enhanced patient safety and patient convenience. The American Medical Association (2019) states that electronic prescribing allows the provider to review the patient's drug history, view drug safety alerts, and check more easily for drug interactions, and it reduces errors associated with hand-written prescribing. Patients find it convenient to leave their provider's office and arrive at their pharmacy to find their prescription ready for pickup (Academy of Managed Care Pharmacy, 2019).

This page titled [3.3.2: Electronic Prescriptions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.4: Medical Assistant's Role in Prescriptions

Medical assistants cannot prescribe drugs or treatments for patients, however, in most states MAs are permitted to prepare prescriptions for providers to sign. Some states allow medical assistants to send prescription refills to the pharmacy under the supervision of the provider if there are no changes to the refill. The provider and medical assistant are responsible for checking their state laws regarding the scope of practice for medical assistants as it relates to prescriptions.

This page titled [3.4: Medical Assistant's Role in Prescriptions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

3.4.1: Patient Education

Patient education is an important task for the Medical Assistant. When a patient receives a new prescription, the MA should educate the patient regarding the name of the drug, the intended action of the drug, side effects and adverse effects of the drug, how the drug is supplied (tablets, liquids, etc.), how often the patient should take the drug, and any other important information. To do this, the MA should be familiar with common medical abbreviations.

Table of Common Medical Abbreviations and their Meanings

Abbreviation	Meaning/Explanation
ss	one-half
i	one
v	five
x	ten
L	fifty
C	one hundred
M	one thousand
5X Day	5 times a day
AC	Before meals
AD	Right ear
Ante	before
AS	Left ear
ASA	aspirin
ATC	Around the clock
AU	Both ears
BCP	Birth control pills
bib	drink
BID	Twice per day
BM	Bowel movement
Bucc	Inside cheek
c	with
cap	capsule
C/O	Complaints of
cc	cubic centimeter (1 mL)
CC	Chief complaint
DC or D/C	Discontinue
Disp	dispense
Et	And
Fe	Iron

Abbreviation	Meaning/Explanation
g	Gram
gr	Grain
gtt	Drops
HA	headache
HS	At bedtime
ID	Intradermal
IM	Intramuscular
IN	intranasal
inh	inhalation
K	potassium
L	liter
lb or #	pound
LMP	Last menstrual period
mcg	Microgram
MDI	Metered dose inhaler
mg	milligram
Mg	Magnesium
mL	Milliliter
N/V	Nausea and vomiting
Na	Sodium
NKA	No known allergies
NKDA	No known drug allergies
noct or noc	Night
NPO	Nothing by mouth
NS	Normal saline
NSAID	Non-steroidal anti-inflammatory
OD	Right eye
OS	Left eye
OTC	Over the counter
OU	Both eyes
oz	Ounce
PC	After meals
Per	By or through
PO	By mouth

Abbreviation	Meaning/Explanation
PR	By rectum
PRN	As needed
Q 2hr	Every 2 hours
Q 4hr	Every 4 hours
Qday	Once per day
QID	Four times per day
QOD	Every odd day
QPM	Every evening
s	Without
SL	Under the tongue
SOB	Shortness of breath
SQ or SC	Subcutaneous
Stat	Immediately
Supp	suppository
Tab	Tablet
tbsp	tablespoon
tsp	teaspoon
TID	Three times per day
Troche	lozenge
U	unit
UG	Until gone
ung	ointment
Wt	Weight

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has published a list of abbreviations that should not be used due to the risk of misinterpretation and potential patient harm. View the list below the the JCAHO Do Not Use list:

Abbreviations that should not be used, the potential problem why, and what should be used instead.

Do Not Use	Potential Problem	Use Instead
U, u (unit)	Mistaken for “0” (zero), the number “4” (four) or “cc”	Write “unit”
IU (International Unit)	Mistaken for IV (intravenous) or the number 10 (ten)	Write “International Unit”
Q.D., QD, q.d., qd (daily)	Mistaken for each other	Write “daily”
Q.O.D., QOD, q.o.d., qod (every other day)	Period after the Q mistaken for “I” and “O” mistaken for “I”	Write “every other day”
Trailing zero (X.0 mg)	Decimal point is missed	Write X mg

Do Not Use	Potential Problem	Use Instead
Lack of leading zero (.X mg)	Decimal point is missed	Write 0.X mg
MS	Can mean morphine sulfate or magnesium sulfate	Write “morphine sulfate” or write “magnesium sulfate”
MSO4 and MgSO4	Confused for one another	

To view the PDF list published by the JCAHO, visit [Official “Do Not Use” List](#)(opens in new window) [www.jointcommission.org]

This page titled [3.4.1: Patient Education](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.4.2: Refill Requests

Medical Assistants are often tasked with answering phone calls or messages regarding patient requests for prescription refills. The MA should take careful notes regarding the request and include the following information before forwarding the request to the provider:

- Provider's name
- Patient name and date of birth
- Patient's phone number
- Date and time of the call or message
- Medication name, dose, form, and frequency of administration
- Patient's preferred pharmacy and pharmacy phone number
- Name of MA noting the request
- Any other pertinent information

It is the provider's responsibility to authorize or deny a prescription refill. If the provider authorizes the refill, the patient will receive a phone call or text from the pharmacy when their prescription is ready to be picked up. If the provider denies the request, the MA may be tasked with contacting the patient and discussing the reasons for the denial. Reasons for denying a prescription refill may include that the patient has not been seen in the office for an extended period, that lab tests may be required, or other reasons determined by the provider.

Example of Prescription Refill Request

Prescription Refill Request					
Provider					
Date		Time			
Patient Name					
Patient DOB		MR Number			
Patient Phone Number					
Patient Email					
Drug(s) Requested to be Refilled	Drug Name	Dose	Frequency	How Supplied	Requested Refills
Preferred Pharmacy					
Pharmacy Phone Number					
Message Taken By:					
Refill Approved by:				# of Refills	
Provider Signature					
Additional Information					

Created by Anna Jannak 2024

This page titled [3.4.2: Refill Requests](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

3.4.3: Medication Reconciliation

During the patient intake process, the medical assistant may be responsible for conducting a medication reconciliation with the patient. This is the process of comparing all drugs a patient is currently taking with the patient's medical record and updating the record with new medications or medications that have been discontinued. The medication reconciliation process should also include over-the-counter medications, vitamins, and supplements that the patient is currently taking. This process is vital for patient safety because the provider will refer to this reconciled medication list when determining which medications to prescribe, continue, or discontinue. Any omissions or mistakes increase the risk of life-threatening or life-altering events for the patient (Holt & Thompson, 2018).

This page titled [3.4.3: Medication Reconciliation](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.4.4: Documentation in the Medical Record

Any drug that the medical assistant administers must be documented in the patient's medical record as soon as possible. Accurate and complete healthcare documentation is vital for high-quality, safe patient care. Documentation must include the patient's name, date and time of administration, prescriber name, drug name, dose, route, technique, signature of the MA administering the drug, and any pertinent information gathered by the MA. Pertinent information may include patient pain level, vital signs, or patient response to a drug. Vaccine administration requires additional documentation, including the drug manufacturer name, lot number, and date of the CDC vaccine information statement issued to the patient (Hammer et al., 2019).

Documentation examples:

01/01/20xx 10:30am. Tylenol 1000mg tablet given by mouth to Veronica Guillen for headache as ordered by Dr Mansur. Patient states pain is at 5 on a 1–10 scale. Patient tolerated administration well, no adverse effects. Tomas Carvallo, CMA

01/01/20xx 11:45am. Metoprolol 50mg tablet given by mouth to Shelby Saunders as ordered by Dr. Mansur. Patient heart rate 82 prior to administration. Patient tolerated administration well, no adverse effects. Aishah Bonner, RMA

01/01/20xx 03:10pm. Depo-Provera 150mg administered to Christine Malley intramuscularly to left ventrogluteal muscle as ordered by Dr Mansur. UCC negative prior to administration. Patient has normal gait 30 minutes after injection. Laurie Stark, RMA

01/01/20xx 11:20am Priorix prefilled syringe 0.5mL administered to Eliot Simon subcutaneously to right thigh. Manufacturer is GlaxoSmithKline. Lot number 1345689. VIS date 8/6/2021 provided to patient's mother prior to administration. Patient tolerated administration well, no adverse effects. Hope Tucker, CMA

This page titled [3.4.4: Documentation in the Medical Record](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by Anna Jannak (Consortium of Academic and Research Libraries in Illinois (CARLI)).

SECTION OVERVIEW

3.5: Other Types of Drug Orders

A drug order is a direction given by the provider for a specific drug to be administered to the patient. The provider must include the patient's name, patient's date of birth, patient identification number (if applicable), drug name, drug dose, and drug route. Drug orders can be routine, standing, PRN, single, stat, or verbal.

3.5.1: Routine Order

3.5.2: Standing Order

3.5.3: PRN Order

3.5.4: Single Order

3.5.5: STAT Order

3.5.6: Verbal Order

This page titled [3.5: Other Types of Drug Orders](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.5.1: Routine Order

A routine order includes directions for a drug to be administered at a regular interval until it is discontinued. An example of a routine order is an order for an antihypertensive drug to be administered daily.

Example:

Patient: Clyde Robbins. DOB 01/01/19xx. Date: 01/01/20xx.

Lisinopril 5mg tablet, one tablet by mouth every morning. Dr R. Mansur

This page titled [3.5.1: Routine Order](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.5.2: Standing Order

A standing order consists of directions that are to be followed for patients who meet specific criteria. Standing orders can save time for the provider as the standing order frees up time that would have been spent documenting the same order for similar patients. For example, an office that treats patients with retina conditions may have a standing order that all patients who have their retinas examined by the provider are to receive eye drops that will dilate the patient's pupils to allow for easier assessment of their retinas by the provider.

Example of a Standing Order:

Standing Orders for Administering Tropicamide to Adult Patients

Procedure:

1. Identify patients who will require retinal assessment
2. Question the patient about the previous diagnosis of open-angle glaucoma. Do not administer to patients with open-angle glaucoma.
3. Explain the plain eye drop administration procedure to the patient
4. Explain vision changes with pupil dilation and how long vision changes will last
5. Gain consent from the patient for eye drop administration
6. Administer tropicamide (one drop of 1% ophthalmic solution) to eye or eyes to be assessed
7. Help patient transfer to waiting room 4. (Waiting room 4 must be kept darkened for patient comfort)
8. Document eye drop administration in the patient's record
9. Notify provider of any adverse effects

Standing Orders Authorization: This policy and procedure shall remain in effect for all patients of the Happy Town Retina Clinic effective 01/01/20xx until rescinded or until 12/31/20xx. Signed by the Medical Director of Happy Town Retina Clinic. Dr R Matthews. 01/01/20xx

This page titled [3.5.2: Standing Order](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

3.5.3: PRN Order

PRN orders are directions to administer drugs as needed. An example of a PRN order would be when a provider orders a pain reliever to be given to a patient when the patient has pain. The pain reliever is not administered regularly, only when needed.

Example:

Patient: Clyde Robbins. DOB 01/01/19xx. Date: 01/01/20xx.

Acetaminophen 1000mg tablet per mouth every 6 hours as needed for headache. Dr R. Mansur

This page titled [3.5.3: PRN Order](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.5.4: Single Order

A single order consists of directions for a drug to be administered one time. An example of a single order is a provider ordering a tetanus vaccine. A tetanus vaccine is ordered and administered once.

Example:

Patient: Clyde Robbins. DOB 01/01/19xx. Date: 01/01/20xx.

Administer Boostrix 0.5mL vaccine intramuscular injection. Dr. R Mansur

This page titled [3.5.4: Single Order](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.5.5: STAT Order

A STAT order is similar to a single order but it is ordered to be administered immediately. An example of a STAT order is a provider who orders an antihistamine for a patient who is suffering from a mild allergic reaction.

Example:

Patient: Clyde Robbins. DOB 01/01/19xx. Date: 01/01/20xx.

Diphenhydramine 50mg tablet by mouth STAT for allergic reaction. Dr R. Mansur

This page titled [3.5.5: STAT Order](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

3.5.6: Verbal Order

Verbal orders are orders that are given verbally by the provider during an emergency. During an emergency, it would be irrational for the MA to expect the provider to physically write or enter an order for a drug to be administered while the patient was suffering potentially life-threatening events. It is important for the MA to repeat the order and wait for verbal verification from the provider before administering the drug. The order and the administration of the drug must be documented as soon as possible once the patient is stable.

This page titled [3.5.6: Verbal Order](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

3.6: Chapter 3 References

- Academy of Managed Care Pharmacy. (2019, July 18). *Electronic prescribing*. Concepts in Managed Care Pharmacy. <https://www.amcp.org/about/managed-care-pharmacy-101/concepts-managed-care-pharmacy/electronic-prescribing>
- The Joint Commission. (n.d.). *Do-not-use list fact sheet*. <https://www.jointcommission.org/reso...-not-use-list/>
- Hammer, A., Wagner, A., Rieger, M. A., Manser, T., & WorkSafeMed Project Consortium. (2019, November 18). Assessing the quality of medication documentation: development and feasibility of the MediDocQ instrument for retrospective chart review in the hospital setting. *BMJ Open*, 9(11), e034609. <https://doi.org/10.1136/bmjopen-2019-034609>
- Holt, K. M., & Thompson, A. N. (2018, March 24). Implementation of a medication reconciliation process in an internal medicine clinic at an academic medical center. *Pharmacy*, 6(2), 26. <https://doi.org/10.3390/pharmacy6020026>
- Kenny, B. J. & Preuss, C. V. (2022, September 24). Pharmacy prescription requirements. *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK538424/>

This page titled [3.6: Chapter 3 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

CHAPTER OVERVIEW

Chapter 4: Pharmacology Math

Medical assistants should be certain that the drug administered to the patient is the correct dose ordered by the provider. In many cases, the dose ordered by the provider may differ from the dose provided by the pharmacy or the pharmaceutical manufacturer. This requires the medical assistant to accurately perform pharmacology math so that the patient receives the correct dose. Accurately calculating the correct dose is of utmost importance for patient safety. What may be considered a minor calculation mistake can cause catastrophic complications for the patient. Therefore, the medical assistant is tasked with being meticulous when calculating all drug dosages.

[4.1: Main Terms](#)

[4.2: Chapter Goals](#)

[4.3: Drug Labels](#)

[4.3.1: Drug Form](#)

[4.3.2: Drug Strength](#)

[4.3.3: Measurement Systems](#)

[4.3.3.1: Metric system](#)

[4.3.3.2: Household System](#)

[4.3.3.3: Conversions between Metric and Household](#)

[4.4: Equivalencies and Conversions](#)

[4.5: Healthcare Rules when Writing Numbers](#)

[4.6: The Formula Method](#)

[4.7: Medications and Pediatrics Doses](#)

[4.8: Legal and Ethical Issues](#)

[4.9: Chapter 4 References](#)

This page titled [Chapter 4: Pharmacology Math](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

4.1: Main Terms

Conversion – the process of converting or changing units from one form to another

Drug form – the formulation of the product manufactured by a pharmaceutical company, such as tablets or liquids

Drug strength – the amount of drug in a unit of a drug, such as 100 milligrams of drug in one tablet

Equivalent – two numbers or quantities that have the same value (for example, 1 gram is the same as 1000 milligrams)

Formula method – a formula used to calculate the amount of drugs to be administered.

Household system – a measurement system used in most homes in the United States that utilizes pounds, liquid ounces, and inches

Leading Zeros – a decimal number preceded by a zero, such as 0.4. Leading zeros should always be used in healthcare

Metric system – a measurement system based on units of 10 that uses meter, liter, and gram as base units

Trailing Zeros – number that ends in a zero after a decimal point, such as 4.0. Trailing zeros should never be used in healthcare

Weight-based drugs – drugs that are prescribed and calculated based on the patient's weight

This page titled [4.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

4.2: Chapter Goals

- Summarize the important parts of a drug label
 - Define basic units of measurement in the household system
 - Define basic units of measurement in the metric system
 - Convert between household and metric systems
 - Perform pharmacology calculations using equivalencies and the formula method
 - Perform pharmacology calculations for weight-based drugs
-

This page titled [4.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

4.3: Drug Labels

When calculating the correct dose to be administered, the medical assistant must carefully examine the drug label. The Food and Drug Administration mandates that drug labels contain important information. The medical assistant will check the label for the brand name, generic name, drug strength, total amount or volume of drug, and drug form. The medical assistant should also check the drug's expiration date, directions, and storage. In certain situations, the medical assistant may also be required to check and document the drug manufacturer and lot number. All prescription and OTC drugs are labeled with a National Drug Code, a unique 10-digit number product identifier (Lopez & Prasanna, 2022; U.S. Food and Drug Administration, 2017).

This page titled [4.3: Drug Labels](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

4.3.1: Drug Form

The drug label lists the formulation or form of the drug. For example, acetaminophen is manufactured in tablets, capsules, suppositories, and liquids. The medical assistant should note the drug form to calculate the accurate amount to be administered.

This page titled [4.3.1: Drug Form](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

4.3.2: Drug Strength

The drug strength is the amount of drug in a unit of the drug. For example, it is common for one unit of acetaminophen to contain 500mg of drug in each tablet. Thus, the strength of this drug is 500mg per tablet. Some drugs are supplied in liquid forms, and the strength is provided on the label. For example, it is common for liquid acetaminophen to contain 160mg in 5 milliliters of liquid. Thus, the strength of this drug is 160mg per 5mL. The medical assistant will need this information when calculating the correct dose to be administered.

This page titled [4.3.2: Drug Strength](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

4.3.3: Measurement Systems

It is considered best practice to use the metric system in healthcare. However, drugs are manufactured using both the metric system and the household system. Therefore, it is vital that the medical assistant understands both systems and knows how to convert from one to the other.

This page titled [4.3.3: Measurement Systems](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

4.3.3.1: Metric system

The metric system is based on units of ten and utilizes standards for all measurements. Weight is measured in grams, volume is measured in liters, and length is measured in meters. Grams, liters, and meters are the root words indicating the base unit and are preceded by prefixes to indicate the size of the unit. For example, gram, when preceded by the prefix milli-, indicates that the unit of measurement is one-one thousandth of a gram. See Table 4.1 to learn more about metric measurements and their abbreviations. See Tables 4.2 and 4.3 below to learn more about common metric units of measurement and equivalents used in healthcare (NCPDP, 2021).

Table 4.1

Metric Measurement Units and Abbreviations

Metric measurement units and abbreviations

Weight	Volume	Length
Gram (g) Kilogram (kg) Milligram (mg) Microgram (mcg)	Liter (L) Milliliter (mL)	Meter (m) Centimeter (cm) Millimeter (mm)

Table 4.2

Metric Base Units

Metric based units

Prefix (larger to smaller)	Size	Conversion	Abbreviation
Kilo-	1000 base units	1 kilo = 1000 units	k
Centi-	0.01 base unit	1 centi = 0.01 unit 100 centi = 1 unit	c
Milli-	0.001 base unit	1 milli = 0.001 unit 1000 milli = 1 unit	m
Micro-	0.000001 base unit	1 micro = 0.000001 unit 1,000,000 micro = 1 unit	mc

Table 4.3

Commonly Used Metric Equivalents

Commonly used metric equivalents

Weight	Volume	Length
1g = 1000mg 1g = 1,000,000 mcg 1mg = 1000mcg 1kg = 1000g	1L = 1000mL	1m = 100cm 1m = 1000mm 1cm = 10mm

This page titled [4.3.3.1: Metric system](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

4.3.3.2: Household System

Patients are often more comfortable using the household system of measurement, which the medical assistant is required to understand. For example, pediatric patients should be weighed in kilograms to calculate accurate drug dosages, but parents and caregivers are more familiar with weights calculated in pounds and ounces. See Table 4.4 to learn more about household equivalents.

Table 4.4

Household equivalents

Household equivalents		
Weight	Volume	Length
1 pound = 16 ounces 1 ton = 2000 pounds	1 tablespoon = 3 teaspoons 1 ounce = 2 tablespoons 1 cup = 8 fluid ounces 1 pint = 2 cups (16 fluid ounces) 1 quart = 2 pints (32 fluid ounces) 1 gallon = 4 quarts (128 fluid ounces)	1 foot = 12 inches 1 yard = 3 feet 1 mile = 1760 yards

This page titled [4.3.3.2: Household System](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

4.3.3.3: Conversions between Metric and Household

Use Table 4.5 to convert from metric to household measurements.

Table 4.5

Metric and Household Conversions

Metric and household conversions

Weight	Volume	Length
1 kilogram = 2.2 pounds	1 teaspoon = 5 milliliters 1 tablespoon = 15 milliliters 1 ounce = 30 milliliters 1 cup = 240 milliliters	1 inch = 2.54 centimeters 1 foot = 30.48 centimeters

This page titled [4.3.3.3: Conversions between Metric and Household](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

SECTION OVERVIEW

4.4: Equivalencies and Conversions

The medical assistant should determine if the drug ordered and the drug available are measured in the same units. The strength of the medication and the form prepared by the manufacturer should be checked against the drug ordered by the provider. If there is a discrepancy, the medical assistant will use ratio and proportion math formulas to find the correct dose. For example, if the provider ordered 1 gram of a drug and the drug available is manufactured in milligrams, the medical assistant should use a conversion formula to convert grams to milligrams or milligrams to grams.

For example, the provider orders 2000 milligrams of ABC drug to be administered to the patient. The medical assistant finds ABC drug in the supply cabinet, but it is formulated in 1-gram tablets.

Step 1: Turn the information into a fraction. The top part of the fraction represents what is ordered (2000mg), and the bottom part represents what we want to know (the number of grams).

$$\frac{2000\text{mg}}{X \text{ g}}$$

Step 2: Next, add an equal sign and create a fraction on the other side that represents the equivalent to help solve the problem. In this case, we will use the equivalent 1000mg = 1g. Make sure that the units on the tops and bottoms of each fraction are the same. In this example, milligrams are on the top, and grams are at the bottom of each fraction.

$$\frac{2000\text{mg}}{X \text{ g}} = \frac{1000\text{mg}}{1 \text{ g}}$$

Step 3: Cross-multiply the fractions. In this case multiply 2000mg by 1 and then multiply 1000mg by X g.

$$\begin{array}{ccc} \frac{2000\text{mg}}{X \text{ g}} & = & \frac{1000\text{mg}}{1 \text{ g}} \\ \swarrow \quad \searrow & & \nwarrow \quad \nearrow \\ (2000)(1) & = & (1000)(X) \end{array}$$

Step 4: Solve for X and label the answer.

$$\begin{aligned} (2000)(1) &= (1000)(X) \\ 2000 &= 1000X \end{aligned}$$

Step 5: Divide each side by 1000.

$$\begin{aligned} \frac{2000}{1000} &= \frac{1000X}{1000} \\ 2 &= X \end{aligned}$$

Answer is 2000mg = 2g

This page titled [4.4: Equivalencies and Conversions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

SECTION OVERVIEW

4.5: Healthcare Rules when Writing Numbers

The following rules must be applied for patient safety when using and documenting numbers.

- Follow the number with the correct abbreviation for the unit of measure, and do not use a period with abbreviations.
- Fractions should not be used; instead, convert all fractions to decimal numbers.
- If a dose is less than 1, place a zero to the left of the decimal point. This is called a leading zero. Always use leading zeros.
Example: .4 should not be used because it could be misinterpreted as 4
- Do not place a decimal point and a zero after a whole number. These are called trailing zeros. Never use trailing zeros.
Example: 4.0 should not be used because it could be misinterpreted for 40
- To round numbers, find the place value where you want to end up. If the number to the right of the place value is 4 or below, drop the number to the right of the place value. If the number is 5 or above, add 1 to rounded place value and drop the number to the right of the place value.

Examples:

5.44 should be rounded to 5.4 or 5, depending on what place value you want to end up.

5.66 should be rounded to 5.7 or 6, depending on what place value you want to end up.

- When Roman numerals are used in healthcare, they are written as lowercase letters.

Examples:

ss = 0.5

i = 1

ii = 2

iii = 3

iv = 4

v = 5

x = 10

This page titled [4.5: Healthcare Rules when Writing Numbers](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

SECTION OVERVIEW

4.6: The Formula Method

The formula method is appropriate for use in most outpatient settings. If the medical assistant has any doubt about their calculations, they should seek assistance from a pharmacist or another staff member who is an expert with pharmacology math. Do not administer any drugs without being 100% certain that the calculation is correct.

The formula method is the dose ordered, divided by the dose available, multiplied by the dose form, which equals the dose to be given. The dose ordered and the dose available must be the same unit, so conversion may be necessary.

$$\frac{\text{Dose Ordered}}{\text{Dose Available}} \times \text{Dose Form} = \text{Dose to Give}$$

$$\frac{DO}{DA} \times DF = DG$$

Example:

The provider ordered 200mg of ABC drug to be given to the patient. The medical assistant finds ABC drug formulated in 100mg tablets.

Step 1: Determine if the ordered and available doses are in the same units. In this problem the DO and the DA are in mg, so no conversion is necessary.

Step 2: Determine the dose form. In this case, the DF is 1 tablet.

Step 3: Set up the formula.

$$\frac{200\text{mg}}{100\text{mg}} \times 1 \text{ tablet} = DG$$

Step 4: Calculate the dose to give (DG).

$$\frac{200\text{mg}}{100\text{mg}} = 2$$

$$2 \times 1 \text{ tablet} = 2 \text{ tablets}$$

Answer: The dose to give (DG) is 2 tablets.

This page titled [4.6: The Formula Method](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

4.7: Medications and Pediatrics Doses

Pediatric doses of drugs are usually based on the patient's weight in kilograms. This requires extra steps to accurately calculate a weight-based drug.

Example: The provider ordered amoxicillin 17mg/kg for a child who weighs 33 pounds. The medical assistant finds amoxicillin 500mg per 2mL in the drug supply cabinet.

Step 1: Determine the child's weight in kilograms. In this case, the child weighs 33 pounds. This will be converted to kilograms. Use the proportion method to convert using the equivalency of 2.2 pounds equals 1 kilogram.

$$\begin{array}{rcl} 33\text{lb} & \times & 2.2\text{lb} \\ \text{X kg} & & 1\text{kg} \end{array}$$

Cross multiply

$$(33)(1) = (2.2)(X)$$

$$33 = 2.2X$$

Divide each side by 2.2

$$\frac{33}{2.2} = \frac{2.2X}{2.2}$$

$$15 = X$$

Answer: 33lb = 15kg

Step 2: Determine the dose to be given by multiplying the patient's weight in kilograms by the dose ordered. In this case, the dose ordered is 17mg per kg. This means that for every one kilogram of the child, the medical assistant will administer 17mg of drug. The child weighs 15kg, which we will multiply by 17mg. 17mg multiplied by 15kg equals 255mg of amoxicillin. This is the new calculated dose ordered.

$$17\text{mg} \times 15\text{kg} = 255\text{mg of amoxicillin}$$

Step 3: Use the calculated dose ordered of 255mg of amoxicillin in the formula method. The dose ordered is divided by the dose available and multiplied by the dose form to get the dose to give.

Dose Ordered X Dose Form = Dose to Give

Dose Available

$$\frac{DO}{DA} \times DF = DG$$

DA

In this case, 255mg will be divided by 500mg and multiplied by 2mL is the dose to give.

$$\frac{255\text{mg}}{500\text{mg}} \times 2\text{mL} = 1.02\text{mL of amoxicillin}$$

Answer: 1.02mL of amoxicillin will be administered to the patient.

This page titled [4.7: Medications and Pediatrics Doses](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

SECTION OVERVIEW

4.8: Legal and Ethical Issues

Not all states allow medical assistants to calculate drug dosages. Always be aware of the state's scope of practice laws. In Illinois, medical assistants can calculate drug dosages under the direct supervision of the provider ordering the drug. Some healthcare organizations and clinics may also have policies and procedures regarding calculating drug dosages. Medical assistants should always be aware of and follow scope of practice and policies and procedures where they are employed.

This page titled [4.8: Legal and Ethical Issues](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

4.9: Chapter 4 References

- Lopez, M. J. & Prasanna, T. (2022, September 24). Drug labeling. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK557743/>
- NCPDP recommendations for standardizing dosing in metric units (mL) on prescription container labels of oral liquid medications, version 2.0. (2021). *American Journal of Health-System Pharmacy: AJHP: official journal of the American Society of Health-System Pharmacists*, 78(7), 578–605. <https://doi.org/10.1093/ajhp/zxab023>
- U. S. Food and Drug Administration. (2017, March 20). *National Drug Code Database Background Information*. <https://www.fda.gov/drugs/development-and-research/national-drug-code-database-background-information>

This page titled [4.9: Chapter 4 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

CHAPTER OVERVIEW

Chapter 5: The Gastrointestinal System and Administering Enteral Drugs

- 5.1: Main Terms
- 5.2: Chapter Goals
- 5.3: Anatomy Review of the Gastrointestinal System
 - 5.3.1: Pharynx
 - 5.3.2: Esophagus
 - 5.3.3: Stomach
 - 5.3.4: Small Intestine
 - 5.3.5: Large Intestine
 - 5.3.6: Rectum and Anus
- 5.4: Review of Gastrointestinal System Pathology
 - 5.4.1: Conditions of the Mouth and Pharynx
 - 5.4.2: Conditions of the Esophagus
 - 5.4.3: Conditions of the Stomach
 - 5.4.4: Conditions of the Large and Small Intestines
 - 5.4.5: Conditions of the Rectum and Anus
- 5.5: Gastrointestinal System Drugs
- 5.6: Enteral Routes of Administration
 - 5.6.1: Oral Route
 - 5.6.2: Sublingual and Buccal Route
 - 5.6.3: Rectal Route
- 5.7: Chapter 5 References

This page titled [Chapter 5: The Gastrointestinal System and Administering Enteral Drugs](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

5.1: Main Terms

Buccal route – drugs administered between the cheek and gum

Candidiasis – a fungal infection of the mouth

Chyme – food that has been mixed with digestive juices found in the stomach and small intestine

Constipation – infrequent or difficult bowel movements

Diarrhea – frequent passage of loose, watery stools

Enteral route – drugs administered via the digestive tract

Esophagus – a tube that connects the pharynx to the stomach

Feces – chyme after passing into the large intestine

Gastritis – inflammation of the stomach lining

GERD – gastroesophageal reflux disease when stomach contents backflow into the esophagus

Hemorrhoids – swollen and inflamed veins in the rectum and anus

Inflammatory bowel disease – chronic conditions characterized by inflammation and damage to the lining of the digestive tract

Oral herpes – a viral infection of the mouth

Oral route – drugs administered via the mouth

Peptic ulcer – open sores that develop on the stomach lining

Pharynx – the throat, a muscular tube-like structure in the head and neck

Rectal route – drugs administered into the rectum

Sphincter – a muscular ring that allows for the passage of liquids and solids and prohibits backflow

Sublingual route – drugs administered under the tongue

This page titled [5.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

5.2: Chapter Goals

- Discuss the anatomy of the gastrointestinal system and the accessory organs
 - Identify pathologies of the gastrointestinal system and drugs used to treat them
 - Describe the process of oral drug administration
 - Describe the process of sublingual and buccal drug administration
 - Describe the process of rectal drug administration
-

This page titled [5.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

5.3: Anatomy Review of the Gastrointestinal System

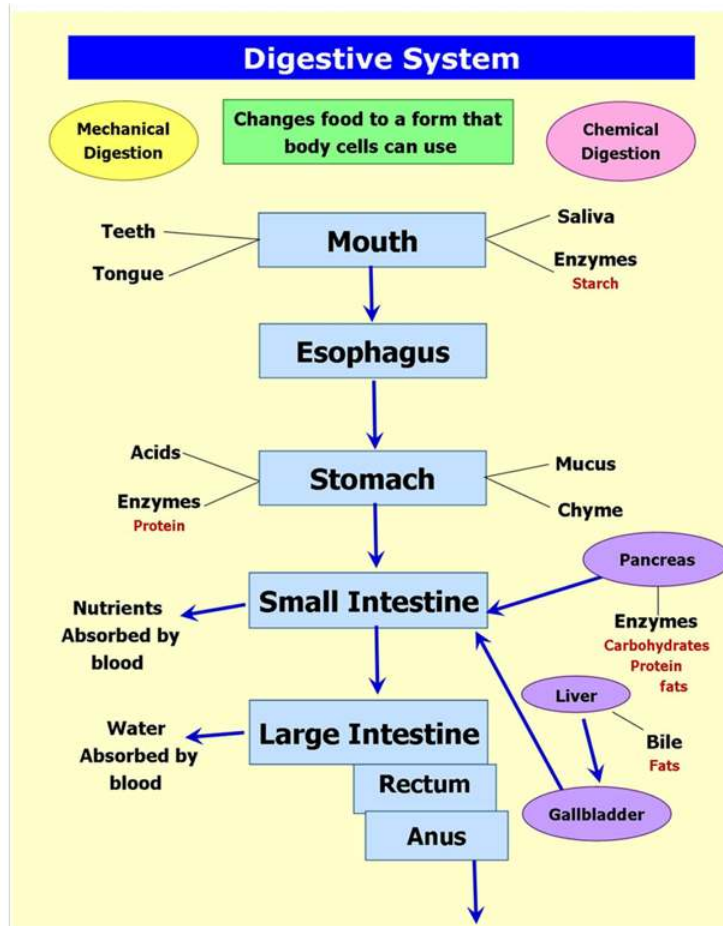


Image of the digestive system created by Anna Jannak

The gastrointestinal (GI) system, or the digestive system, is a complex and essential network of organs and tissues responsible for digesting and absorbing nutrients and eliminating waste products from the body. It plays a vital role in maintaining overall health.

The gastrointestinal tract comprises the mouth, pharynx, esophagus, stomach, small intestine, large intestine, and anal canal. These organs transport food, chyme, and fecal matter. The liver, gallbladder, and pancreas are accessory organs that assist the gastrointestinal tract in breaking down food.

The digestion process begins in the mouth, where food is broken down into smaller pieces through mechanical and chemical means. Mechanically chewing food breaks the food into smaller particles. Enzymes in saliva break down carbohydrates, which initiate the chemical process of breaking down food.

This page titled [5.3: Anatomy Review of the Gastrointestinal System](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

5.3.1: Pharynx

The pharynx (throat) is a muscular tube-like structure in the head and neck, divided into three regions. The nasopharynx is the uppermost part of the pharynx, located behind the nasal passages. It serves as a passage for air and contains adenoids, a collection of lymphoid tissue that plays a role in immune defense. The oropharynx, the middle part of the pharynx, is located behind the oral cavity and serves as a passage for air and food. The tonsils are in the oropharynx and play a role in immune function. The laryngopharynx is the lowest part of the pharynx, which connects with the esophagus for food and the larynx for air. A flap-like structure called the epiglottis prevents food from entering the trachea during swallowing by protecting and covering the larynx (“Biology of the digestive tract,” 2024).

This page titled [5.3.1: Pharynx](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

5.3.2: Esophagus

The esophagus is a muscular tube, measuring about 25–30 centimeters, that connects the pharynx to the stomach. It transports food and liquids from the mouth to the stomach through coordinated, wave-like muscle contractions known as peristalsis. The lower esophageal sphincter at the lower end of the esophagus relaxes to allow food to pass through and contracts to prevent stomach contents and acid from refluxing or flowing back into the esophagus (“Biology of the digestive tract,” 2024).

This page titled [5.3.2: Esophagus](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

5.3.3: Stomach

The stomach is located just below the diaphragm and has a distinctive J-shape. The stomach is comprised of the fundus (upper region), the body (central region), the antrum (lower area), and the pylorus (sphincter at the lower end). The stomach acts as a temporary storage for food as the digestive process continues. Peristalsis churns and mixes the food with highly acidic gastric juices and transforms the food into chyme. Chyme is gradually released into the small intestine through the pyloric sphincter at about 3mL per 20 seconds. Gastric emptying into the duodenum takes 40 minutes to 2 hours (“Biology of the digestive tract”, 2024).

This page titled [5.3.3: Stomach](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

5.3.4: Small Intestine

The small intestine is where most digestion and nutrient absorption take place. It is a long tubular structure that measures about twenty feet in adults. The small intestine is lined with tiny finger-like projections called villi, which increase its surface area for better absorption of nutrients. The small intestine comprises three main sections: the duodenum, jejunum, and ileum. In the duodenum, the chyme is mixed with an alkalizing agent from the pancreas to neutralize acid. Bile, created by the liver, is expelled into the small intestine to start the breakdown of fats. The middle section of the small intestine, the jejunum, is where most of the nutrients from the chyme are absorbed into the bloodstream. The last part of the small intestine, the ileum, absorbs nutrients until the chyme reaches the large intestine (“Biology of the digestive tract,” 2024).

This page titled [5.3.4: Small Intestine](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

5.3.5: Large Intestine

The large intestine, or colon, surrounds the small intestine in the lower abdomen. It measures about five feet in most adults and is comprised of the ascending colon, the transverse colon, the descending colon, the sigmoid colon, the rectum, and ending at the anus. When chyme passes into the large intestine, it is now called fecal matter or feces. The large intestine regulates water and electrolyte absorption, forms feces, and controls bowel movements. The large intestine is where most intestinal microbes are found. Gut microbes or flora are significant in various physiological functions and contribute to overall well-being. The composition of gut flora can vary significantly from person to person and can be influenced by diet, age, genetics, and health status ("Biology of the digestive tract," 2024).

This page titled [5.3.5: Large Intestine](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

5.3.6: Rectum and Anus

The last part of the digestive system is the rectum and anus. The rectum is the last portion of the large intestine, and its primary function is to store feces until they are ready to be eliminated from the body during a bowel movement. The rectum contains nerve endings that sense the presence of feces and trigger the urge to defecate. The anus is the opening at the end of the digestive tract. It has two sphincters, the internal anal sphincter, and the external anal sphincter, which control the expulsion of feces and maintain continence (“Biology of the digestive tract”, 2024).

This page titled [5.3.6: Rectum and Anus](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

5.4: Review of Gastrointestinal System Pathology

5.4.1: Conditions of the Mouth and Pharynx

5.4.2: Conditions of the Esophagus

5.4.3: Conditions of the Stomach

5.4.4: Conditions of the Large and Small Intestines

5.4.5: Conditions of the Rectum and Anus

This page titled [5.4: Review of Gastrointestinal System Pathology](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#) .

5.4.1: Conditions of the Mouth and Pharynx

Candidiasis

Candidiasis of the mouth, commonly called oral thrush, is a fungal infection caused by the overgrowth of *Candida albicans*, a normally harmless yeast found in the mouth and digestive tract. *Candida albicans* overgrowth can be caused by a weakened immune system, corticosteroid use, antibiotics use, or poor oral hygiene. The symptoms of candidiasis include white or yellowish patches in the oral cavity, mouth pain, loss of taste, and dry mouth. Treatment for candidiasis includes topical or systemic antifungals and addressing the underlying condition if present.

Oral Herpes

The herpes simplex virus is highly contagious and can be transmitted through direct contact with the virus, such as kissing, sharing utensils, or oral-genital contact. The symptoms of oral herpes can vary from person to person, and outbreaks range from individual outbreaks to recurrent outbreaks. Some patients experience a tingling or itching sensation before an outbreak. Symptoms include the formation of tiny, painful blisters or cold sores on or around the lips, gums, tongue, or the roof of the mouth, swelling and redness in the affected area, pain and discomfort during eating, drinking, or talking, fever and general malaise. Treatment for oral herpes includes antiviral medications to manage symptoms and reduce the frequency and severity of outbreaks. However, there is no cure for oral herpes.

(Krueger et al., 2012).

This page titled [5.4.1: Conditions of the Mouth and Pharynx](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

5.4.2: Conditions of the Esophagus

GERD

Gastroesophageal reflux disease (GERD) is a chronic digestive disorder characterized by frequent and persistent regurgitation of stomach acid into the esophagus due to weakness of the lower esophageal sphincter. Repeated exposure to stomach acid can irritate the esophagus lining, causing heartburn, regurgitation of stomach contents into the mouth, and a sour taste in the mouth. Other symptoms include coughing, wheezing, difficulty swallowing, and chest pain, which can be mistaken for heart attack symptoms. GERD can be aggravated by fatty or spicy foods, citrus fruits, alcohol, caffeine, obesity, smoking, and reclining after a meal. If left untreated or poorly managed, GERD can lead to Barrett's esophagus and an increased risk of esophageal cancer. GERD is treated with over-the-counter antacids or prescription medications such as proton pump inhibitors (PPIs) or H2-receptor antagonists to reduce acid production in the stomach.

Barrett's Esophagus

Barrett's esophagus is primarily caused by long-term exposure to stomach acid due to chronic GERD. The continuous irritation and inflammation of the lower esophagus can lead to changes in the lining, replacing the normal squamous epithelium with precancerous cells. Symptoms of Barrett's esophagus are like the symptoms of GERD but also include difficulty swallowing and unexplained weight loss. Treatment includes PPIs, H-2 receptor agonists, and regular surveillance to monitor for cancer.

(Krueger et al., 2012).

This page titled [5.4.2: Conditions of the Esophagus](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

5.4.3: Conditions of the Stomach

Gastritis

Gastritis is a common digestive disorder characterized by acute or chronic stomach lining inflammation. Gastritis can be caused by taking non-steroidal anti-inflammatory drugs (NSAIDs), excessive alcohol consumption, stress, and infectious agents. The symptoms of gastritis can vary but commonly include abdominal pain or discomfort, nausea and vomiting, bloating, heartburn, anorexia, blood in feces or vomitus, and unexplained weight loss. Treatment goals for gastritis are alleviating symptoms, reducing inflammation, and addressing underlying causes. Patients may be prescribed proton pump inhibitors (PPIs), antacids, or H₂-receptor antagonists to reduce stomach acid. Patients are instructed to avoid irritants such as alcohol, spicy foods, and NSAIDs and to adopt dietary changes and stress reduction techniques.

Peptic Ulcers

Peptic ulcers are open sores that develop on the stomach lining, small intestine, or sometimes the esophagus. Peptic ulcers can occur due to varied factors, including *Helicobacter pylori* (*H. pylori*) infection, taking NSAIDs, smoking, and alcohol consumption. The most common symptoms of peptic ulcers include a burning or gnawing pain in the upper abdomen, usually between meals or during the night, bloating, nausea and vomiting, anorexia, unexplained weight loss, and bloody or dark stools. The treatment of peptic ulcers depends on the underlying cause but often includes PPIs, antacids, H₂-receptor antagonists, and an antibiotic regimen if the cause is *H. pylori*.

(Krueger et al., 2012).

This page titled [5.4.3: Conditions of the Stomach](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

5.4.4: Conditions of the Large and Small Intestines

Diarrhea

Diarrhea is a common digestive disorder characterized by frequent passage of loose, watery stools. It can be a temporary and mild condition or a more serious and persistent one, depending on its underlying causes and duration. Diarrhea is a symptom of an underlying condition. Causes of diarrhea include bacterial, viral, or parasitic infections, food poisoning, chronic conditions such as Crohn's disease, food allergies, stress or anxiety, and certain medications. In addition to frequent watery bowel movements, patients can experience abdominal cramps, dehydration, and fever. Treatment of diarrhea targets the cause and can include fluid replacement, antibiotics, anti-diarrheal drugs, rest, and avoiding trigger foods. It is important to note that infants, children, and elderly patients can become dehydrated much faster than healthy adults, so rehydration is paramount.

Constipation

Constipation is characterized by infrequent or difficult bowel movements, often resulting in the passage of hard, dry stools. It can be a temporary problem or a chronic condition, and it can cause discomfort and impact one's overall well-being. Constipation can be caused by a low-fiber diet, insufficient fluid intake, a sedentary lifestyle, medications such as opioids, emotional distress, or ignoring the urge to defecate. Symptoms include difficulty passing stools, infrequent bowel movements, hard, dry stools, and abdominal discomfort. Treatment for constipation aims to alleviate symptoms and address the underlying causes. It includes increasing dietary fiber, adequate fluid intake, moderate exercise, and medications such as laxatives or stool softeners.

Inflammatory Bowel Diseases

Crohn's disease is a chronic inflammatory bowel disease (IBD) characterized by inflammation and damage to the lining of the digestive tract. The exact cause of Crohn's disease remains unknown but is believed to result from a combination of genetic, environmental, and immune system factors. Crohn's disease can affect any part of the digestive tract, from the mouth to the anus. Common symptoms include abdominal pain, diarrhea, weight loss, fatigue, fever, rectal bleeding, fistulas and fissures in the anal area, anemia, and nutritional deficiencies due to malabsorption. Managing Crohn's disease aims to control inflammation, alleviate symptoms, and prevent complications. Treatment options include anti-inflammatory drugs, immunomodulators, and biologics. Surgical intervention may be necessary to remove damaged portions of the intestine and to treat complications like fistulas.

(Krueger et al., 2012).

This page titled [5.4.4: Conditions of the Large and Small Intestines](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

5.4.5: Conditions of the Rectum and Anus

Hemorrhoids

Hemorrhoids are swollen and inflamed veins in the rectum and anus. They can be uncomfortable and painful; however, they are usually not a severe or life-threatening condition. Causes of hemorrhoids include straining during bowel movements due to constipation or diarrhea, pregnancy and childbirth, obesity, and prolonged sitting or standing. Symptoms of hemorrhoids include rectal bleeding, pain, discomfort, itching, and inflammation. Hemorrhoids can be treated with over-the-counter creams, ointments, or suppositories containing witch hazel or hydrocortisone to relieve itching, pain, and inflammation. A healthcare provider may prescribe stronger medications or topical treatments for severe pain or persistent symptoms (Krueger et al., 2012).

This page titled [5.4.5: Conditions of the Rectum and Anus](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

SECTION OVERVIEW

5.5: Gastrointestinal System Drugs

Table 5.1 Gastrointestinal Drugs

Gastrointestinal drugs			
Drug Name	Drug Class	Indication	Patient Teaching
Nystatin		Oral candidiasis	
Zovirax (acyclovir)	Antiviral	Oral herpes simplex	
Tums, Mylanta (calcium carbonate)	Antacid	Gastritis, GERD, H. Pylori	Can cause constipation Take 1 hour before PPI or H2 receptor blocker Will reduce the effectiveness of other drugs when taken at the same time
Rolaids (magnesium hydroxide)	Antacid	Gastritis, GERD, H. Pylori	Can cause constipation Take 1 hour before PPI or H2 receptor blocker Will reduce the effectiveness of other drugs when taken at the same time
Amoxicillin	Antibiotic	H. Pylori	Antibiotics may cause diarrhea, promote opportunistic infections, and interfere with the absorption of many other drugs, including oral contraceptives.
Zantac (ranitidine)	H2 receptor blocker	Gastritis, GERD, H. Pylori	Take 10-60 minutes before food known to cause heartburn
Pepcid (famotidine)	H2 receptor blocker	Gastritis, GERD, H. Pylori	Take 10-60 minutes before food known to cause heartburn
Prilosec (omeprazole)	PPI	GERD, H. Pylori	Long-term use may increase the risk of fractures, hypomagnesemia, Clostridium difficile-associated diarrhea, and vitamin B12 deficiency.
Nexium (esomeprazole)	PPI	GERD, H. Pylori	Long-term use may increase the risk of fractures, hypomagnesemia, Clostridium difficile-associated diarrhea, and vitamin B12 deficiency.
Protonix (pantoprazole)	PPI	GERD, H. Pylori	Long-term use may increase the risk of fractures, hypomagnesemia, Clostridium difficile-associated diarrhea, and vitamin B12 deficiency.
Zofran (ondansetron)	Antiemetic	Nausea and vomiting	

Drug Name	Drug Class	Indication	Patient Teaching
MiraLAX (polyethylene glycol)	Osmotic laxative	Constipation	Increase fluid intake
Metamucil (psyllium fiber)	Bulk-forming laxative	Constipation	Increase fluid intake
Colace (docusate sodium)	Stool softener	Constipation	Increase fluid intake
Dulcolax (bisacodyl)	Stimulant laxative	Constipation	For occasional use only, may cause habituation
Fleet suppository (glycerin suppository)	Osmotic laxative	Constipation	For occasional use only, may cause habituation
Imodium (loperamide)	Anti-diarrheal	Diarrhea	For short-term use only
Pepto-Bismol (bismuth subsalicylate)	Anti-diarrheal, anti-emetic,	Diarrhea, gastritis, nausea, vomiting	May turn stool black

This page titled [5.5: Gastrointestinal System Drugs](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

5.6: Enteral Routes of Administration

Enteral routes of administration are those routes in which drugs are absorbed through the digestive system. This includes oral, sublingual, buccal, and rectal. When administering any drugs, be familiar with emergency drugs and supplies and know your role in the event of an emergency.

5.6.1: Oral Route

5.6.2: Sublingual and Buccal Route

5.6.3: Rectal Route

This page titled [5.6: Enteral Routes of Administration](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

5.6.1: Oral Route

The oral route is the most common route of drug administration. Patients are usually comfortable taking oral drugs. The oral route is generally economical, safe, and convenient. Disadvantages of the oral route may be a bad taste or smell, irritation to the stomach lining, less predictable absorption of drugs, and the inability to administer if the patient has nausea or vomiting.

Supplies and equipment required to administer drugs orally include:

- Provider's drug order
- Documentation system
- Gloves and other appropriate personal protective equipment (PPE)
- Drug supply
- Medicine cup or oral syringe
- Water
- Tablet crusher, if needed

When preparing oral drugs, practice medical asepsis and work in a well-lit area without distractions; follow the nine rights of drug administration and check for drug allergies. Only administer drugs ordered by the provider and that you have prepared yourself. If the MA has any questions about the drug, do not administer the drug until all questions have been answered.

Follow the following steps for safe administration of oral drugs:

1. Use a drug reference source to review information on the drug ordered.
2. Calculate the amount of drug to be administered
3. Wash your hands.
4. Check the drug label against the provider's order. Check for the drug name, form, and route.
5. Check the expiration date on the drug packaging.
6. Remove the container's cover for bulk tablets and pour the correct number into the cap. Pouring extra tablets back into the container only if they are in the container's cap is acceptable.
7. For liquid drugs, place the plastic medicine cup on an even surface. Uncap the container and place the label under your palm. When at eye level with the medicine cup, pour the liquid drug into the cup and measure to the bottom of the meniscus.
8. When the correct number of tablets has been in the cap, pour the tablets into the paper medicine cup.
9. Place the medicine cup on the medication tray and clean up the work area
10. Perform another check for the right name, form, route, and dose.
11. Greet the patient and identify yourself. Verify the patient's identity by asking for their name and date of birth. Check the patient's identification bracelet if required.
12. Ask the patient if they have any drug allergies.
13. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
14. Perform any assessments before administering the drug
15. Allow the patient to ask questions.
16. Hand the medicine cup and cup of water to the patient and stay with the patient until the patient has consumed the drug.
17. Document the procedure in the health record.

(Ernstmeyer & Christman, 2021).

This page titled [5.6.1: Oral Route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

5.6.2: Sublingual and Buccal Route

The sublingual route includes placing a drug under the tongue, and the buccal route is placing a drug between the cheek and gum. The mucous membranes of the mouth have a rich blood supply very close to the surface. Drugs can easily and very rapidly be absorbed into the bloodstream via these routes.

Supplies and equipment required to administer drugs orally include:

- Provider's drug order
- Documentation system
- Gloves and other appropriate personal protective equipment (PPE)
- Drug supply
- Medicine cup
- Water

When preparing sublingual or buccal drugs, practice medical asepsis and work in a well-lit area without distractions; follow the nine rights of drug administration and check for drug allergies. Only administer drugs ordered by the provider and that you have prepared yourself. If the MA has any questions about the drug, do not administer the drug until all questions have been answered.

Follow the following steps for safe administration of sublingual and buccal drugs:

1. Use a drug reference source to review information on the drug ordered.
2. Calculate the amount of drug to be administered
3. Wash your hands.
4. Check the drug label against the provider's order. Check for the drug name, form, and route.
5. Check the expiration date on the drug packaging.
6. For bulk tablets, remove the container's cover and pour the correct number of tablets into the cap. It is acceptable to pour extra tablets back into the container only if they are in the container's cap.
7. When the correct number of tablets has been in the cap, pour the tablets into the paper medicine cup.
8. Place the medicine cup on the medication tray and clean up the work area
9. Perform another check for the right name, form, route, and dose.
10. Greet the patient and identify yourself. Verify the patient's identity by asking for their name and date of birth. Check the patient's identification bracelet if required.
11. Ask the patient if they have any drug allergies.
12. Ask the patient if they are experiencing a dry mouth. If yes, allow the patient to take a sip of water.
13. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
14. Perform any assessments prior to administering the drug
15. Allow the patient to ask questions.
16. Hand the medicine cup to the patient. Instruct the patient to place the drug under their tongue for the sublingual route or between their cheek and gum for the buccal route. Instruct the patient not to chew or swallow the tablet but allow it to dissolve in their mouth. Stay with the patient until the drug has dissolved.
17. Document the procedure in the health record.

This page titled 5.6.2: Sublingual and Buccal Route is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by Anna Jannak (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

5.6.3: Rectal Route

The rectal route is used when the patient cannot tolerate oral drugs due to nausea or vomiting. The rectal route is also used to relieve constipation.

Supplies and equipment required to administer drugs orally include:

- Provider's drug order
- Documentation system
- Gloves and other appropriate personal protective equipment (PPE)
- Drug supply
- Water soluble lubrication
- Paper towels or tissues

When preparing rectal drugs, practice medical asepsis and work in a well-lit area without distractions. Follow the nine rights of drug administration and check for drug allergies. Only administer drugs ordered by the provider and that you have prepared yourself. If the MA has any questions about the drug, do not administer the drug until all questions have been answered.

Follow the following steps for safe administration of sublingual and buccal drugs:

1. Use a drug reference source to review information on the drug ordered.
2. Calculate the amount of drug to be administered
3. Wash your hands.
4. Check the drug label against the provider's order. Check for the drug name, form, and route.
5. Check the expiration date on the drug packaging.
6. For bulk tablets, remove the container's cover and pour the correct number of suppositories into the cap. It is acceptable to pour extra suppositories back into the container only if they are in the container's cap.
7. When the correct number of suppositories is in the cap, pour the tablets into the paper medicine cup.
8. For unit doses, tear the foil or plastic packaging and drop the suppository into the medicine cup.
9. Place the medicine cup on the medication tray and clean up the work area
10. Perform another check for the right name, form, route, and dose.
11. Greet the patient and identify yourself. Verify the patient's identity by asking for their name and date of birth. Check the patient's identification bracelet if required.
12. Ask the patient if they have any drug allergies.
13. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
14. Explain the procedure to the patient. Instruct the patient that they will be asked to retain the suppository for 10 minutes before they can use the toilet. When the suppository is inserted into the rectum, they may feel a bit of pressure; this is normal. Instruct the patient not to flush the toilet when 10 minutes have elapsed after suppository insertion.
15. Perform any assessments prior to administering the drug
16. Allow the patient to ask questions.
17. Allow for patient privacy. Ask the patient to disrobe from the waist and provide a paper drape.
18. Ask the patient to lie on the examination table on their left side. Ask the patient to raise their right knee as far as is comfortable.
19. Apply water-soluble lubrication to the suppository.
20. Tell the patient when you are about to insert the suppository and ask them to take a deep breath and relax. With a gloved hand, insert the suppository 1-2 inches into the rectum. Provide emotional comfort to the patient.
21. Wipe any lubricant from the patient's anal area with a paper towel or tissue. Remind the patient they are expected to hold in the suppository for 10 minutes.
22. After 10 minutes, help the patient to the toilet and remind them not to flush.
23. After the patient uses the toilet, examine the return upon toileting and include this in the patient's health record documentation.
24. Document the procedure in the health record, along with the patient's response to the procedure.

This page titled [5.6.3: Rectal Route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

5.7: Chapter 5 References

Biology of the digestive system. (n.d.) In *Merck Manual Consumer Version*. Merck & Co., Inc. Retrieved January 8, 2024, from <https://www.merckmanuals.com/home/di...gestive-system>

Krueger, G. R. F., Wagner, M., & Chandrasekhar, C. (2012). Pathology of the gastrointestinal tract. *Atlas of Anatomic Pathology with Imaging: A Correlative Diagnostic Companion*, 191–230. https://doi.org/10.1007/978-1-4471-2846-5_4

Ernstmeyer K, Christman E. (Eds.). (2021). *Nursing skills*. Chippewa Valley Technical College, Eau Claire (WI). <https://www.ncbi.nlm.nih.gov/books/NBK593215/>

This page titled [5.7: Chapter 5 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

CHAPTER OVERVIEW

Chapter 6: Integumentary System and Other Sense Organs

- 6.1: Main Terms
- 6.2: Chapter Goals
- 6.3: Anatomy review of the integumentary system
 - 6.3.1: Skin
 - 6.3.2: Associated Structures of the Skin
 - 6.3.3: Hair and Hair Follicles
 - 6.3.4: Nails
- 6.4: Anatomy review of the ears and eyes
 - 6.4.1: Ears
 - 6.4.2: Eyes
- 6.5: Review of Skin Disorders
 - 6.5.1: Skin Lesions
 - 6.5.2: Impetigo
 - 6.5.3: Fungal Infections of the Skin
 - 6.5.4: Dermatitis
- 6.6: Review of Ear and Eye Disorders
 - 6.6.1: Otitis Externa
 - 6.6.2: Otitis Media
 - 6.6.3: Impacted Cerumen
 - 6.6.4: Meniere's Disease
 - 6.6.5: Glaucoma
 - 6.6.6: Cataracts
 - 6.6.7: Infections of the Eyes
- 6.7: Drugs to Treat Skin, Ear, and Eye Disorders
- 6.8: Routes of Administration
 - 6.8.1: Topical Route
 - 6.8.2: Otic route
 - 6.8.3: Ophthalmic route
- 6.9: Chapter 6 References

This page titled [Chapter 6: Integumentary System and Other Sense Organs](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

6.1: Main Terms

Auditory canal – a tube that connects the middle ear to the back of the throat

Cataracts – clouding of the eye's lens

Cerumen – earwax

Conjunctival sac – the open area that appears when the lower eyelid is pulled downward

Conjunctivitis – pink eye or infection of the conjunctiva

Cornea – clear, dome-shaped front of the surface of the eye

Dermatitis – inflammation of the skin

Dermis – the middle layer of the skin

Epidermis – the upper layer of the skin

Glaucoma – damage to the optic nerve, usually from increased intraocular pressure

Impetigo – a contagious bacterial skin infection

Integumentary – related to the skin

Middle ear – air-filled space between the eardrum and the inner ear

Otitis externa – inflammation of the outer ear

Otitis media – inflammation of the middle ear

Outer ear – the visible part of the ear and includes the pinna and the external auditory meatus

Retina – a light-sensitive layer at the back of the eye that contains photoreceptor cells that convert light into electrical signals sent to the brain

Sclera – the tough, white outer layer of the eye that provides structural support and protection for the inner eye structures

Sebaceous glands – microscopic glands found throughout the skin that produce an oily substance called sebum to keep the skin moisturized and act as a protective barrier

Subcutaneous – the deepest layer of skin and comprises adipose tissue

Tinea – fungal infections of the skin

This page titled [6.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

6.2: Chapter Goals

- Discuss the anatomy of the integumentary system and other sense organs.
 - Identify pathologies of the integumentary system and other sense organs and drugs to treat them.
 - Describe the steps in topical drug administration.
 - Describe the steps in the process of administering ear drops.
 - Describe the steps in the process of administering eye drops.
-

This page titled [6.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

6.3: Anatomy review of the integumentary system

The integumentary system is a complex and vital organ system in the human body that serves as a protective barrier between the internal organs and the external environment. It comprises the skin, hair, nails, and associated structures. The integumentary system is crucial in maintaining homeostasis, protecting against pathogens, regulating body temperature, and facilitating sensory perception.

This page titled [6.3: Anatomy review of the integumentary system](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

6.3.1: Skin

The skin is the largest organ in the body and consists of three primary layers: the epidermis, the dermis, and the subcutaneous layer. The epidermis is the outermost skin layer and is composed primarily of keratinocytes. It provides a waterproof barrier and contains pigments responsible for skin color. The dermis lies beneath the epidermis and consists of connective tissue, blood vessels, hair follicles, sweat glands, and nerve endings. It plays a role in regulating temperature, providing nutrients to the epidermis, and housing sensory receptors. The subcutaneous layer is the deepest layer of skin and comprises adipose (fat) tissue. It serves as an insulator and energy reservoir, connecting the skin to underlying tissues.

This page titled [6.3.1: Skin](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.3.2: Associated Structures of the Skin

Sebaceous glands are found throughout the skin and produce an oily substance called sebum. Sebum helps to keep the skin moisturized and acts as a protective barrier. Sweat glands are distributed across the skin and are responsible for producing sweat. Sweat helps regulate body temperature and excrete waste products. The integumentary system is richly supplied with blood vessels, which regulate body temperature by dilating (expanding) or constricting (narrowing) in response to temperature changes. The skin contains various nerve endings, such as tactile receptors, nociceptors (pain receptors), and thermoreceptors. These receptors allow us to perceive sensations like touch, pressure, temperature, and pain.

This page titled [6.3.2: Associated Structures of the Skin](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.3.3: Hair and Hair Follicles

Hair is made up of dead keratinized cells and grows from hair follicles located within the dermis. It functions to protect the skin and regulate body temperature.

This page titled [6.3.3: Hair and Hair Follicles](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

6.3.4: Nails

Nails are formed by specialized keratinized cells and grow from the nail matrix. They provide protection to the fingertips and enhance dexterity.

This page titled [6.3.4: Nails](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

6.4: Anatomy review of the ears and eyes

6.4.1: Ears

6.4.2: Eyes

This page titled [6.4: Anatomy review of the ears and eyes](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

6.4.1: Ears

The ears are complex sensory organs responsible for our ability to hear and maintain balance. They consist of several distinct structures, each with specific functions. These include the outer ear, the middle ear, the inner ear, and the auditory canal.

The outer ear is the visible part of the ear and includes the pinna and the external auditory meatus. The pinna is the fleshy, cartilaginous structure that protrudes from the side of the head. It helps collect sound waves and funnel them into the ear canal. The external auditory meatus, or ear canal, is a tubular structure that extends from the pinna to the eardrum. It is lined with ceruminous glands that produce earwax to protect and lubricate the ear canal.

The middle ear, or tympanic cavity, is an air-filled space between the eardrum and the inner ear. It contains the tympanic membrane and ossicles. The tympanic membrane, or the eardrum, is a thin, sensitive membrane that vibrates when struck by sound waves transmitted through the ear canal. Three small bones in the middle ear called the ossicles (malleus, incus, and stapes) transmit vibrations from the eardrum to the inner ear. They amplify the sound signal. The auditory canal connects the middle ear to the back of the throat and helps equalize air pressure between the middle ear and the external environment.

The inner ear is a complex, fluid-filled structure located deep within the skull's temporal bone. It comprises the cochlea, the vestibular system, and the auditory nerve. The cochlea is the spiral-shaped, snail-like structure responsible for converting sound vibrations into electrical signals that can be interpreted by the brain. It plays a crucial role in hearing. The vestibular system helps maintain balance and spatial orientation. It detects changes in head position and movement. The auditory nerve, or the cochlear nerve, carries electrical signals generated in the cochlea to the brain for processing and interpretation. Once sound signals are transmitted from the cochlea to the brain through the auditory nerve, they travel through the auditory pathway to the auditory cortex in the brain's temporal lobe, where they are processed and perceived as sound.

This page titled [6.4.1: Ears](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.4.2: Eyes

The eyes are complex sensory organs responsible for vision, allowing us to perceive the world around us. They have a highly specialized anatomy with various structures working together to capture, focus, and transmit visual information to the brain. The eyes consist of the cornea, sclera, iris, pupil, lens, retina, macula, optic nerve, vitreous humor, aqueous humor, conjunctiva, eyelids, and eyelashes.

The cornea is the clear, dome-shaped front surface of the eye. It acts as a protective and refractive element, bending incoming light to help focus it onto the retina.

The sclera is the tough, white outer layer of the eye that provides structural support and protection for the inner eye structures. It also connects to the eye's muscles.

The colored part of the eye, known as the iris, controls the size of the pupil and regulates the amount of light entering the eye. It adjusts the pupil's size in response to changing lighting conditions.

The pupil is the black, central opening in the iris. It allows light to enter the eye and contracts and dilates in response to light levels and the eye's focus needs.

The lens is a flexible, transparent structure located behind the iris. It fine-tunes the focus of incoming light onto the retina by changing its shape through a process called accommodation.

The retina is a light-sensitive layer at the back of the eye that contains photoreceptor cells known as rods and cones. These cells convert light into electrical signals sent to the brain through the optic nerve.

The macula is a small, specialized area at the retina's center. It is responsible for central vision and lets us see fine details and colors. The optic nerve is a bundle of nerve fibers that carries visual information from the retina to the brain, allowing us to interpret and perceive images.

The vitreous humor is a gel-like substance that fills the space between the lens and the retina, helping to maintain the eye's shape and providing support.

The aqueous humor is a clear fluid that fills the front portion of the eye between the cornea and the lens. It nourishes the cornea and lens and maintains intraocular pressure.

The conjunctiva is a thin, transparent mucous membrane that covers the front of the eye and lines the inside of the eyelids. It helps protect and lubricate the eye.

Finally, the eyelids protect the eyes from debris, light, and excessive moisture, while eyelashes help filter out foreign particles and protect the eyes from dust and other irritants.

This page titled [6.4.2: Eyes](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

6.5: Review of Skin Disorders

6.5.1: Skin Lesions

6.5.2: Impetigo

6.5.3: Fungal Infections of the Skin

6.5.4: Dermatitis

This page titled [6.5: Review of Skin Disorders](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

6.5.1: Skin Lesions

Skin lesions refer to abnormal growths, bumps, or changes in the skin's texture, color, or appearance. Skin lesions can occur for various reasons, including infections, injuries, or underlying medical conditions. They are often a visual indicator of an underlying issue, ranging from harmless moles and freckles to more concerning conditions such as skin cancer. The following are common types of skin lesions:

Macules are small, flat, discolored spots on the skin. They are typically less than 1 centimeter in diameter. Examples include freckles, flat moles, and petechiae (tiny red or purple dots from bleeding under the skin).

Papules are small, raised, solid bumps on the skin's surface. They are usually less than 1 centimeter in diameter. Common examples include acne pimples and insect bites.

Plaques are large, raised, and flat-topped lesions that extend over a larger surface area. They often have defined borders. Psoriasis is a condition known for causing plaques.

Nodules are larger, solid, raised bumps that extend deeper into the skin. They are typically 1 centimeter or more in diameter. Dermatofibromas and lipomas are examples of nodules.

Vesicles are small, fluid-filled sacs that can appear on the skin's surface. They are less than 1 centimeter in diameter. Examples include blisters caused by burns or herpes simplex virus.

Bullae are larger, fluid-filled sacs like vesicles but larger than 1 centimeter in diameter. Bullous pemphigoid is a condition characterized by the development of bullae.

Pustules are small, raised bumps filled with pus. They are often associated with infections like acne or impetigo.

Ulcers are open sores in the skin that may result from tissue loss or damage. They can be caused by conditions such as venous stasis ulcers or pressure ulcers.

Wheals are raised, red, and itchy areas of the skin. They are often caused by an allergic reaction and can be temporary. Hives are an example of wheals.

Cysts are closed sacs or pockets filled with fluid, semi-solid material, or pus. They often feel like a lump under the skin. Sebaceous cysts and epidermoid cysts are common examples.

Erosions are shallow, open sores that result from the loss of the skin's top layer. They can occur due to a range of factors, including infections and autoimmune disorders.

Petechiae are tiny, pinpoint-sized red or purple spots that appear on the skin due to broken blood vessels or bleeding under the skin. They can be a sign of underlying medical conditions or trauma.

Purpura refers to larger areas of bleeding under the skin, often forming purple or red patches. It can result from various causes, including blood disorders or trauma.

Treatment of skin lesions is aimed at the severity and underlying condition. It includes oral or topical antibiotics, corticosteroids, oral or topical antifungals, antivirals, cryotherapy, laser therapy, or other surgical interventions.

This page titled [6.5.1: Skin Lesions](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

6.5.2: Impetigo

Impetigo is a contagious bacterial skin infection that primarily affects children, although it can occur in individuals of any age. It is characterized by developing small, red sores or blisters that can rupture and form honey-colored crusts. Impetigo is typically caused by bacteria, most commonly *Streptococcus pyogenes* (group A *Streptococcus*) and *Staphylococcus aureus*, that can enter the skin through cuts, scratches, insect bites, or other skin protective barrier breaks. These bacteria can spread from person to person through direct contact, such as touching the infected skin or sharing contaminated items like towels or clothing.

The signs and symptoms of impetigo can vary but often include small, red sores or blisters that quickly rupture and ooze fluid, the formation of honey-colored, crusty scabs over the sores, itching, and discomfort in the affected areas, and swollen lymph nodes in severe cases or if the infection becomes systemic. Impetigo is usually diagnosed based on its characteristic appearance and clinical symptoms. Treatment for impetigo typically involves antibiotic therapy and good hygiene practices to prevent the infection from spreading. Mild cases of impetigo may be treated with topical antibiotic creams or ointments. In more severe or widespread cases, oral antibiotics may be prescribed to eliminate bacterial infection. Proper hygiene practices are essential to prevent the spread of impetigo. Individuals with impetigo should avoid close contact with others, especially young children and individuals with weakened immune systems, until the sores are no longer contagious (usually 24–48 hours after starting antibiotics).

This page titled [6.5.2: Impetigo](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.5.3: Fungal Infections of the Skin

Fungal infections of the skin, also known as tinea infections, are common and can affect people of all ages. These infections are caused by several types of fungi that thrive in warm, moist environments. Fungal skin infections are typically not serious but can be uncomfortable and unsightly. The symptoms of fungal skin infections may include itching, burning, stinging sensations, redness, inflammation, scaling or peeling skin, raised circular or oval-shaped rashes, blisters, and pustules. Treatment for fungal skin infections typically involves antifungal medications, which can be applied topically or taken orally. The following describes several types of fungal infections.

Tinea corporis (ringworm) is a circular, red, and itchy rash that often has a raised border. It can occur on various body parts and is not caused by a worm but by a fungal infection.

Tinea pedis (athlete's foot) affects the feet, particularly between the toes. It can cause itching, burning, peeling skin, and sometimes blisters.

Tinea cruris (jock itch) primarily affects the groin area, inner thighs, and buttocks. It often presents as a red, itchy rash with a raised edge.

Tinea versicolor results in discolored patches on the skin, usually on the chest, back, or shoulders. These patches may be lighter or darker than the surrounding skin and can be more noticeable after sun exposure.

Tinea capitis is a fungal infection of the scalp and hair. It can cause hair loss, scaling, and sometimes swollen lymph nodes.

Onychomycosis is toenail or fingernail fungus. It can cause the nails to appear yellow, thick, and brittle (Centers for Disease Control and Prevention, 2018).

This page titled [6.5.3: Fungal Infections of the Skin](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

6.5.4: Dermatitis

Dermatitis, or skin inflammation, is a common skin condition that may result from several factors, including genetics, environmental triggers, and underlying health conditions. Dermatitis is not contagious but can be uncomfortable and negatively impact a person's quality of life.

Types of dermatitis include atopic dermatitis, contact dermatitis, and seborrheic dermatitis. Atopic dermatitis, or eczema, is a chronic form of dermatitis often associated with a family history of allergic conditions such as asthma and hay fever. It typically begins in childhood and is characterized by red, itchy rashes that can occur on the face, arms, and behind the knees. Contact dermatitis is caused by direct contact with an irritating substance or allergen. There are two types: irritant contact dermatitis, which occurs when the skin is exposed to harsh chemicals or physical irritants, and allergic contact dermatitis, which results from an allergic reaction to a specific substance, such as certain metals or cosmetics. Seborrheic dermatitis primarily affects the scalp, face (particularly around the nose and eyebrows), and other oily areas of the skin. It can cause redness, scaling, and flaking, often called dandruff, when it affects the scalp.

The symptoms of dermatitis can vary depending on the type and severity but often include redness and inflammation of the skin, itching, rash, dry, scaly, or flaky skin, crusting, weeping, or oozing, and pain. Treatment for dermatitis aims to alleviate symptoms, manage flare-ups, and prevent recurrence. Treatment options may include regular use of moisturizers or emollients to help keep the skin hydrated and reduce dryness and itching, topical corticosteroids to reduce redness and itching during flare-ups, and oral antihistamines to relieve itching. In severe or unresponsive cases, oral medications like corticosteroids or immunosuppressive drugs may be prescribed.

This page titled [6.5.4: Dermatitis](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

6.6: Review of Ear and Eye Disorders

6.6.1: Otitis Externa

6.6.2: Otitis Media

6.6.3: Impacted Cerumen

6.6.4: Meniere's Disease

6.6.5: Glaucoma

6.6.6: Cataracts

6.6.7: Infections of the Eyes

This page titled [6.6: Review of Ear and Eye Disorders](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

6.6.1: Otitis Externa

Otitis externa, commonly known as swimmer's ear, is a painful and often irritating infection or inflammation of the external ear canal. Otitis externa can be caused by numerous factors, including bacterial or fungal infections, and it is typically associated with activities that involve water exposure, such as swimming. The most common cause of otitis externa is bacterial infection, often due to bacteria such as *Pseudomonas* or *Staphylococcus aureus*. These bacteria thrive in a moist environment, making the ear canal susceptible to infection after exposure to water. Fungal otitis externa, caused by species such as *Aspergillus* or *Candida*, can also occur, especially in individuals with underlying skin conditions or weakened immune systems. Scratching or inserting foreign objects (like cotton swabs) into the ear can damage the ear canal's delicate skin, creating an entry point for infection. Allergic reactions to certain substances, such as hair products or earplugs, can cause inflammation and contribute to otitis externa.

Otitis externa typically presents with ear pain or discomfort, often worsened by pulling on the ear or pressing the tragus (the small, pointed part in front of the ear canal). Other symptoms include itching, redness, swelling in the ear canal, drainage of clear or pus-like fluid, decreased hearing, and pain when moving the jaw or opening the mouth. An otoscope is used to examine the ear canal and assess any inflammation, discharge, or blockage. Treatment for otitis externa aims to alleviate symptoms, resolve the infection, and prevent complications. Common treatment options include antibiotic or antifungal ear drops, over-the-counter pain relievers such as acetaminophen or ibuprofen, avoidance of water, topical corticosteroids, and oral antibiotics.

This page titled [6.6.1: Otitis Externa](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.6.2: Otitis Media

Otitis media, often referred to as middle ear infection, is a common childhood ailment that can also affect adults. It is characterized by inflammation and infection of the middle ear, the space behind the tympanic membrane. Otitis media can be acute or chronic, typically caused by viral or bacterial infections. Viruses, such as those responsible for the common cold or flu, are common causes of acute otitis media. These infections can lead to inflammation in the middle ear. Bacterial infections, particularly *Streptococcus pneumoniae* or *Haemophilus influenzae*, are also common culprits, especially in severe or recurring cases. The Eustachian tube connects the middle ear to the back of the throat and helps regulate air pressure in the ear. Dysfunction of this tube, often due to allergies, respiratory infections, or structural issues, can contribute to otitis media.

The symptoms of otitis media can vary in severity. They may include ear pain or discomfort, hearing loss or muffled hearing, clear or pus-filled drainage from the ear, fever, irritability and fussiness in children, and balance problems or dizziness. The provider makes a diagnosis via the use of an otoscope.

The treatment for otitis media depends on several factors, including the patient's age, the severity of symptoms, and whether the infection is bacterial or viral. In some cases, particularly for mild acute otitis media in older children or adults, a healthcare provider may recommend observation without antibiotics, as many cases resolve on their own. Antibiotics are often prescribed to clear the infection if the infection is bacterial or if symptoms are severe. Commonly used antibiotics include amoxicillin and azithromycin. Over-the-counter pain relievers, such as acetaminophen or ibuprofen, can help manage ear pain and reduce fever. A warm compress to the affected ear can provide comfort and relieve pain. In cases of recurrent or chronic otitis media, particularly when associated with fluid accumulation behind the eardrum (effusion), surgical procedures such as tympanostomy tube placement may be recommended to improve ventilation and drainage in the middle ear.

This page titled [6.6.2: Otitis Media](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.6.3: Impacted Cerumen

Impacted cerumen, commonly known as earwax blockage, is a common ear condition that occurs when excessive earwax accumulates in the ear canal and becomes impacted, causing a blockage. Earwax, called cerumen, is a naturally occurring substance produced by the glands in the ear canal. It plays a crucial role in protecting the ear by trapping dust and debris and preventing infection. However, when earwax becomes impacted, it can lead to uncomfortable symptoms and potential hearing problems. Some individuals naturally produce more earwax than others, making them more prone to cerumen impaction. Attempts to clean the ears with cotton swabs or other objects can push earwax deeper into the ear canal, leading to impaction. People with naturally narrow or curved ear canals may be at a higher risk of developing earwax blockages. As people age, their earwax becomes drier and harder, making it more likely to become impacted. Hearing aids, earplugs, or in-ear headphones can push earwax deeper into the ear canal, increasing the risk of impaction.

The symptoms of impacted cerumen may include earache or discomfort, reduced or muffled hearing, tinnitus (ringing in the ears), dizziness or vertigo, a sensation of fullness or blockage in the ear, and discharge from the ear. The provider makes a diagnosis by using an otoscope. The primary goal of treatment for impacted cerumen is to remove the earwax blockage safely. Treatment options include over-the-counter or prescription earwax softening drops to soften and loosen the impacted cerumen. Sometimes, a provider may perform ear irrigation, where warm water is flushed into the ear canal to remove the softened earwax. In cases of severe impaction, the provider may use special instruments to remove the impacted earwax carefully.

This page titled [6.6.3: Impacted Cerumen](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

6.6.4: Meniere's Disease

Meniere's disease is a chronic and often disabling inner ear disorder that primarily affects the inner ear's balance and hearing functions. It is characterized by recurring episodes of vertigo (a spinning sensation), fluctuating hearing loss, tinnitus, and a feeling of fullness or pressure in the affected ear. Meniere's disease can significantly impact a person's quality of life, and its exact cause remains unclear. Meniere's disease is known for its episodic nature, and individuals with this condition may experience a combination of the following symptoms during an "attack." Sudden and severe vertigo episodes can last anywhere from a few minutes to several hours. Vertigo often leads to nausea, vomiting, and an unsteady feeling. Hearing loss in Meniere's disease typically fluctuates, affecting one ear at a time. Over time, it may become progressively worse and could potentially lead to permanent hearing impairment. People with Meniere's disease often report feeling fullness or pressure in the affected ear, like having a plugged or blocked ear. Diagnosis is typically based on the presence of specific symptoms and a thorough evaluation by a healthcare provider. Treatment of Meniere's disease aims to alleviate symptoms and improve the patient's quality of life. Treatment options may include reducing salt intake and avoiding caffeine and alcohol to help control fluid retention in the inner ears. Drugs such as diuretics, anti-nausea drugs, and vestibular suppressants can be prescribed to manage symptoms during attacks. Surgical interventions may be considered in severe cases where other treatments are ineffective.

This page titled [6.6.4: Meniere's Disease](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.6.5: Glaucoma

Glaucoma is a group of eye conditions that can damage the optic nerve and cause vision loss. It is often characterized by elevated intraocular pressure (IOP) but can also occur with normal or low IOP. Glaucoma is a serious eye disease and a leading cause of blindness worldwide, but early diagnosis and treatment can help slow or prevent vision loss. The primary risk factor for glaucoma is increased IOP. Still, other factors may contribute, such as genetics, family history, age (especially in individuals over 60), race (African Americans and Hispanics are at higher risk), and certain medical conditions like diabetes and hypertension. Glaucoma is often called the "silent thief of sight" because it typically progresses without noticeable symptoms until significant vision loss has occurred. In the late stages, individuals may experience peripheral vision loss, tunnel vision, and complete blindness. Glaucoma is usually diagnosed by measuring IOP, examining the optic nerve for signs of damage, and assessing visual field loss. The primary goal of glaucoma treatment is to lower IOP and prevent further damage to the optic nerve. Treatment options include eye drops or oral medications to reduce IOP by increasing drainage or decreasing the production of aqueous humor (fluid in the eye). Other treatments include laser therapy and surgery.

This page titled [6.6.5: Glaucoma](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.6.6: Cataracts

Cataracts are a common eye condition characterized by the clouding of the eye's natural lens, which can lead to blurry vision and decreased visual clarity. Cataracts typically develop slowly over time and are more common in older adults, although they can occur at any age. The most common cause of cataracts is aging. With age, the proteins in the eye's lens clump together, clouding the lens and obstructing the passage of light. Other factors that can contribute to cataract development include genetics, ultraviolet radiation, medical conditions such as diabetes, eye trauma, smoking, alcohol consumption, and certain drugs such as corticosteroids. Symptoms of cataracts include blurred or hazy vision, reduced night vision, and increased sensitivity to glare. The only effective treatment for cataracts is surgical removal. Cataract surgery is one of the most performed surgeries worldwide and is considered safe and highly successful.

This page titled [6.6.6: Cataracts](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

6.6.7: Infections of the Eyes

Infections of the eye, also known as ocular infections, can affect various parts of the eye and can be caused by bacteria, viruses, fungi, or parasites. These infections range from mild and easily treatable conditions to severe and potentially vision-threatening diseases. Prompt diagnosis and appropriate treatment are crucial for managing eye infections effectively and minimizing potential complications.

Conjunctivitis (Pink Eye)

Viral or bacterial infections, including adenovirus, *Staphylococcus aureus*, and *Streptococcus pneumoniae*, often cause conjunctivitis. Allergic reactions and irritants can also lead to conjunctivitis. Symptoms include redness, itching, tearing, discharge, and a gritty feeling in the eye. Allergic conjunctivitis may include itching, while bacterial conjunctivitis can result in a thick, yellow, or green discharge. Treatment depends on the cause. Viral conjunctivitis is typically self-limiting and managed with supportive care. Bacterial conjunctivitis may require antibiotics. Allergic conjunctivitis can be treated with antihistamines and avoiding allergens (Centers for Disease Control and Prevention, 2019).

Stye (Hordeolum)

Styes are typically caused by a bacterial infection, often due to *Staphylococcus aureus*. Styes are painful, red, swollen bumps on the eyelid, usually near the base of an eyelash. They can be filled with pus. Warm compresses can help relieve pain and promote drainage. In some cases, antibiotic ointment or oral antibiotics may be prescribed.

Blepharitis

Blepharitis is a chronic condition characterized by inflammation of the eyelid margins. It can be due to bacteria (*Staphylococcus* species), seborrheic dermatitis, or other factors. Symptoms include red, swollen eyelids, itching, burning, and crusting along the eyelashes. Treatment involves warm compresses, eyelid hygiene, and antibiotic ointments. Management of underlying conditions like seborrheic dermatitis may also be necessary.

Keratitis

Keratitis is an inflammation of the cornea and can be caused by bacterial, viral, fungal, or parasitic infections. Contact lens wearers are at a higher risk. Symptoms include eye pain, redness, blurred vision, sensitivity to light, and discharge. Treatment depends on the cause and severity. Bacterial keratitis requires antibiotics, while viral keratitis may need antiviral medications. Fungal and parasitic keratitis can be more challenging to treat and may require specialized medications.

This page titled [6.6.7: Infections of the Eyes](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

6.7: Drugs to Treat Skin, Ear, and Eye Disorders

Table 6.1 Skin, Ear, and Eye Drugs

Skin, ear, and eye drugs

Drug Name	Drug Class	Indication	Patient Teaching
Amoxil (amoxicillin)	Penicillin antibiotic	Otitis media	May cause diarrhea. Discontinue if rash appears
AzaSite (azithromycin ophthalmic)	Macrolide antibiotic	Conjunctivitis	Do not wear contact lenses while using this drug
Bactroban (mupirocin topical ointment)	Antibiotic	Impetigo	Do not use on skin areas that have cuts, scrapes, or burns
Benadryl (diphenhydramine)	Antihistamine	Dermatitis	May cause drowsiness
Betopic S (betaxolol)	Beta-blocker	Glaucoma	May cause blurry vision, redness, and stinging in the eye but may improve with time
Curanail (amorolfine)	Antifungal	Onychomycosis	Requires months of application with low rates of cure
Debrox (carbamide peroxide)	Cerumenolytic	Impacted cerumen	Do not use for more than 4 days. May cause dizziness
Isopto (pilocarpine)	Miotic	Glaucoma	May cause blurry vision, redness, and stinging in the eye but may improve with time
Lotrimin (clotrimazole)	Antifungal	Tinea skin infections	May take up to 2 weeks to work
Mirvaso (brimonidine)	Alpha agonist	Glaucoma	May cause blurry vision, redness, and stinging in the eye but may improve with time
Solu-Cortef (hydrocortisone cream)	Anti-inflammatory	Dermatitis	Do not get in eyes or mouth

This page titled [6.7: Drugs to Treat Skin, Ear, and Eye Disorders](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

SECTION OVERVIEW

6.8: Routes of Administration

6.8.1: Topical Route

6.8.2: Otic route

6.8.3: Ophthalmic route

This page titled [6.8: Routes of Administration](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

6.8.1: Topical Route

Supplies and equipment required to administer drugs topically include

- Provider's medication order
- Appropriate equipment for order
- Gloves
- Supplies to cleanse the skin
- Dressings or bandages, if appropriate

When preparing topical drugs, practice medical asepsis and work in a well-lit area without distractions; follow the nine rights of drug administration and check for drug allergies. Only administer medications ordered by the provider and that you have prepared yourself. If the MA has any questions about the drug, do not administer the drug until all questions have been answered.

Follow the following steps for safe administration of topical drugs:

1. Use a drug reference source to review information on the drug ordered.
2. Calculate the amount of drug to be administered.
3. Wash hands.
4. Check the drug label against the provider's order. Check for the drug name, form, and route.
5. Check the expiration date on the drug packaging.
6. Prepare medication with the correct equipment for the topical administration route.
7. Perform another check for the right name, form, route, and dose.
8. Greet the patient and identify yourself. Verify the patient's identity by asking for their name and date of birth. Check the patient's identification bracelet if required.
9. Ask the patient if they have any drug allergies.
10. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
11. Perform any assessments before administering the drug.
12. Allow the patient to ask questions.
13. Don gloves.
14. Cleanse and dry skin in area where medication is to be applied.
15. Change gloves if contaminated.
16. Place medication on a sterile applicator or gauze bandage, ensuring the tip of the medication container does not become contaminated.
17. Use long, even strokes to apply medication or apply medication to bandage or dressing.
18. Bandage dressing if appropriate.
19. Remove gloves and wash hands.
20. Document medication administration.
21. Document patient response and patient education.

This page titled [6.8.1: Topical Route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .



6.8.2: Otic route

Supplies and equipment required to administer ear drops include:

- Provider's medication order
- Appropriate equipment for order
- Gloves
- Gauze
- Ear drops

When preparing ear drops, practice medical asepsis and work in a well-lit area without distractions; follow the nine rights of drug administration and check for drug allergies. Only administer drugs ordered by the provider and that you have prepared yourself. If the MA has any questions about the drug, do not administer the drug until all questions have been answered.

Follow the following steps for safe administration of topical drugs:

1. Use a drug reference source to review information on the drug ordered.
2. Calculate the amount of drug to be administered.
3. Wash hands.
4. Check the drug label against the provider's order. Check for the drug name, form, and route.
5. Check the expiration date on the drug packaging.
6. Prepare medication with the correct equipment for the otic administration route.
7. Perform another check for the right name, form, route, and dose.
8. Greet the patient and identify yourself. Verify the patient's identity by asking for their name and date of birth. Check the patient's identification bracelet if required.
9. Ask the patient if they have any drug allergies.
10. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
11. Perform any assessments before administering the drug
12. Allow the patient to ask questions.
13. Wash hands.
14. Assist the patient into a side-lying position with the affected ear facing up.
15. Remove the cover of the bottle. With your nondominant hand, gently pull the pinna up and back for adults and down and back for patients under 3. This straightens the external auditory canal.
16. Hold the dropper firmly in your dominant hand. Place the tip of the dropper about ½ inch above the ear canal. Be sure not to contaminate the dropper. Carefully drop the required number of drops in the patient's ear. Avoid dropping directly onto the eardrum; this may cause dizziness. Replace the cover.
17. Instruct the patient to keep the ear facing up for 3–5 minutes.
18. After 3-5 minutes, assist the patient to get up. The patient may feel dizzy.
19. Remove gloves and wash hands.
20. Document medication administration.
21. Document patient response and patient education.

This page titled [6.8.2: Otic route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

6.8.3: Ophthalmic route

▶ ~~Supplies and equipment required to administer eye drops include:~~

- Provider's medication order
- Appropriate equipment for order
- Gloves
- Sterile Gauze
- Ear drops

Practice medical asepsis and work in a well-lit area without distractions when preparing eye drops. Eye drops must remain sterile. If the eye drop bottle is contaminated, do not use it. Follow the nine rights of drug administration and check for drug allergies. Only administer drugs ordered by the provider and that you have prepared yourself. If the MA has any questions about the drug, do not administer the drug until all questions have been answered.

Follow the following steps for safe administration of ophthalmic drugs:

1. Use a drug reference source to review information on the drug ordered.
2. Calculate the amount of drug to be administered.
3. Wash hands.
4. Check the drug label against the provider's order. Check for the drug name, form, and route.
5. Check the expiration date on the drug packaging.
6. Prepare medication with the correct equipment for the ophthalmic administration route.
7. Perform another check for the right name, form, route, and dose.
8. Greet the patient and identify yourself. Verify the patient's identity by asking for their name and date of birth. Check the patient's identification bracelet if required.
9. Ask the patient if they have any drug allergies.
10. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
11. Perform any assessments before administering the drug.
12. Allow the patient to ask questions.
13. Wash hands.
14. Assist the patient into a sitting or supine position.
15. Don gloves.
16. If crusting is present on the eye, wipe gently with moistened sterile gauze from the inner canthus to the outer canthus of the eye. Discard gauze after each wipe. Dry the area.
17. Hold a sterile gauze with the non-dominant hand and use the gauze to pull the lower conjunctival sac downward to create a pocket in the lower eyelid. Instruct the patient to look up toward their forehead.
18. With the dominant hand, hold the dropper $\frac{3}{4}$ inch above the eye (or higher if the patient has longer eyelashes) to prevent contamination.
19. Drop the required number of drops into the conjunctival sac.
20. Instruct the patient to gently press against the inner corner of their eye near the nose (lacrimal duct) for one minute to prevent the eye drops from draining into the nose.
21. Instruct the patient to keep their eye closed for 2-3 minutes.
22. Assist the patient into a comfortable position.
23. Clean the area, remove gloves, and wash hands.
24. Document medication administration.
25. Document patient response and patient education.

This page titled [6.8.3: Ophthalmic route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

SECTION OVERVIEW

6.9: Chapter 6 References

Centers for Disease Control and Prevention. (2018, September 13). *Fungal nail infections*. U.S. Department of Health & Human Services. <https://www.cdc.gov/fungal/nail-infections.html>

Centers for Disease Control and Prevention. (2019, January 4). *Conjunctivitis treatment*. U.S. Department of Health & Human Services. <https://www.cdc.gov/conjunctivitis/about/treatment.html>

This page titled [6.9: Chapter 6 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

CHAPTER OVERVIEW

Chapter 7: Parenteral Routes- Intradermal and Subcutaneous

Medical assistants administer injectable drugs via the parenteral route using intramuscular (IM), subcutaneous (SC), or intradermal (ID) routes. Proper injection techniques, equipment handling, and infection control measures are crucial to prevent complications and ensure patient safety. This route can be painful for the patient and is associated with a higher risk of injury to the patient than other routes of administration. Do not attempt any parenteral administration unless you are confident that you have mastered the proper techniques for safe administration.

[7.1: Main Terms](#)

[7.2: Chapter Goals](#)

[7.3: Parenteral Supplies](#)

[7.3.1: Needles and Syringes](#)

[7.3.2: Vials](#)

[7.3.3: Ampules](#)

[7.3.4: Prefilled Syringes](#)

[7.3.5: Reconstituting Powders](#)

[7.4: Intradermal Route](#)

[7.5: Subcutaneous Route](#)

[7.6: Chapter 7 References](#)

This page titled [Chapter 7: Parenteral Routes- Intradermal and Subcutaneous](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

7.1: Main Terms

Calibration marks – lines on the barrel of a syringe that indicates the amount of fluid inside

Gauge – the measurement of the inside of the needle

Intradermal (ID) route – injection just under the epidermis at a 15-degree angle

Lumen – the area inside of the needle

Needlestick Safety and Prevention Act – requires employers to use safer medical devices to reduce the risk of employee injury

Parenteral route – a drug administration route that utilizes injections into the skin or tissues

Plunger – a part of the syringe that can be pushed up or down to adjust fluid levels inside the barrel

Subcutaneous (SC) route – injection into the fatty layer under the dermis

Syringe – a medical device that has a hollow cylinder with a plunger that slides in and out

Vials - a plastic or glass container with a sterile rubber stopper that can contain liquid or powdered drugs

This page titled [7.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

7.2: Chapter Goals

1. Explain the different parts of a syringe and their functions.
 2. Define intradermal injections and subcutaneous injections.
 3. Learn proper techniques for preparing and administering parenteral medications, including injection sites and needle insertion angles.
 4. Discuss the correct disposal methods for used parenteral supplies and how to safely handle sharps.
 5. Discuss the procedures for using prefilled cartridges.
 6. Explain the process of reconstituting powdered drugs.
-

This page titled [7.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

7.3: Parenteral Supplies

This page titled [7.3: Parenteral Supplies](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

7.3.1: Needles and Syringes

Hypodermic needles and hypodermic syringes are used for injectable drugs. The entire hypodermic needle must remain sterile to avoid infection. The parts of a hypodermic needle include the hub, hilt, bevel, and lumen. The hub is the part of the needle that attaches to the syringe. The hilt is where the needles connect to the hub. The bevel is the slanted end of the needle. The lumen is the area inside the needle through which the liquids travel.

Needles are manufactured in various gauges and lengths. The lower the gauge number, the wider the needle lumen size. For example, a 25-gauge needle is much thinner than an 18-gauge needle. Medical assistants choose needle gauges depending on the liquid's viscosity (thickness) or how deep the needle will be injected into the tissue. Thicker needles with a larger lumen are used for thicker liquids and deeper injections. Thinner needles are used for more superficial injections and more aqueous liquids.

The needle length depends on how deep the injection will enter the tissue and the patient's size. An injection into muscle tissue will require a longer needle than an injection into subcutaneous or intradermal tissue. A patient who weighs over 300 pounds would need a longer needle for an intramuscular injection than a person who weighs under 150 pounds. Medical assistants must use good assessment skills to determine needle length and gauge when administering parenteral drugs.

The Needlestick Safety and Prevention Act requires employers to use safer medical devices to reduce the risk of employee injury. Hypodermic needles, categorized as sharps, are manufactured with safety devices to reduce this risk. The medical assistant should use safety devices whenever possible. (Needlestick Safety and Prevention Act, 2000)

Hypodermic syringes attach to needles and hold the liquid drug that will be injected into tissues. Syringes are manufactured in sizes 1, 3, 5, 10, and 12mL. Calibration marks on the syringe are used to measure the correct amount of drug. A good rule of thumb is to use the smallest syringe capable of containing the amount of liquid to be injected to get the most accurate measurement of the drug.

Some needles and syringes are manufactured separately, and some are manufactured preassembled. When opening a preassembled syringe, twist the needle clockwise to ensure it is secure. When opening a syringe that is packaged by itself, do not contaminate the tip attached to the needle. Both the needle and the syringe tip must remain sterile. Do not place the syringe on the table until it has been aseptically attached to a needle. Do not remove the needle cover until you are ready to inject or aspirate fluid from a vial, ampule, or other sterile container. The part of the syringe that pulls and pushes fluid in and out of the syringe is called the plunger. Do not touch the part of the plunger that goes into the syringe because it may contaminate the liquid inside.

Recapping needles should never happen after a needle has been used on a patient. After aspirating fluid into the syringe, but before the needle has been used on a person, the needle can be recapped using the scoop method. To do this, place the needle cap on the table, carefully place the needle into the cap to avoid contamination, scoop the cap up onto the needle, and secure the cover.

This page titled [7.3.1: Needles and Syringes](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

7.3.2: Vials

A vial is a plastic or glass container with a sterile rubber stopper covered with a cap. Vials can contain liquid drugs or powdered drugs. Some vials are single-use, and others are used for multiple doses. Each time a needle accesses a vial, the rubber stopper must be disinfected with an alcohol pad.

To prepare drugs from a vial, follow these steps.

Supplies needed:

- Providers order
 - Drug reference book
 - Vial with medication
 - Syringe and needle
 - Alcohol wipe
 - Medicine tray
1. Carefully read the provider's order and calculate the amount of drug to be administered.
 2. Check drug references for information about medication
 3. Wash hands and don gloves.
 4. Select a medication and check against the provider's order.
 5. Check the expiration date.
 6. Select the correct size syringe and needle.
 7. Remove the cap from the vial and clean it with an alcohol wipe.
 8. Remove the cover from the needle.
 9. Pull the plunger back to inject the same amount of air into the syringe as fluid will be aspirated out of the vial.
 10. Push the needle through the center of the rubber stopper and inject air into the vial.
 11. Turn the needle and vial upside down and withdraw fluid from the vial.
 12. Remove any large bubbles from the syringe.
 13. Check the amount of liquid in the syringe is the correct dose.
 14. Remove the needle from the vial and use the scoop method to recap the needle.
 15. Check the vial label against the provider order.
 16. Place the fluid-filled syringe on the medicine tray.
 17. Remove gloves.
 18. Wash hands.

This page titled [7.3.2: Vials](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

7.3.3: Ampules

Ampules are small glass tubes that contain a single dose of a drug. Ampules do not have a rubber stopper and must be cracked open at the score mark with an ampule breaker to access the drug. Ampules are used for drugs that react with plastic or rubber. It is essential to use a filter needle to aspirate the drug from the ampule, but never use a filter needle to inject it into a patient. Always change the filter needle for another needle before administering it to the patient.

To prepare drugs from an ampule, follow these steps.

Supplies needed:

- Providers order
- Drug reference book
- Vial with medication
- Syringe
- Filter needle
- Non-filter needle
- Alcohol wipe
- Medicine tray

1. Carefully read the provider's order and calculate the amount of drug to be administered.
2. Check drug references for information about medication.
3. Wash hands and don gloves.
4. Select a medication and check against the provider's order.
5. Check the expiration date.
6. Select the correct size syringe and attach a filter needle.
7. Gently tap on the top of the ampule to release the drug into the bottom of the container.
8. Wipe the neck of the ampule with an alcohol pad.
9. Using the ampule breaker, crack open the ampule away from yourself.
10. Discard the ampule top into a sharps container.
11. Insert the filter needle into the open ampule and withdraw the amount needed.
12. Remove any large air bubbles and adjust the plunger to the correct amount needed.
13. Recap the filter needle using the scoop method.
14. Check the ampule against the provider's order.
15. Dispose of the ampule in the sharps container.
16. Twist off the filter needle and attach a new needle that will be used for administration of the drug.
17. Dispose of the filter needle in the sharps container.
18. Place the needle and syringe on the medicine tray.
19. Clean up the area.
20. Remove gloves and wash your hands.

This page titled [7.3.3: Ampules](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

7.3.4: Prefilled Syringes

Prefilled sterile syringes or cartridges are manufactured with a single drug dose. The prefilled syringe may come with or without a needle and with or without a plunger. If a cartridge is supplied, a reusable cartridge holder will be required.

Follow these steps to prepare a prefilled cartridge.

Supplies needed:

- Provider's order
- Drug reference material
- Sterile prefilled cartridge
- Reusable cartridge holder
- Patient's health record
- 1 mL syringe with ¼ to 5/8-inch 25–27 gauge safety needle
- Bandage
- Medication tray
- Sharps container
- Gloves

1. Review the provider's order and review drug reference material.
2. Wash hands and don gloves.
3. Select the right medication and check it against the provider's order.
4. Check the expiration date.
5. Calculate the dose to be given.
6. Assemble the supplies needed.
7. Check the medication against the provider's order.
8. Break the seal by placing one hand on the needle cover and the other on the barrel of the prefilled cartridge. Next, move your hands together until you hear a click. If needed, remove the cover on the cartridge and attach a covered safety needle.
9. Hold the reusable cartridge holder so the opening (for the barrel) is facing up. Pull the plunger rod out until it clicks. Turn the blue lock until it clicks to increase the space between the blue lock and the flange.
10. Insert the cartridge into the reusable cartridge holder. To secure the cartridge, turn the blue lock on the reusable cartridge holder until it clicks to decrease the space between the blue lock and the flange. Turn the white plunger rod until it screws onto the rubber stopper.
11. Remove needle cap. Hold the syringe unit vertically with the uncapped needle pointed upward. Tap the barrel carefully with the fingertips or a pen to move the air bubbles up to the top.
12. Push the plunger slowly to the correct calibration marking for the ordered dose.
13. Recap the needle using the one-hand scoop technique.
14. Check the medication against the provider's order.
15. After "administering" the injection, unscrew the plunger rod and pull it out until it clicks. Turn the blue lock until it clicks to increase the space between the blue lock and the flange.
16. Carefully invert the reusable cartridge holder over a biohazard sharps container to discard the cartridge. Hold the reusable cartridge holder firmly to avoid falling into the sharps container.
17. Disinfect the reusable cartridge holder.
18. Clean up the work area.

This page titled [7.3.4: Prefilled Syringes](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

7.3.5: Reconstituting Powders

Certain drugs have a short shelf life if manufactured in liquid form, so they are sold in powdered form to be reconstituted just before use. Powdered medications are mixed with a diluent. Follow the manufacturer's instructions when choosing a diluent. Common diluents are sterile saline or sterile water; however, the manufacturer may provide a special diluent that must be used.

Follow these steps to reconstitute a powder drug.

Supplies needed:

- Provider's order
- Drug reference material
- Vial of sterile powder
- Vial of diluent
- Alcohol wipes
- 3 mL syringe
- 10 mL syringe
- Two safety needles
- Sharps container
- Marker
- Gloves

1. Review the provider's order and review drug reference material.
2. Wash hands and don gloves.
3. Select the right medication and check it against the provider's order.
4. Check the expiration date.
5. Determine the correct diluent.
6. Calculate the dose to be given.
7. Assemble the supplies needed.
8. Check the medication against the provider's order.
9. Open and assemble the syringes and needles.
10. Use the marker to label the 3 mL syringe with the drug name.
11. Remove the caps from the vials and clean them with alcohol wipes. Allow to dry.
12. Place the powdered medication vial on a firm surface and insert the needle of the 10 mL syringe. Make sure the tip stays out of the powder.
13. Pull back on the plunger and withdraw air equal to the amount of diluent that must be added. Pull the needle/syringe out of the stopper.
14. Using the syringe with the aspirated air (equal to the amount of diluent needed), insert the needle into the center of the rubber stopper of the diluent vial. Push the air into the vial.
15. Use your non-dominant hand to grasp the vial between your middle and index fingers. Keep the syringe unit in the vial, pick up and invert them. Use the other fingers of your non-dominant hand to stabilize the syringe in the vial. Pull down on the plunger and withdraw fluid until there is more diluent than you need in the barrel.
16. Use your fingers or a pen to tap the bubbles to the top of the barrel with your dominant hand. Once all the air bubbles are at the top, push the plunger slowly to the correct calibration marking for the ordered dose. Keep the syringe at eye level.
17. Remove the vial from the syringe/needle unit.
18. Using an alcohol wipe, clean the rubber stopper of the powdered medication vial. With the vial flat on a hard surface, insert the needle into the dried stopper. Push the diluent into the vial. If resistance is met, take your finger off the plunger and allow air to fill the syringe. Gradually push all the diluent into the vial. Withdraw the needle from the vial and dispose of the needle and syringe in the biohazard sharps container.
19. Gently mix the vial by rolling it in your palms. Roll the vial until all the powder has dissolved.
20. Clean the rubber stopper of the powdered medication vial with an alcohol wipe. Allow the stopper to dry.
21. With the second syringe in a vertical position, pull the syringe plunger down. Draw up an amount of air equal to the amount of medication ordered.
22. Hold the vial firmly against a flat surface. Insert the needle into the center of the dried rubber stopper. Inject the aspirated air above the fluid in the vial.

23. With the palm of your non-dominant hand facing upward, grasp the vial between your middle and index fingers. Keeping the syringe unit in the vial, pick up and invert them. Use the other fingers of your non-dominant hand to stabilize the syringe in the vial.
24. With the syringe at eye level, pull the plunger down using your dominant hand. Fill the syringe with more drug than what was ordered.
25. With your dominant hand, use either your fingers or a pen to tap the bubbles to the top of the barrel and use the plunger to remove the bubbles and obtain the correct dose.
26. Remove the syringe from the vial.
27. Use the one-hand scoop technique to cover the needle.
28. Check the drug against the provider's order.
29. Maintain the sterility of the medication and the needle throughout the procedure.
30. If the drug is in a multidose vial, label the vial with the expiration date, diluent added, and your initials.
31. Clean up the work area. Discard the vial(s) in the biohazard waste container.

This page titled [7.3.5: Reconstituting Powders](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

7.4: Intradermal Route

Intradermal injections are administered just under the epidermis at a 15-degree insertion angle. The maximum dose to be administered is 0.1mL. A tuberculin (1 mL) syringe is used with a 25-27 gauge needle with a length of ¼ to 5/8 inch. This administration method causes stinging and burning that resolves quickly. This administration route is used for Mantoux tuberculin skin testing (TST), intradermal flu vaccines, and allergy testing. Sites for intradermal injections include the anterior forearms, the upper arms, and the upper back. When performing TST administration, the medical assistant should schedule the patient for a follow-up visit within 48–72 hours to assess the injection site for a positive or negative result.

Follow these steps to administer an intradermal injection safely.

Supplies needed:

- Provider's order
- Drug reference material
- Patient's health record
- Alcohol wipes
- Medication ordered
- 1 mL syringe with ¼ to 5/8-inch 25-27 gauge safety needle
- Bandage
- Medication tray
- Sharps container
- Marker
- Gloves

1. Review the provider's order and review drug reference material.
2. Wash hands and don gloves.
3. Select the right medication and check it against the provider's order.
4. Check the expiration date.
5. Calculate the dose to be given.
6. Assemble the supplies needed.
7. Check the medication against the provider's order.
8. Open the syringe and needle; attach the needle to the syringe if packaged separately.
9. Use the marker to label the syringe with the drug name.
10. Remove the cap from the vial and clean it with an alcohol wipe.
11. Using the syringe, pull the plunger down to the amount of drug to be administered.
12. Insert the needle into the vial and inject the air.
13. Invert the vial and syringe and pull the plunger down to fill it with liquid from the vial.
14. Use the plunger to remove any large bubbles.
15. Use the plunger to fill the syringe with the correct dose.
16. Remove the needle from the vial and use the scoop method to recap the needle.
17. Check the provider's order against the vial and the syringe.
18. Place the syringe on the medicine tray and clean the area.
19. Remove gloves and wash hands.
20. Greet the patient and identify yourself. Verify the patient's identity by asking for their name and date of birth. Check the patient's identification bracelet if required.
21. Ask the patient if they have any drug allergies.
22. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
23. Perform any assessments before administering the drug.
24. Allow the patient to ask questions.
25. Wash hands and don gloves.

26. Instruct the patient to extend their forearm or expose the area to be injected.
27. Assess the injection site for intact, healthy skin. Palpate the skin for any lumps or bumps under the skin.
28. Clean the site with an alcohol wipe and allow it to dry.
29. Remove the cap from the syringe. Grasp it with your dominant hand and turn the syringe so the bevel is up.
30. With your nondominant hand, hold the skin taut around the area of insertion.
31. With your dominant hand, slowly inject the needle into the skin at a 15-degree angle.
32. Slowly move your nondominant hand to the plunger and slowly inject the drug by pressing the plunger. Watch the skin to ensure a 6-10mm wheal appears.
33. Withdraw the needle, activate the safety device, and discard into the sharps container.
34. Do not massage the area and instruct the patient not to massage the area.
35. Place a bandage on the injection area.
36. Observe the patient for any reactions.
37. Clean the area, remove gloves, and wash hands.
38. Document the procedure in the patient's health record. Include the injection site, patient response, patient assessments, patient teaching, and the patient's return visit to have the site assessed.

This page titled [7.4: Intradermal Route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

7.5: Subcutaneous Route

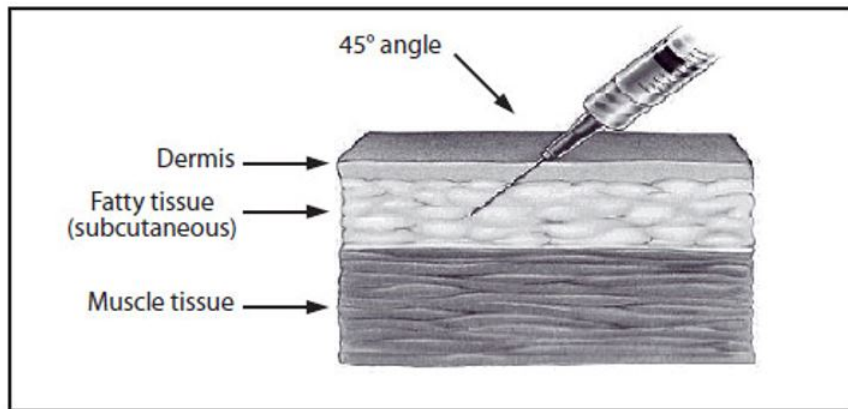


Figure 4.1 Subcutaneous injection (Centers for Disease Control and Prevention, 2023).

Subcutaneous drugs are injected into the fatty layer under the dermis. The subcutaneous layer has fewer blood vessels than the muscular tissue, so drugs are absorbed more slowly than with the intramuscular route. Subcutaneous injections use a 1–3 mL syringe, a 5/8-inch needle, and a 23–25-gauge needle. Subcutaneous injections are administered at a 45-degree angle. The maximum volume is 0.5 to 1.5mL, but only 0.5mL is injected for children. Sites for subcutaneous administration include the anterior thigh, abdomen, upper outer arm, flank region, and subscapular area of the back. For children, inject into the anterior thigh only. It is important to note that if a patient has routine subcutaneous injections, the injection sites should be rotated to avoid injuring the skin and forming scar tissue.

Follow these steps to administer an intradermal injection safely.

Supplies needed:

- Provider's order
 - Drug reference material
 - Patient's health record
 - Alcohol wipes
 - Medication ordered
 - 1 mL or 3 mL syringe with 5/8-inch 23–25-gauge safety needle
 - Gauze
 - Bandage
 - Medication tray
 - Sharps container
 - Marker
 - Gloves
1. Review the provider's order and review drug reference material.
 2. Wash hands and don gloves.
 3. Select the right medication and check it against the provider's order.
 4. Check the expiration date.
 5. Calculate the dose to be given.
 6. Assemble the supplies needed.
 7. Check the medication against the provider's order.
 8. Open the syringe and needle; attach the needle to the syringe if packaged separately.
 9. Use the marker to label the syringe with the drug name.
 10. Remove the cap from the vial and clean it with an alcohol wipe.

11. Using the syringe, pull the plunger down to the amount of drug to be administered.
12. Insert the needle into the vial and inject the air.
13. Invert the vial and syringe and pull the plunger down to fill it with liquid from the vial.
14. Use the plunger to remove any large bubbles.
15. Use the plunger to fill the syringe with the correct dose.
16. Remove the needle from the vial and use the scoop method to recap the needle.
17. Check the provider's order against the vial and the syringe.
18. Place the syringe on the medicine tray and clean the area.
19. Remove gloves and wash hands.
20. Greet the patient and identify yourself. Verify the patient's identity by asking for their name and date of birth. Check the patient's identification bracelet if required.
21. Ask the patient if they have any drug allergies.
22. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
23. Perform any assessments before administering the drug.
24. Allow the patient to ask questions.
25. Wash hands and don gloves.
26. Instruct the patient to extend their forearm or expose the area to be injected.
27. Assess the injection site for intact, healthy skin. Palpate the skin for any lumps or bumps under the skin.
28. Clean the site with an alcohol wipe and allow it to dry.
29. Remove the cap from the syringe.
30. Place the gauze between your nondominant hand's index and middle finger. Use your index finger and thumb to pinch the skin.
31. Hold the syringe between your dominant hand's thumb and index finger.
32. Quickly and smoothly insert the needle into the site at a 45- or 90-degree angle, depending on the needle size. Insert the entire needle. Ensure that the needle tip is not pointed toward your non-dominant hand.
33. Release the pinched skin.
34. Push the plunger to inject the drug. Inject slowly and smoothly until the syringe is empty. Inject 1mL over 10 seconds.
35. Pull the needle from the skin at the same entry angle.
36. Activate the needle's safety device with one hand while the other covers the site with gauze. Gently apply pressure at the site to stop any bleeding.
37. Apply the bandage.
38. Dispose of the syringe in the sharps container.
39. Observe the patient for any reactions.
40. Clean the area, remove gloves, and wash hands.
41. Document the procedure in the patient's health record. Include the injection site, patient response, assessments, and teaching.

(Centers for Disease Control and Prevention, 2023).

This page titled [7.5: Subcutaneous Route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

7.6: Chapter 7 References

Needlestick Safety and Prevention Act, H.R.5178, 106th Congress (2000, November 6). <https://www.congress.gov/bill/106th-congress/house-bill/5178>

Centers for Disease Control and Prevention. (2023, June 20). *Vaccine administration*. U.S. Department of Health & Human Services. <https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/administration.html>

This page titled [7.6: Chapter 7 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

CHAPTER OVERVIEW

Chapter 8: Parenteral Routes- Intramuscular

Medical assistants administer injectable drugs via the parenteral route using intramuscular (IM), subcutaneous (SC), or intradermal (ID) routes. Proper injection techniques, equipment handling, and infection control measures are crucial to prevent complications and ensure patient safety. This route can be painful for the patient and is associated with a higher risk of injury to the patient when compared to other routes of administration. Do not attempt any parenteral administration unless you are confident that you have mastered the proper techniques for safe administration.

[8.1: Main Terms](#)

[8.2: Chapter Goals](#)

[8.3: Intramuscular Route](#)

[8.3.1: Aspiration](#)

[8.4: Intramuscular Injection Sites](#)

[8.4.1: Deltoid Site](#)

[8.4.2: Vastus Lateralis Site](#)

[8.4.3: Ventrogluteal Site](#)

[8.5: Airlock and Z-Track Techniques](#)

[8.6: Chapter 8 References](#)

This page titled [Chapter 8: Parenteral Routes- Intramuscular](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by Anna Jannak (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

8.1: Main Terms

Acromion process – a bony prominence in the area where the arm meets the shoulder

Airlock technique – an injection technique that is used when liquids are irritating or staining

Aspiration – pulling back on the plunger of a syringe

Deltoid muscle – the triangular-shaped muscle located at the top of the shoulder near the upper arm

Greater trochanter – bony prominence found near the joint between the hip and femur

Vastus lateralis muscle – the muscle located at the lateral thigh

Ventrogluteal muscle – a large muscle near the hip

Z-track – injection technique used when liquids are irritating or staining

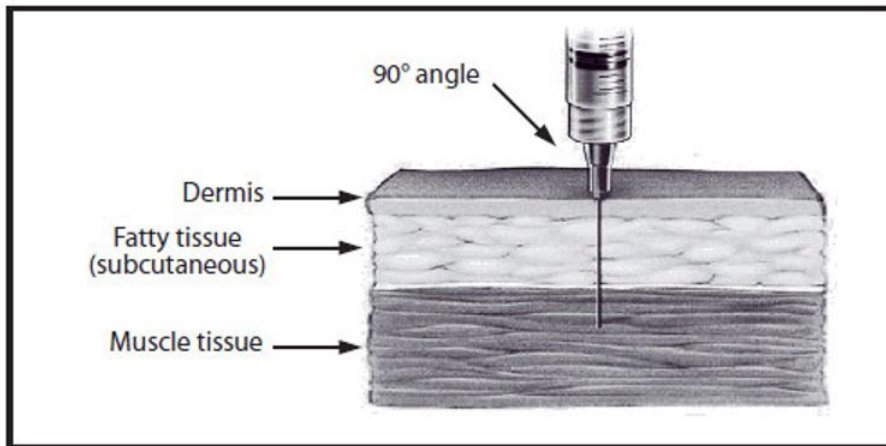
This page titled [8.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

8.2: Chapter Goals

- Discuss the 3 types of intramuscular injection techniques.
 - Locate the landmarks and injection sites for deltoid, vastus lateralis, and ventrogluteal sites.
 - Explain the procedure for intramuscular injections.
 - Explain Z track and airlock techniques and describe why they are used.
-

This page titled [8.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

8.3: Intramuscular Route



(Centers for Disease Control and Prevention, 2023).

The intramuscular route for injections involves placing drugs into muscle tissue underneath the skin. Muscles are innervated with blood vessels. Therefore, drugs are absorbed rapidly into the bloodstream with this route. Common drugs administered intramuscularly include certain antibiotics and vaccines. It is imperative that the medical assistant identify IM sites correctly and follow guidelines for asepsis. Failure to do so may result in serious injury to the patient. Intramuscular injections are administered at a 90-degree angle deep into the muscle tissue. Intramuscular injections require longer lengths and lower gauge needles than SC or ID injections.

This page titled [8.3: Intramuscular Route](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

8.3.1: Aspiration

When administering an IM injection, it is important for the patient's safety to aspirate or pull up gently on the plunger before injecting the drug. If blood is visualized during aspiration, it could indicate that the needle is in a blood vessel. Injecting drugs into a blood vessel is beyond the scope of practice for most medical assistants and may be dangerous. If aspiration results in a blood return, remove the needle, discard the syringe, and restart the procedure.

This page titled [8.3.1: Aspiration](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

8.4: Intramuscular Injection Sites

Sites for IM injections include the deltoid muscle, the vastus lateralis muscle, and the ventrogluteal muscle.

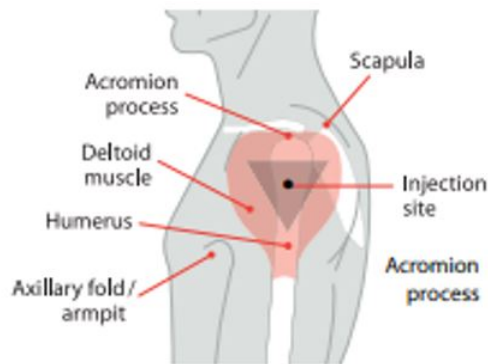
8.4.1: Deltoid Site

8.4.2: Vastus Lateralis Site

8.4.3: Ventrogluteal Site

This page titled [8.4: Intramuscular Injection Sites](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

8.4.1: Deltoid Site

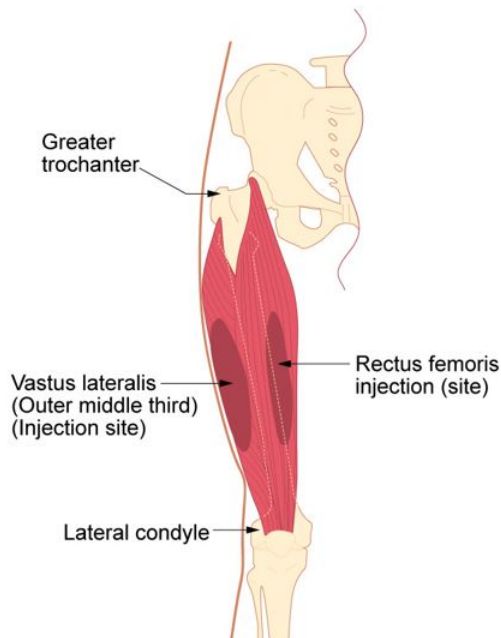


(National Center for Immunization and Respiratory Diseases, 2023)

The deltoid muscle is a triangular-shaped muscle located at the top of the shoulder near the upper arm. This site is for adults only and is used to administer small amounts of fluid, 0.5–1mL. The needle length is 5/8 inch to 1½ inch, and the gauge is 22–25. The patient is usually in a seated position during this administration type. To locate the deltoid muscle, find and palpate the acromion process, a bony prominence in the area where the arm meets the shoulder. Place a finger on the acromion process and measure two fingerbreadths below. Use the other hand to make a V shape with your fingers using the fingers below the acromion process as the top of an upside-down triangle. The center of this triangle is the largest part of the deltoid muscle in most patients. This technique will help to avoid injecting into the axillary nerve or the brachial artery.

This page titled [8.4.1: Deltoid Site](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

8.4.2: Vastus Lateralis Site



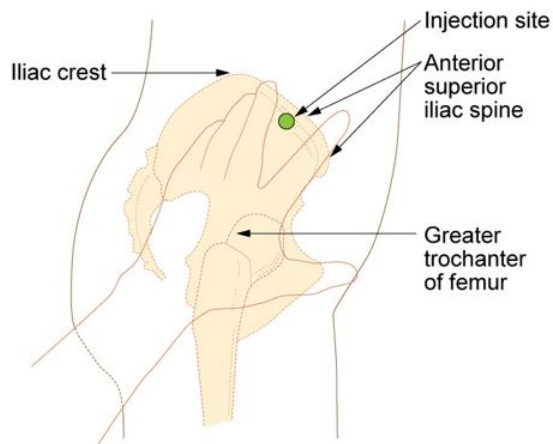
(Ernstmeyer & Christman, 2021a).

The vastus lateralis site is used for patients of all ages, including infants and children. This muscle is located at the lateral thigh. The patient will be placed in a sitting or supine position. Since this is a larger muscle than the deltoid muscle, larger amounts of fluid can be injected: up to 1 mL for infants to 12 months, up to 2mL for children up to 11 years, and up to 3mL for adults. The needle length will be chosen based on the patient's size, ranging from 5/8 inch for infants to 1½ inch for larger adults and a needle gauge of 22–25.

The landmarks used to find this muscle include the proximal end of the greater trochanter and the lateral epicondyle of the femur near the patella (kneecap). On either end of the femur, palpate the two landmarks. Place one of your hands below the greater trochanter near the joint between the hip and femur. Place your other hand above the lateral epicondyle of the knee to create a rectangle between your two hands. Locate the middle one-third of this rectangle lengthwise. In this middle third of the rectangle, locate the midline of the thigh and the midline of the outer thigh. The center of this area is the injection site. If viewing the thigh from a transverse plane, the injection site would be almost 10 o'clock.

This page titled [8.4.2: Vastus Lateralis Site](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

8.4.3: Ventrogluteal Site



(Ernstmeyer & Christman, 2021b).

The ventrogluteal muscle is a large muscle in most patients. Therefore, it is a good choice for drugs that are oil-based, irritating, or in larger amounts. This site requires skill and expertise given its proximity to the sciatic nerve and large blood vessels. Injecting into the sciatic nerve can cause nerve damage and long-term patient complications. The ventrogluteal muscle can accommodate up to 3mL of fluid. The needle length for this site ranges from 1 to 1 ½ inches, and the needle gauge is 22–25. The patient will be placed in a side-lying position.

To find landmarks for this site, use the hand opposite of the injection site. For example, if the injection will be in the patient's left ventrolateral muscle, use your right hand to locate the site. The landmarks for the ventrogluteal site include the greater trochanter, the anterior iliac spine, and the iliac crest. Find the greater trochanter and place the base of your palm over it, ensuring your fingers are pointed toward the patient's head and your thumb is pointed to the patient's groin. Place your index finger on the anterior iliac spine and your middle finger along the iliac crest. Your index and middle finger will form a triangle. The middle of this triangle is the area for injection. After injection, it is vital that the patient's gait be assessed for a limp. The presence of a limp may indicate that the injection was placed in or near the sciatic nerve, and the provider should be notified immediately.

This page titled [8.4.3: Ventrogluteal Site](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

8.5: Airlock and Z-Track Techniques

The airlock and Z-track techniques are used when liquids are irritating or staining. For the airlock technique, measure the amount of drug in the syringe. Next, add 0.2 to 0.5 mL of air into the syringe. When using the airlock technique, the liquid is injected first, followed by the air. The air creates a “lock” preventing the fluid from escaping through the tunnel made by the needle, thus reducing pain.

The Z-track method, recommended for the ventrogluteal site, also prevents liquid from leaking back into tissues but creates a zigzag pattern to keep the irritating fluid in the muscle. Pull the skin laterally with your nondominant hand to perform the Z-track technique before injecting the fluid. After pushing the fluid into the muscle, pull the needle at the same insertion angle and immediately release the skin.

Follow these steps to administer an intramuscular injection safely.

Supplies needed:

- Provider’s order
 - Drug reference material
 - Patient’s health record
 - Alcohol wipes
 - Drug vial
 - 1 mL or 3 mL syringe with 5/8 inch to 1 1/2-inch, 22–25-gauge safety needle
 - Bandage
 - Gauze
 - Medication tray
 - Sharps container
 - Marker
 - Gloves
1. Review the provider’s order and review drug reference material.
 2. Wash hands and don gloves.
 3. Select the right medication and check it against the provider’s order.
 4. Check the expiration date.
 5. Calculate the dose to be given.
 6. Assemble the supplies needed.
 7. Check the medication against the provider’s order.
 8. Open the syringe and needle; attach the needle to the syringe if packaged separately.
 9. Use the marker to label the syringe with the drug name.
 10. Remove the cap from the vial and clean it with an alcohol wipe.
 11. Using the syringe, pull the plunger down to the amount of drug to be administered.
 12. Insert the needle into the vial and inject the air.
 13. Invert the vial and syringe and pull the plunger down to fill it with liquid from the vial.
 14. Use the plunger to remove any large bubbles.
 15. Use the plunger to fill the syringe with the correct dose.
 16. Remove the needle from the vial and use the scoop method to recap the needle.
 17. Check the provider’s order against the vial and the syringe.
 18. Place the syringe on the medicine tray and clean the area.
 19. Remove gloves and wash hands.
 20. Greet the patient and identify yourself. Verify the patient’s identity by asking for their name and date of birth. Check the patient’s identification bracelet if required.
 21. Ask the patient if they have any drug allergies.

22. Provide patient education. Explain the drug ordered, the indication for the drug, side effects, adverse effects, and the provider who ordered the drug.
23. Perform any assessments before administering the drug.
24. Allow the patient to ask questions.
25. Wash hands and don gloves.
26. Assist the patient into the proper position for the IM injection site and expose the area to be injected, protect the patient's privacy.
27. Using landmarks, locate the appropriate IM site.
28. Assess the injection site for intact, healthy skin. Palpate the skin for any lumps or bumps under the skin.
29. Clean the site with an alcohol wipe and allow it to dry.
30. Remove the cap from the syringe. Grasp it with your dominant hand and turn the syringe so the bevel is up.
31. Stretch or flatten the skin around the insertion area with your nondominant hand.
32. With your dominant hand, quickly inject the needle into the skin in a dart-like motion at a 90-degree angle. Insert the entire needle.
33. Aspirate the syringe for 5 seconds and check the barrel for a blood return. If no blood is seen, progress with the procedure. If blood is seen, remove the needle and restart the procedure.
34. Push the plunger slowly and smoothly at a rate of 10 seconds per milliliter.
35. Wait ten seconds before removing the needle.
36. Withdraw the needle at the same insertion angle, activate the safety device, and discard it into the sharps container.
37. Apply gentle pressure with gauze to stop any bleeding.
38. Place a bandage on the injection area.
39. Observe the patient for any reactions.
40. Clean the area, remove gloves, and wash hands.
41. Document the procedure in the patient's health record. Include the injection site, patient response, patient assessments, and patient teaching.

Table 8.1 Intramuscular Injections

Intramuscular injections			
	Deltoid	Vastus Lateralis	Ventrogluteal
Syringe Size	1 – 3 ml		
Needle length Based on patient's size	1 – 1 ½ inch	5/8 inch – 1 ½ inch	1 – 1 ½ inch Make sure the patient can walk after ½ hour
Needle gauge	22 – 25		
Angle of entry	90 degrees		
Maximum volume	0.5 – 1 mL	Birth – 1 yr: 1 mL 1 – 11 yr: 2 mL >11 yr: 3 mL	
Patient position	Sitting	Sitting/ supine	Side-lying
Skin	pinch	pinch	taut

(Centers for Disease Control and Prevention, 2023; Polania Gutierrez & Munakomi, 2023).

This page titled [8.5: Airlock and Z-Track Techniques](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

8.6: Chapter 8 References

Centers for Disease Control and Prevention. (2023, June 20). *Vaccine administration*. U.S. Department of Health & Human Services. <https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/administration.html>

National Center for Immunization and Respiratory Diseases. (2023, December 4). *How to administer multiple intramuscular vaccines to adults during one visit*. <https://www.immunize.org/wp-content/uploads/catg.d/p2030.pdf>

Ernstmeyer K, Christman E. (Eds.). (2021a). Figure 18.33: Vastus lateralis site. In *Nursing skills*. Chippewa Valley Technical College, Eau Claire (WI). <https://www.ncbi.nlm.nih.gov/books/NBK593214/figure/ch18adminprntlmeds.F18.33>

Ernstmeyer K, Christman E. (Eds.). (2021b). Figure 18.31: Locating the ventrogluteal site. In *Nursing skills*. Chippewa Valley Technical College, Eau Claire (WI). <https://www.ncbi.nlm.nih.gov/books/NBK596739/figure/ch18adminprntlmeds.F18.31/>

Polania Gutierrez, J.J. & Munakomi, S. (2023, August 13). Intramuscular injection. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK556121/>

This page titled [8.6: Chapter 8 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

CHAPTER OVERVIEW

Chapter 9: Immune System, Allergies, and Vaccines

- 9.1: Main Terms
- 9.2: Chapter Goals
- 9.3: Review of the Anatomy of the Immune System
 - 9.3.1: Antigens and Antibodies
 - 9.3.2: Innate and Adaptive Immunity
 - 9.3.3: White Blood Cells (Leukocytes)
 - 9.3.4: Lymphatic System
 - 9.3.4.1: Immunological Memory
 - 9.3.4.1.1: Primary and Secondary Responses
 - 9.3.4.1.2: Memory Cell Formation
 - 9.3.4.1.3: Rapid and Robust Secondary Response
 - 9.3.4.1.4: Long-lasting Protection
 - 9.3.4.1.5: Vaccination
 - 9.3.4.2: Allergies
 - 9.3.4.2.1: Anaphylactic Shock
 - 9.3.4.3: Autoimmune Disorders
 - 9.3.5: Vaccines
 - 9.3.5.1: Centers for Disease Control and Prevention (CDC)
 - 9.3.5.2: Vaccine Schedules
 - 9.3.5.3: Vaccine Information Statement (VIS)
 - 9.3.5.4: CDC Pink Book
 - 9.3.5.5: Vaccine Administration Documentation
 - 9.3.5.6: Immunization Information Systems
 - 9.3.5.7: The Vaccine Adverse Event Reporting System (VAERS)
- 9.4: Chapter 9 References

This page titled [Chapter 9: Immune System, Allergies, and Vaccines](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

9.1: Main Terms

Anaphylaxis – a severe and life-threatening allergic reaction that occurs rapidly after exposure to an allergen

Antibodies – proteins that bind specifically to antigens to mark them for destruction by immune cells

Antigens – molecules on the surface of pathogens that trigger an immune response

Immune system – defense system that the human body relies on to protect against pathogens

Leukocytes – white blood cells

Pathogen – a foreign invader in the human body

Vaccine – contains a weakened form of a pathogen or a part of it to trigger the formation of memory cells without causing illness.

This page titled [9.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

9.2: Chapter Goals

- Discuss the immune system, adaptive immunity, and innate immunity.
 - Discuss the symptoms of anaphylaxis.
 - Explain the benefits of vaccinations and the medical assistant's responsibilities in vaccine administration and documentation.
 - Describe the process of administering an EpiPen.
 - Discuss the CDC's role in vaccines.
-

This page titled [9.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

9.3: Review of the Anatomy of the Immune System

The immune system is a remarkable defense system that the human body relies on to protect against pathogens like bacteria, viruses, and other pathogens. It is a highly intricate and sophisticated network of cells, tissues, organs, and molecules that protect the body from infections and foreign invaders while maintaining overall health. The critical components of the immune system include white blood cells (leukocytes), which can be further categorized into neutrophils, lymphocytes (including B cells and T cells), monocytes, eosinophils, and basophils. These white blood cells serve as the immune system's frontline soldiers, involved in phagocytosis, antibody production, and cytokine release. The lymphatic system, consisting of lymph nodes, the spleen, and the thymus, acts as command centers for immune cell interaction and maturation. Bone marrow is responsible for producing immune cells, while antibodies and complement proteins, as well as the concept of immunological memory, are crucial components of adaptive immunity.

This page titled [9.3: Review of the Anatomy of the Immune System](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.1: Antigens and Antibodies

Antigens are molecules on the surface of pathogens that trigger an immune response. B cells produce antibodies, proteins that bind specifically to antigens, marking the pathogens for destruction by immune cells. Antibodies come in various classes (IgG, IgM, IgA, IgD, and IgE) and have different functions, such as neutralizing pathogens, activating immune cells, and complement activation. The thymus is responsible for the maturation of T cells, a critical component of adaptive immunity (Institute for Quality and Efficiency in Health Care, 2020).

This page titled [9.3.1: Antigens and Antibodies](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.2: Innate and Adaptive Immunity

The immune system can be divided into two main branches: innate immunity and adaptive immunity. Innate immunity is the body's first line of defense and provides immediate but generic protection against various pathogens. It includes physical barriers like the skin and cells like neutrophils and macrophages that can quickly recognize and engulf invaders. On the other hand, adaptive immunity is a more specific and long-lasting defense mechanism. It involves the production of antibodies by B cells and the activation of T cells, which can recognize and target specific pathogens. Adaptive immunity also forms memory cells, ensuring a rapid and effective response upon re-exposure to the same pathogen (MedlinePlus, 2023).

This page titled [9.3.2: Innate and Adaptive Immunity](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

9.3.3: White Blood Cells (Leukocytes)

Neutrophils are the most abundant white blood cells and act as the body's first responders in infections. They are phagocytic, which means they engulf and destroy bacteria. Lymphocytes include B and T cells, which play critical roles in adaptive immunity. B cells produce antibodies, proteins that can specifically target and neutralize pathogens. T cells, on the other hand, have various roles, including assisting B cells, directly attacking infected cells, and regulating the immune response. Lymphocytes are essential for long-term immunity and immunological memory. Monocytes are large, phagocytic cells that can engulf bacteria, viruses, and other pathogens. Once in tissues, monocytes differentiate into macrophages, which are highly effective at clearing away debris and dead cells and orchestrating immune responses by releasing signaling molecules called cytokines. Eosinophils are primarily involved in combating parasitic infections and modulating allergic responses. Basophils release histamine, a chemical that triggers inflammation and allergic reactions. Both eosinophils and basophils contribute to the body's overall immune response (Tigner et al., 2022).

This page titled [9.3.3: White Blood Cells \(Leukocytes\)](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.4: Lymphatic System

The lymphatic system is a vital part of the circulatory and immune systems, serving multiple essential functions in the human body. It comprises a network of lymphatic vessels, lymph nodes, tonsils, the spleen, and the thymus gland. Lymphatic vessels are thin-walled tubes that parallel blood vessels throughout the body. They transport lymph, a clear, colorless fluid that contains white blood cells, proteins, and waste products, away from tissues and back into the bloodstream. Lymph nodes are small, bean-shaped structures distributed along the lymphatic vessels. They act as filtration and immune system monitoring stations, trapping and removing foreign particles, pathogens, and cancer cells from the lymph fluid. Lymph nodes also facilitate interactions between immune cells, aiding immune response. Tonsils are clusters of lymphatic tissue located in the throat. They help protect against infections that can enter the body through the mouth and nose by producing antibodies and immune cells. The spleen is the largest lymphatic organ in the body. It filters blood, removing old or damaged red blood cells and platelets. The spleen also acts as a reservoir for white blood cells and platelets and is involved in immune responses to blood-borne pathogens. The thymus gland is located in the upper chest and is essential for the maturation and development of T lymphocytes (T cells). T cells are critical components of adaptive immunity and play a central role in immune responses.

The lymphatic system helps maintain the body's fluid balance by collecting excess interstitial fluid (fluid between cells) and returning it to the bloodstream, preventing edema (swelling) and maintaining tissue hydration. Lymph nodes and other lymphatic organs are immune cell activation and communication hubs. They enable the immune system to recognize and mount defenses against pathogens, making the lymphatic system a crucial component of the body's overall defense mechanism. Lymphatic vessels in the small intestine, called lacteals, help absorb dietary fats and fat-soluble vitamins (A, D, E, and K) and transport them to the bloodstream. The lymphatic system assists in the removal of cellular waste and debris, helping to maintain tissue health and overall bodily function.

Lymphatic system disorders can lead to conditions such as lymphedema, which results from the blockage or damage of lymphatic vessels, or lymphomas, which are lymphatic system cancers. Understanding the lymphatic system's functions and role in immunity is crucial for healthcare professionals in diagnosing and treating various diseases and conditions related to this essential system (Cueni & Detmar, 2008).

This page titled [9.3.4: Lymphatic System](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.4.1: Immunological Memory

After exposure to a pathogen or vaccine, the immune system creates memory cells (B and T cells) for rapid response upon reinfection. Immunological memory is a critical component of the immune system's adaptive response. It is a remarkable feature that allows the immune system to remember and respond more effectively when encountering a pathogen it has previously encountered. This memory function is the basis for long-term protection provided by vaccinations and previous infections.

This page titled [9.3.4.1: Immunological Memory](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.4.1.1: Primary and Secondary Responses

When the human body is exposed to a new pathogen (e.g., a virus or bacteria), the immune system initiates a primary response. During this initial encounter, it takes some time for the immune system to recognize the pathogen, mount a defense, and eventually eliminate it. This process may result in symptoms of illness.

This page titled [9.3.4.1.1: Primary and Secondary Responses](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

9.3.4.1.2: Memory Cell Formation

The immune system combats the pathogen and generates memory cells, including memory B and T cells. These specialized cells "remember" the pathogen's specific characteristics, such as its surface proteins (antigens).

This page titled [9.3.4.1.2: Memory Cell Formation](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.4.1.3: Rapid and Robust Secondary Response

If the same pathogen enters the body again, the memory cells recognize it immediately and initiate a secondary immune response. This secondary response is much faster and more robust than the primary response. Memory B cells quickly produce antibodies that target the pathogen, while memory T cells orchestrate a coordinated attack.

This page titled [9.3.4.1.3: Rapid and Robust Secondary Response](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.4.1.4: Long-lasting Protection

Immunological memory provides long-lasting protection against specific pathogens. This memory can persist for years, decades, or even a lifetime, depending on the pathogen and the strength of the initial immune response.

This page titled [9.3.4.1.4: Long-lasting Protection](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.4.1.5: Vaccination

Vaccines expose the immune system to a harmless or weakened form of a pathogen or a part of it. This exposure triggers the formation of memory cells without causing illness. If the person later encounters the actual pathogen, the immune system's memory cells can mount a rapid and effective defense, preventing or mitigating the disease. Some vaccines require booster shots to reinforce immunological memory over time. These boosters help maintain high protection, particularly against diseases with waning immunity (Janeway et al., 2001).

This page titled [9.3.4.1.5: Vaccination](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.4.2: Allergies

Sometimes, the immune system malfunctions, leading to allergic reactions (hypersensitivity) or autoimmune diseases where it mistakenly attacks the body's tissues. Allergies, also known as allergic reactions or hypersensitivity reactions, are a common and often chronic immune system response to substances that are typically harmless to most people. These substances, called allergens, can trigger an allergic response in individuals sensitized to them. Allergies can range from mild and annoying to severe and life-threatening.

Allergies can manifest in various forms, including allergic rhinitis (hay fever), food, skin, and insect bite allergies. Hay fever is caused by allergens like pollen, dust mites, or pet dander, leading to sneezing, runny nose, and itchy eyes. Reactions to specific foods like peanuts, tree nuts, shellfish, milk, or eggs can cause symptoms ranging from hives to anaphylaxis. Eczema, contact dermatitis, and hives can result from skin exposure to allergens. Some people may experience severe reactions to insect stings or bites, such as from bees, wasps, or ants.

Allergy symptoms can vary widely but often include runny or stuffy nose, sneezing, itchy or watery eyes, skin rashes or hives, swelling, coughing, wheezing, and anaphylaxis, a severe, life-threatening allergic reaction characterized by difficulty breathing, swelling of the throat, a drop in blood pressure, and loss of consciousness. Anaphylaxis requires immediate medical attention. Allergies can be diagnosed through various methods, including skin prick tests, blood tests for specific IgE antibodies, and clinical evaluation by providers specializing in allergies and immunology.

Managing allergies often begins with avoiding known allergens. This may include dietary changes, environmental modifications, and using air purifiers or allergen-proof covers for bedding. Antihistamines, decongestants, corticosteroids, and other medications can help alleviate allergy symptoms. Allergy shots (subcutaneous immunotherapy) or sublingual immunotherapy (under-the-tongue tablets) can desensitize the immune system to allergens and reduce allergic reactions over time.

This page titled [9.3.4.2: Allergies](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

9.3.4.2.1: Anaphylactic Shock

Anaphylactic shock, also known as anaphylaxis, is a severe and life-threatening allergic reaction that occurs rapidly after exposure to an allergen. This reaction can affect various systems in the body and lead to a range of symptoms, including difficulty breathing, swelling, a drop in blood pressure, and loss of consciousness. Anaphylactic shock requires immediate medical attention and intervention to prevent severe complications or death.

Symptoms of anaphylactic shock include difficulty breathing, swelling of the face, lips, tongue, or throat, rapid and weak pulse, drop in blood pressure, hives or widespread skin rash, nausea, vomiting, or diarrhea, confusion or altered mental state, and loss of consciousness or coma. Common triggers of anaphylactic shock include foods, insect bites, medications, and latex.

The primary treatment for anaphylactic shock is epinephrine (adrenaline), administered through an autoinjector (e.g., EpiPen). Other measures may include administering antihistamines and corticosteroids to reduce allergic symptoms. Patients may require intravenous fluids and medications to support blood pressure and open airways in severe cases.

It is crucial to recognize the signs of anaphylactic shock because timely treatment with epinephrine can be lifesaving. The MA should know where the Epi-pens are stored and how to use them before they are in an emergency. The MA should also check the expiration dates on EpiPens regularly to ensure that an expired EpiPen isn't used during an emergency.

To safely administer an EpiPen, follow these steps:

1. When the pharmacy stock order is received, read EpiPen insert.
2. Practice administering the EpiPen with the trainer found in the EpiPen package.
3. Check expiration dates of EpiPens on a routine basis.
4. Report signs of severe allergic reaction to the provider, which includes swelling, which can lead to difficulty breathing or swallowing, shortness of breath or wheezing, abdominal pain, chest tightness, dizziness, vomiting, confusion, hypotension, and severe hives or rash.
5. Ask or help the patient to lie down (if not lying down already).
6. Collect the EpiPen from emergency medication storage upon the provider's verbal order.
7. Call out loudly for another staff member to call 911.
8. Flip the yellow cap and remove the EpiPen from the carrier tube.
9. State loudly, "I am preparing the EpiPen."
10. Hold the Epi-pen in your fist with the orange tip facing downward and the blue tip facing upward.
11. Remove the blue safety cap.
12. Place the orange safety tip against the middle of the outer thigh. Hold the leg firmly in place. Note: The autoinjector is designed to be injected through clothing.
13. Firmly and loudly state, "I am giving the EpiPen now." Note the time that the EpiPen is being administered. Listen for any instructions from the provider.
14. Using a slight swing, jab the autoinjector into the thigh at a 90-degree angle until you hear the device make a click sound.
15. Hold the pen firmly in place for three full seconds. State loudly, "The EpiPen has been administered."
16. Remove the autoinjector from the thigh. Check to ensure the window in the autoinjector has been obscured (this means the EpiPen has been discharged).
17. Massage the injection site for 10 seconds.
18. Check the patient's vital signs and responsiveness.
19. Prepare a second EpiPen if instructed by the provider.
20. Continue to monitor the patient until their condition improves or emergency personnel arrive.
21. Remind the provider to document the order for EpiPen.
22. Document the procedure, patient vital signs, patient response, patient education, and patient disposition.

This page titled [9.3.4.2.1: Anaphylactic Shock](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.4.3: Autoimmune Disorders

Autoimmune disorders are a group of chronic diseases characterized by the immune system mistakenly attacking and damaging the body's tissues and organs. The immune system becomes dysregulated in autoimmune disorders and targets healthy cells and tissues. These disorders can affect virtually any body part, leading to many symptoms and complications. Some common autoimmune disorders include rheumatoid arthritis (RA), type 1 diabetes mellitus, Hashimoto's thyroiditis, and Graves' disease. When patients have RA, the immune system attacks the joints, causing pain, swelling, and deformities. The immune system damages insulin-producing cells in the pancreas, resulting in high blood sugar levels in type 1 diabetes mellitus. Hashimoto's thyroiditis and Graves' disease are immune system dysfunctions that affect the thyroid gland, leading to hypo- or hyperthyroidism, respectively.

Diagnosing autoimmune disorders often involves a combination of medical history, physical examination, blood tests to detect autoantibodies, and imaging studies to assess organ damage. Diagnosis can be challenging, as symptoms may mimic other conditions, and multiple autoimmune disorders can coexist. Treatment for autoimmune disorders typically involves immunosuppressive medications to reduce inflammation and modulate the immune response. Management may also include symptom-specific medications, physical therapy, and lifestyle modifications to alleviate symptoms and improve quality of life. In some cases, lifestyle changes such as stress management, a balanced diet, and regular exercise may help manage symptoms. Patients living with an autoimmune disorder can find it challenging, but with proper medical care and management, many patients with these conditions lead fulfilling lives. Early diagnosis and treatment are crucial for improving outcomes and preventing complications associated with autoimmune disorders.

This page titled [9.3.4.3: Autoimmune Disorders](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.5: Vaccines

As mentioned above, vaccines expose the immune system to a harmless or weakened form of a pathogen or a part of it. Vaccines are one of the most critical and influential tools in public health for preventing infectious diseases. They have saved countless lives and significantly reduced the burden of many deadly diseases worldwide. Vaccines are biological preparations that stimulate the immune system to recognize and fight specific pathogens, such as bacteria or viruses. They typically contain either a weakened or inactivated form of the pathogen, a small piece of the pathogen (like a protein), or a similar, harmless version.

When a vaccine is administered, it introduces the pathogen or its components to the immune system without causing the disease. The immune system then produces antibodies and activates immune cells to recognize and remember the pathogen. If the vaccinated person later encounters the actual pathogen, their immune system can rapidly mount a strong and targeted response, preventing or reducing the severity of the disease.

There are various types of vaccines, including live attenuated, inactivated, recombinant or conjugate, and mRNA. Live attenuated vaccines contain a weakened, live form of the pathogen (e.g., measles, mumps, rubella). Inactivated vaccines contain killed versions of the pathogen (e.g., polio, hepatitis A). Recombinant or conjugate vaccines contain specific components of the pathogen (e.g., hepatitis B, human papillomavirus). mRNA vaccines (e.g., Pfizer-BioNTech and Moderna COVID-19 vaccines) are a newer type that uses a small piece of the pathogen's genetic material to stimulate an immune response.

Vaccines undergo rigorous testing in clinical trials before receiving approval for use. Ongoing monitoring and surveillance systems ensure that vaccines are safe and effective. Adverse reactions to vaccines are typically rare and mild, such as soreness at the injection site or a mild fever. Serious side effects are exceedingly rare.

This page titled [9.3.5: Vaccines](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

9.3.5.1: Centers for Disease Control and Prevention (CDC)

The Centers for Disease Control and Prevention (CDC) in the United States plays a central role in managing and coordinating vaccination programs to protect the public from vaccine-preventable diseases. The CDC's vaccination program encompasses various aspects, including vaccine research, development, regulation, distribution, education, and monitoring. The CDC researches to develop new vaccines and improve existing ones. They collaborate with other organizations, such as the National Institutes of Health (NIH) and pharmaceutical companies, to advance vaccine science. The CDC also conducts studies to determine the safety and effectiveness of vaccines.

The CDC works closely with manufacturers, healthcare providers, and public health agencies to ensure an adequate supply of vaccines. They maintain the Vaccines for Children (VFC) program, which provides vaccines at no cost to eligible children who might not otherwise have access to immunizations.

The CDC plays a crucial role in educating healthcare professionals, the public, and community leaders about the importance of vaccines. They develop educational materials, host webinars, and engage in public awareness campaigns to promote vaccination.

The CDC monitors vaccine safety through the Vaccine Adverse Event Reporting System (VAERS) and the Vaccine Safety Datalink (VSD). These systems track and investigate potential adverse events following vaccination. Timely surveillance helps identify rare or unexpected side effects, contributing to vaccine safety. In the event of vaccine-preventable disease outbreaks, the CDC provides guidance and support to contain the spread of the disease and increase vaccination coverage in affected communities.

This page titled [9.3.5.1: Centers for Disease Control and Prevention \(CDC\)](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak \(Consortium of Academic and Research Libraries in Illinois \(CARLI\)\)](#).

9.3.5.3: Vaccine Information Statement (VIS)

CDC Vaccine Information Statements (VISs) are essential educational materials provided by the Centers for Disease Control and Prevention (CDC) to inform vaccine recipients, their parents, or legal representatives about the benefits and risks associated with vaccines. VISs facilitate informed decision-making regarding vaccinations and promote vaccine safety and public health. VISs serve as a crucial communication tool to ensure that individuals receiving vaccines have access to clear and comprehensive information about the vaccine, its potential side effects, and the importance of vaccination. The goal is to help recipients make informed decisions about vaccination based on their personal circumstances and medical history.

Healthcare providers are required by law in the United States to provide a copy of the appropriate VIS to vaccine recipients or their parents/legal representatives before administering specific vaccines. This requirement is mandated by the National Childhood Vaccine Injury Act (NCVIA) to enhance vaccine safety and the informed consent process.

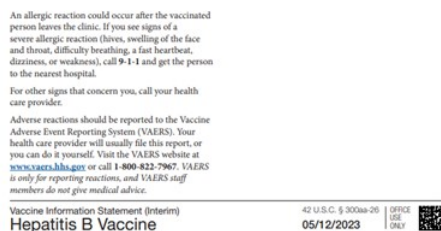
Each VIS contains specific information related to a particular vaccine, including

- The name of the vaccine.
- Why the vaccine is recommended.
- A description of the disease(s) the vaccine prevents.
- The recommended vaccination schedule.
- Possible side effects or adverse reactions.
- Who should or should not receive the vaccine.
- What to do in case of an adverse event.

VISs are available in multiple languages to accommodate diverse populations in the United States. Healthcare providers should offer the appropriate language version to ensure that individuals can fully understand the information provided. Healthcare providers typically provide a copy of the relevant VIS to the vaccine recipient, parent, or legal representative before vaccination. Depending on their practice's policies and patient preferences, they may use printed copies, electronic versions, or both. After reviewing the VIS, healthcare providers should address any questions or concerns the recipient or their representative may have.

The medical assistant is responsible for ensuring that the most current issue of the VIS is presented to the patient. Presentation of the VIS to the patient must be documented along with the publication date of the VIS. The date can be found at the bottom of the VIS PDF form available from the website [CDC Vaccine Information Statements](https://www.cdc.gov/vaccines/imz/downloads/) [www.cdc.gov].

See the image below at the bottom of a VIS statement. Note the date of publication.



(Centers for Disease Control and Prevention, 2023a).

This page titled [9.3.5.3: Vaccine Information Statement \(VIS\)](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by Anna Jannak (Consortium of Academic and Research Libraries in Illinois (CARLI)).

9.3.5.4: CDC Pink Book

The CDC Pink Book is a reliable resource for the medical assistant to use when administering vaccines. It provides the most comprehensive information on routinely used vaccines and the diseases they prevent. It includes general immunization recommendations, vaccine safety, storage and handling instructions, and detailed information about vaccine-preventable diseases and the vaccines administered to avoid them (National Center for Immunization and Respiratory Diseases, 2021).

This page titled [9.3.5.4: CDC Pink Book](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.3.5.5: Vaccine Administration Documentation

In addition to documenting the presentation of the VIS to the patient or the patient's guardian, there are other items that the MA must legally enter into the patient's health record. The National Childhood Vaccine Injury Act mandates that the following must be documented in the patient's health record.

- Date of administration
- Vaccine manufacturer
- Vaccine lot number
- Name and title of the person who administered the vaccine and address of the facility where the permanent record will reside
- Vaccine information statement (VIS)
- Date printed on the VIS
- Date the VIS was given to the patient or parent/guardian

Most facilities also require the MA to document the site of vaccine administration and the patient's response (National Center for Immunization and Respiratory Diseases, 2019).

This page titled [9.3.5.5: Vaccine Administration Documentation](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

9.3.5.6: Immunization Information Systems

Immunization information systems (IISs) are confidential, computerized databases that record information on all vaccine doses administered. In Illinois, this allows patients to access Vax Verify from the Illinois Department of Public Health to view their personal vaccination history. This can help the patient and the provider keep patients up to date with the CDC vaccine schedules (Illinois Department of Public Health, 2024).

This page titled [9.3.5.6: Immunization Information Systems](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

9.3.5.7: The Vaccine Adverse Event Reporting System (VAERS)

The Vaccine Adverse Event Reporting System (VAERS) is a national vaccine safety surveillance program for reporting adverse events after administering any vaccine in the United States. VAERS is co-managed by the Centers for Disease Control and Prevention (CDC) and the U.S. Food and Drug Administration (FDA). Anyone can report an adverse event to VAERS, but healthcare professionals must report certain adverse events, and vaccine manufacturers must report all adverse events that come to their attention. Adverse events should be reported even if the cause of the adverse event is uncertain (U.S. Department of Health and Human Services, n.d.)

This page titled [9.3.5.7: The Vaccine Adverse Event Reporting System \(VAERS\)](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

9.4: Chapter 9 References

Centers for Disease Control and Prevention. (2023a, May 12). *Hepatitis B vaccine: What you need to know*. <https://www.cdc.gov/vaccines/hcp/vis/vis-statements/hep-b.pdf>

Centers for Disease Control and Prevention. (2023b, October 26). *Recommended child and adolescent immunization schedule for ages 18 years or younger*. <https://www.cdc.gov/vaccines/schedules/downloads/child/0-18yrs-child-combined-schedule.pdf>

Cueni, L. N., & Detmar, M. (2008). The lymphatic system in health and disease. *Lymphatic research and biology*, 6(3-4), 109–122. <https://doi.org/10.1089/lrb.2008.1008>

Illinois Department of Public Health. (2024). *Vax verify*. <https://dph.illinois.gov/vaxverify.html>

Institute for Quality and Efficiency in Health Care. (2020, April 23). *How does the immune system work?* Retrieved January 10, 2024, from <https://www.ncbi.nlm.nih.gov/books/NBK279364/>

Janeway, C.A., Travers, P., Walport, M. & Shlomchik, M. (2001). Chapter 10: Adaptive immunity to infection; immunological memory. In *Immunobiology: The Immune System in Health and Disease* (5th ed.). Garland Science. <https://www.ncbi.nlm.nih.gov/books/NBK27158/>

MedlinePlus. (2023, December 26). *Immune system and disorders*. Retrieved January 10, 2024. Available from: <https://medlineplus.gov/immunesystemanddisorders.html>

National Center for Immunization and Respiratory Diseases. (2019, May 7). *Healthcare providers/professional: Document the vaccination(s)*. U.S. Department of Health & Human Services, Centers for Disease Control and Prevention. <https://www.cdc.gov/vaccines/hcp/admin/document-vaccines.html>

National Center for Immunization and Respiratory Diseases. (2021, August 18). *Epidemiology and prevention of vaccine-preventable diseases*. U.S. Department of Health & Human Services, Centers for Disease Control and Prevention. <https://www.cdc.gov/vaccines/pubs/pinkbook/index.html>

Tigner, A., Ibrahim, S.A., & Murray, I. V. (2022, Nov 14). Histology, white blood cell. In *StatPearls*. <https://www.ncbi.nlm.nih.gov/books/NBK563148/>

U.S. Department of Health and Human Services. (n.d.) *About VAERS*. Vaccine Adverse Event Reporting System. <https://vaers.hhs.gov/about.html>

This page titled [9.4: Chapter 9 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

CHAPTER OVERVIEW

Chapter 10: Infections and Drugs to Treat Infections

- 10.1: Main Terms
- 10.2: Chapter Goals
- 10.3: Infectious Agents and Infections
 - 10.3.1: Common Pathogens
- 10.4: Infections and Healthcare
- 10.5: Antibiotic Resistance
- 10.6: Sepsis
- 10.7: Drugs for Infectious Diseases
 - 10.7.1: Bacterial Infections
 - 10.7.2: Viral Infections
 - 10.7.3: Fungal Infections
 - 10.7.4: Parasitic Infections
- 10.8: Antibiotic Patient Teaching
 - 10.8.1: Most Prescribed Antibiotics
- 10.9: Antiviral Drugs Patient Teaching
- 10.10: Chapter 10 References

This page titled [Chapter 10: Infections and Drugs to Treat Infections](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

10.1: Main Terms

Antibiotic resistance – when bacteria and other microorganisms develop the ability to resist the effects of antibiotics

Pathogens – microbes that can cause disease

Sepsis – a severe medical condition that can lead to organ dysfunction and failure

Viruses – pathogens that contain genetic material (DNA or RNA) enclosed in a protein coat

This page titled [10.1: Main Terms](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

10.2: Chapter Goals

- Discuss different types of pathogens.
 - Explain the difference between a bacterial infection and a viral infection.
 - Describe antibiotic resistance and why it is a global health concern.
 - Explain what happens to a patient when they are diagnosed with sepsis.
 - Discuss patient teaching regarding antibiotics and antiviral drugs.
-

This page titled [10.2: Chapter Goals](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

10.3: Infectious Agents and Infections

Microorganisms, often called microbes, are tiny living organisms that cannot be seen with the naked eye and require a microscope for observation. Not all microbes cause human disease, but we call them pathogens if they do. Like any country, infections in the United States encompass various diseases caused by pathogens, including bacteria, viruses, fungi, and parasites. These infections can affect people of all ages and backgrounds, and their impact on public health can vary from minor and manageable cases to severe and widespread outbreaks. Common infectious diseases include respiratory infections, sexually transmitted infections, foodborne illnesses, and vector-borne diseases. The most common respiratory infections in the United States include influenza (flu), pneumonia, and colds. Sexually transmitted infections (STIs) include diseases like chlamydia, gonorrhea, and syphilis. Periodically, the U.S. faces outbreaks of foodborne diseases, with pathogens like *Salmonella*, *E. coli*, and *Listeria* often linked to contaminated food products. Diseases transmitted by vectors such as mosquitoes and ticks, including Lyme disease, West Nile virus, and Zika virus, can affect specific regions. Furthermore, the coronavirus pandemic caused by the SARS-CoV-2 virus significantly impacted the U.S. healthcare system and society. The rise of drug-resistant bacteria poses a growing threat. Infections that were once easily treatable are becoming harder to manage because of antibiotic resistance (Centers for Disease Control and Prevention, 2023).

This page titled [10.3: Infectious Agents and Infections](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

10.3.1: Common Pathogens

Bacteria are single-celled microorganisms that can be found virtually everywhere on Earth. Common bacterial pathogens include the following:

- *Streptococcus*: Responsible for various infections, including strep throat and skin infections.
- *Escherichia coli* (*E. coli*): Some strains can cause food poisoning and urinary tract infections.
- *Salmonella*: Often associated with foodborne illnesses.
- *Mycobacterium tuberculosis*: The causative agent of tuberculosis (TB).
- *Staphylococcus aureus*: Can cause skin infections, pneumonia, and more, including Methicillin-resistant *Staphylococcus aureus* (MRSA).

Viruses are much smaller than bacteria and contain genetic material (DNA or RNA) enclosed in a protein coat. They require a host cell to reproduce. Common viral pathogens include

- Influenza virus: Responsible for seasonal flu outbreaks.
- Human immunodeficiency virus (HIV): The virus that leads to acquired immunodeficiency syndrome (AIDS).
- Herpes simplex virus: Causes oral and genital herpes.
- Human papillomavirus (HPV): Linked to various types of cancer and genital warts.
- Hepatitis viruses (A, B, C): Cause liver inflammation and can lead to chronic liver disease.

Fungi are eukaryotic (made of more than one cell) microorganisms; some species can cause infections in humans and animals. Common fungal pathogens include

- *Candida albicans*: Responsible for yeast infections in the mouth, throat, and genital area.
- *Aspergillus*: Can cause lung infections, especially in individuals with weakened immune systems.
- *Cryptococcus*: Affecting the lungs and central nervous system, especially in individuals with compromised immunity.
- Dermatophytes: Responsible for various skin infections such as athlete's foot and ringworm.

Protozoa are single-celled eukaryotic organisms that can cause various diseases, especially in tropical and subtropical regions. Common protozoal pathogens include

- *Plasmodium*: Responsible for malaria, a widespread and deadly disease.
- *Entamoeba histolytica*: Causes amoebic dysentery.
- *Giardia lamblia*: Causes giardiasis, a gastrointestinal infection.
- *Trypanosoma*: Causes diseases like African sleeping sickness and Chagas disease.

Parasitic worms are multicellular organisms that can infect various parts of the body. Common helminthic pathogens include

- *Ascaris lumbricoides*: Causes intestinal roundworm infections.
- *Schistosoma*: Responsible for schistosomiasis, a tropical disease affecting the urinary and intestinal systems.
- *Taenia saginata* and *Taenia solium*: Tapeworms responsible for intestinal infections.

(Janeway et al., 2001)

This page titled [10.3.1: Common Pathogens](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

10.4: Infections and Healthcare

Hospitals, clinics, and healthcare providers play a vital role in diagnosing and treating infections. Adequate resources and training are essential to manage outbreaks effectively. Public health campaigns promote hand hygiene, safe food handling, safe sex practices, and vaccination to reduce the risk of infections. Education on recognizing symptoms, seeking prompt medical care, and adhering to treatment plans is crucial in preventing the spread of infectious diseases (Fleming-Dutra, 2016).

This page titled [10.4: Infections and Healthcare](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

10.5: Antibiotic Resistance

Antibiotic resistance is a growing global health concern that occurs when bacteria and other microorganisms develop the ability to resist the effects of antibiotics, rendering these medications less effective or completely ineffective. This phenomenon results from adaptation by bacteria in response to the widespread use and misuse of antibiotics. This includes taking antibiotics when they are not needed, not completing a prescribed antibiotic course, and misusing antibiotics. Antibiotic-resistant infections can be more challenging and costly to treat. They often require more potent and more expensive antibiotics and more extended hospital stays, which can result in higher mortality rates. The emergence of antibiotic resistance threatens the effectiveness of standard medical procedures like surgery, cancer chemotherapy, and organ transplantation, which rely on the ability to prevent or treat infections.

Proper antibiotic use is critical. Antibiotics should be prescribed only when necessary and taken as directed by a healthcare professional. Patients should complete the entire course of antibiotics even if they start feeling better before the medication is finished. Healthcare facilities should implement infection control measures to prevent the spread of resistant bacteria (Centers for Disease Control and Prevention, 2022).

This page titled [10.5: Antibiotic Resistance](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

10.6: Sepsis

One might ask, if antibiotic resistance is such a problem, why do we still prescribe antibiotics? The reason is that untreated infections can lead to sepsis. Sepsis is a severe medical condition characterized by a systemic response to infection that can lead to organ dysfunction and failure. Sepsis is a leading cause of mortality in the U.S., and it is estimated that tens of thousands of people die from sepsis each year.

The symptoms of sepsis can vary from person to person, but they typically include fever, tachycardia, tachypnea, hypotension, altered mental state, dyspnea, and organ dysfunction. Sepsis can cause a high fever with a temperature above 101°F (38.3°C) or, conversely, a dangerously low body temperature below 96.8°F (36°C). An elevated heart rate, typically exceeding 90 beats per minute, is expected in sepsis. The heart rate may become significantly higher as the condition worsens. Increased respiratory rate, often more than 20 breaths per minute, may occur as the body attempts to compensate for the decreased oxygen delivery to tissues. Sepsis can cause a drop in blood pressure, leading to symptoms like dizziness, lightheadedness, and confusion. In severe cases, it can lead to shock. Confusion, disorientation, and changes in consciousness are common in sepsis. Patients may appear unusually agitated or lethargic. Rapid breathing and shortness of breath can occur as the body struggles to get enough oxygen to vital organs. As sepsis progresses, multiple organ systems may malfunction, leading to symptoms related to specific organs.

Organ system malfunction from sepsis affects the kidneys, liver, lungs, heart, digestive system, and skin. Kidney failure results in reduced urine output or dark, concentrated urine. Liver dysfunction leads to jaundice. Lung dysfunction results in difficulty in oxygenating the blood, leading to increased respiratory distress. When the cardiovascular system is affected, it results in irregular heartbeats or chest pain. Nausea, vomiting, and diarrhea may manifest when the digestive system starts to fail. The skin may appear mottled or discolored, often with a bluish tint. This is a sign of poor circulation and inadequate oxygen supply. In some cases, sepsis can cause abnormal blood clotting or bleeding issues.

It's important to note that sepsis can progress rapidly, so any signs or symptoms of sepsis should be taken seriously, mainly if they occur in someone with an existing infection or a compromised immune system. Early diagnosis and treatment are critical for improving the chances of survival. In severe sepsis, patients are admitted to the hospital, possibly the intensive care unit (MedlinePlus, 2023b).

This page titled [10.6: Sepsis](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

SECTION OVERVIEW

10.7: Drugs for Infectious Diseases

Bacteria, viruses, fungi, and parasites can be considered pathogens and cause disease. Drugs for infections can be categorized based on the type of microorganisms they target. It's essential to note that the choice of drug and treatment regimen depends on the specific microorganism causing the infection, its resistance patterns, the severity of the disease, and the patient's individual factors. The provider will consider these factors when deciding if to prescribe an antibiotic and which drug to prescribe.

10.7.1: Bacterial Infections

10.7.2: Viral Infections

10.7.3: Fungal Infections

10.7.4: Parasitic Infections

This page titled [10.7: Drugs for Infectious Diseases](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)).

10.7.1: Bacterial Infections

▶ Antibiotics are used to treat bacterial infections. They work by inhibiting bacterial growth or killing the bacteria. Common types of antibiotics include the following: ◀

- Penicillins: Examples include amoxicillin and penicillin. They interfere with bacterial cell wall synthesis.
- Cephalosporins: Drugs such as cephalexin belong to this class and target cell wall formation.
- Macrolides: Erythromycin and azithromycin inhibit protein synthesis in bacteria.
- Tetracyclines: Drugs like doxycycline disrupt protein synthesis in bacteria.
- Fluoroquinolones: Ciprofloxacin and levofloxacin affect DNA replication and repair in bacteria.

(Patel et al., 2023)

This page titled [10.7.1: Bacterial Infections](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

10.7.2: Viral Infections

Antivirals are used to treat viral infections by inhibiting viral replication. They include the following:

- Antiretrovirals: Drugs such as tenofovir and lamivudine are used to manage HIV/AIDS.
- Neuraminidase inhibitors: Oseltamivir (Tamiflu) and zanamivir are used against influenza viruses.
- Protease inhibitors: Used against viruses such as hepatitis C (sofosbuvir) and HIV (dolutegravir). Paxlovid is used to treat COVID-19.
- Nucleoside/nucleotide analogs: These drugs target the replication of viruses like herpes (acyclovir)

(U.S. Food and Drug Administration, 2021, 2023; Xie et al., 2022).

This page titled [10.7.2: Viral Infections](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

10.7.3: Fungal Infections

Antifungals target fungal infections and can be categorized into several classes:

- Azoles: Drugs such as fluconazole and itraconazole inhibit fungal cell membrane synthesis.
- Polyenes: Amphotericin B binds to fungal cell membranes, causing them to become porous.
- Echinocandins: Caspofungin inhibits fungal cell wall synthesis.

(National Health Service England, 2023).

This page titled [10.7.3: Fungal Infections](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

10.7.4: Parasitic Infections

Drugs for parasitic infections can vary widely depending on the type of parasite:

- Antimalarials: Chloroquine, artemisinin-based combination therapies (ACTs), and others used to treat malaria.
- Antiprotozoal drugs: Metronidazole is used against protozoa like Giardia and Entamoeba.
- Anthelmintic drugs: Albendazole and mebendazole are used to treat intestinal worm infections. Ivermectin is used for diseases such as onchocerciasis and lymphatic filariasis.

(Campbell & Soman-Faulkner, 2023; U.S. Food and Drug Administration, 2021).

This page titled [10.7.4: Parasitic Infections](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

10.8: Antibiotic Patient Teaching

Patient education regarding antibiotics is crucial to ensure these medications are used effectively and responsibly. Patient education is vital in promoting responsible antibiotic use and reducing the risk of antibiotic resistance. The medical assistant should take the time to communicate these important messages to patients to ensure that antibiotics are used safely and effectively when needed if it is within their duties.

Purpose of Antibiotics: Explain that antibiotics are prescribed to treat bacterial infections, not viral infections like the common cold or flu. Taking antibiotics for viral infections is ineffective and contributes to antibiotic resistance.

Follow the Provider's Instructions: Stress the importance of following the provider's instructions regarding the antibiotic dosage, frequency, and duration. Completing the entire course of antibiotics, even if symptoms improve before the medication is finished, is essential to eradicate the infection completely.

Never Share Antibiotics: Emphasize that antibiotics are prescribed for specific individuals and conditions. Patients should never share their antibiotics with others or use antibiotics prescribed for someone else.

Ask Questions: Encourage patients to ask questions about their antibiotics. They should understand why the medication was prescribed, how to take it, and any potential side effects to watch for.

Side Effects: Discuss common side effects of antibiotics, such as diarrhea or upset stomach. The provider will most likely encourage the patient to continue the antibiotic unless gastrointestinal symptoms are severe.

Adverse Reactions: Patients should immediately report or seek medical attention if they have any signs of allergic reaction, including rash, hives, swelling, difficulty breathing, tightness of the throat, or altered consciousness. Allergic reactions can be life-threatening, so it is essential to address these symptoms immediately.

Avoid Alcohol and Grapefruit Juice: Some antibiotics can interact with alcohol or grapefruit juice, potentially leading to adverse effects or reducing the effectiveness of the medication. Patients should ask their healthcare provider about specific dietary restrictions.

Storage and Expiration: Explain the importance of storing antibiotics as directed, typically in a cool, dry place. Patients should not use expired antibiotics and should dispose of them properly.

Prevent Recurrent Infections: Educate patients on preventive measures to reduce the risk of recurrent infections, such as proper hand hygiene, vaccination, and lifestyle changes, if applicable (e.g., smoking cessation for respiratory diseases).

Responsible Antibiotic Use: Stress the importance of using antibiotics responsibly to combat antibiotic resistance. Explain how overuse or misuse of antibiotics can lead to developing drug-resistant bacteria, making infections more challenging to treat in the future.

Follow-Up: Advise patients to attend any scheduled follow-up appointments with their healthcare provider to monitor their progress and ensure the infection has been successfully treated (MedlinePlus, 2023a).

10.8.1: Most Prescribed Antibiotics

This page titled [10.8: Antibiotic Patient Teaching](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

10.8.1: Most Prescribed Antibiotics

The following table contains the most prescribed antibiotics from ClinCalc.com.

Table 10.1 Most commonly prescribed antibiotics

Most commonly prescribed antibiotics including indication and patient education.

Antibiotic Class	Generic Name	Brand Name	Indication	Patient Education
Macrolide	Azithromycin	Zithromax	pneumonia, sinusitis, pharyngitis, tonsillitis, otitis media	GI upset is common. Take it with food. Avoid excessive sunlight and wear protection when outside.
	Clarithromycin	Biaxin		
	Clindamycin	Cleocin		
Nitrofurantoin	Nitrofurantoin	Macrobid	urinary tract infections	GI upset is common. Take it with food.
Nitroimidazole antimicrobial	Metronidazole	Flagyl	clostridium difficile, skin infections, oral and dental infections, parasites (giardia)	Take drugs with food and plenty of water. Do not drink alcohol while taking and for 48 hours after the course is completed.
Penicillin	Amoxicillin	Amoxil	pneumonia, streptococcal infections, staphylococcal infections, syphilis, anthrax, diphtheria, bacterial endocarditis	It's best taken on an empty stomach. Allergic reactions are common.
	Penicillin	PC Pen VK		
	Amoxicillin/Clavulanic Acid	Augmentin		
Tetracycline	Tetracycline	Sumycin	respiratory tract infections, pneumonia, acne, eye infections, gonorrhea, chlamydia, syphilis	Take with 8 ounces of water (never milk or dairy products) to prevent esophageal irritation. Take 1 hour before or 2 hours after meals. Do not give to children or lactating mothers; it will stain teeth. Avoid direct sunlight.
	Doxycycline	Vibramycin		

This page titled [10.8.1: Most Prescribed Antibiotics](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)).

SECTION OVERVIEW

10.9: Antiviral Drugs Patient Teaching

Tamiflu (oseltamivir phosphate) is prescribed to individuals diagnosed with influenza. Patient teaching is essential and should include the following.

- It is only effective against influenza viruses and is not effective against other respiratory viruses or bacterial infections.
- It can help alleviate symptoms and shorten the duration of the illness if taken within 48 hours of the onset of symptoms.
- It can reduce the duration of symptoms by about one day on average and may decrease the risk of complications like pneumonia in some cases.
- It is crucial to follow the healthcare provider's instructions and complete the entire course of treatment, even if symptoms improve.
- Common side effects of Tamiflu may include nausea, vomiting, diarrhea, headache, and abdominal pain.
- These side effects are generally mild and temporary. Severe allergic reactions to Tamiflu are rare but should be reported to a healthcare provider immediately.

Paxlovid is a medication used for the treatment of COVID-19. Patient education for Paxlovid is essential to ensure that individuals understand how to take the medication correctly and follow all safety measures during and after treatment. It's crucial to emphasize the importance of early treatment and compliance with the prescribed regimen to maximize its effectiveness in managing COVID-19. Paxlovid is prescribed to individuals with confirmed COVID-19 who are at risk of developing severe disease or complications. It is typically recommended for patients with mild to moderate symptoms within the first five days of symptom onset.

- Patients should take Paxlovid precisely as prescribed by their provider, following the dosing instructions provided. Paxlovid should be taken with food, as this enhances its absorption.
- Common side effects of Paxlovid may include diarrhea, headache, nausea, and fatigue.
- Patients should report any unusual or severe side effects to their provider.
- Patients receiving Paxlovid may need regular monitoring by their provider to assess their response to treatment and potential side effects. Patients should continue to follow all recommended COVID-19 safety measures, including wearing masks, practicing physical distancing, and avoiding close contact with others, especially during the contagious phase of the illness.
- Patients should seek immediate medical attention if COVID-19 symptoms worsen or if breathing difficulties or severe symptoms develop. (U.S. Food and Drug Administration, 2022, 2023.)

This page titled [10.9: Antiviral Drugs Patient Teaching](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) ([Consortium of Academic and Research Libraries in Illinois \(CARLI\)](#)) .

SECTION OVERVIEW

10.10: Chapter 10 References

- Campbell S. & Soman-Faulkner, K. (2023, May 29). Antiparasitic drugs. In *StatPearls*. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK544251/>
- Centers for Disease Control and Prevention. (2022, October 5). *Antimicrobial resistance*. U.S. Department of Health & Human Services. <https://www.cdc.gov/drugresistance/about.html>
- Centers for Disease Control and Prevention. (2023, January 17). *National Center for Emerging and Zoonotic Infectious Diseases (NCEZID)*. U.S. Department of Health & Human Services. <https://www.cdc.gov/ncezid/who-we-are/index.html>
- Fleming-Dutra, K. (2016, November 14). *Antibiotic stewardship in the outpatient setting*. Medscape. <https://www.medscape.com/viewarticle/871205>
- Janeway, C.A., Travers, P., Walport, M. & Shlomchik, M. (2001). Chapter 10: Adaptive immunity to infection; infectious agents and how they cause disease. In *Immunobiology: The Immune System in Health and Disease*. 5th edition. Garland Science. <https://www.ncbi.nlm.nih.gov/books/NBK27114/>
- MedlinePlus (2023a, April 17). *Antibiotics*. Retrieved January 10, 2024. Available from: <https://medlineplus.gov/antibiotics.html>
- MedlinePlus (2023b, November 13). *Sepsis*. Retrieved January 10, 2024. Available from: <https://medlineplus.gov/sepsis.html>
- National Health Service England. (2023, April 3). *Antifungal medicines*. <https://www.nhs.uk/conditions/antifungal-medicines/>
- Patel P., Wermuth H.R., Calhoun C., & Hall, G.A. (2023, May 26). Antibiotics. *StatPearls*. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK535443/>
- U.S. Food and Drug Administration. (2023, November). *Fact sheet for healthcare providers: Emergency use authorization for Paxlovid*. <https://www.fda.gov/media/155050/download>
- U.S. Food and Drug Administration. (2023, November 1). *Frequently asked questions on the emergency use authorization for Paxlovid for treatment of COVID-19*. <https://www.fda.gov/media/155052/download>
- U.S. Food and Drug Administration. (2022, December 8). *Influenza (flu) antiviral drugs and related information*. <https://www.fda.gov/drugs/information-drug-class/influenza-flu-antiviral-drugs-and-related-information>
- U.S. Food and Drug Administration. (2021, December 10). *Why you should not use Ivermectin to treat or prevent COVID-19*. <https://www.fda.gov/consumers/consumer-updates/why-you-should-not-use-ivermectin-treat-or-prevent-covid-19>
- Xie, J., Xu, B., Wei, L., Huang, C., & Liu, W. (2022). Effectiveness and safety of Sofosbuvir/Velpatasvir/Voxilaprevir as a Hepatitis C virus infection salvage therapy in the real world: A systematic review and meta-analysis. *Infectious Diseases and Therapy*, 11(4), 1661–1682. <https://doi.org/10.1007/s40121-022-00666-0>

This page titled [10.10: Chapter 10 References](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Anna Jannak](#) (Consortium of Academic and Research Libraries in Illinois (CARLI)) .

Welcome to the Health Sciences Library. This Living Library is a principal hub of the [LibreTexts project](#), which is a multi-institutional collaborative venture to develop the next generation of open-access texts to improve postsecondary education at all levels of higher learning. The LibreTexts approach is highly collaborative where an Open Access textbook environment is under constant revision by students, faculty, and outside experts to supplant conventional paper-based books.

Detailed Licensing

Overview

Title: Pharmacology - Principles and Application for Medical Assistants

Webpages: 269

All licenses found:

- [CC BY 4.0](#): 99.3% (267 pages)
- [Undeclared](#): 0.7% (2 pages)

By Page

- [Pharmacology - Principles and Application for Medical Assistants - CC BY 4.0](#)
 - [Front Matter - CC BY 4.0](#)
 - [TitlePage - CC BY 4.0](#)
 - [InfoPage - CC BY 4.0](#)
 - [Preface - Undeclared](#)
 - [Table of Contents - Undeclared](#)
 - [Licensing - CC BY 4.0](#)
 - [Chapter 1: Introduction to clinical pharmacology for the medical assistant - CC BY 4.0](#)
 - [1.1: Main Terms - CC BY 4.0](#)
 - [1.2: Chapter Goals - CC BY 4.0](#)
 - [1.3: Introduction - CC BY 4.0](#)
 - [1.3.1: What are Drugs? - CC BY 4.0](#)
 - [1.3.2: History of Drugs - CC BY 4.0](#)
 - [1.3.3: Pharmacognosy- The Sources of Drugs - CC BY 4.0](#)
 - [1.3.3.1: Plants - CC BY 4.0](#)
 - [1.3.3.2: Animals - CC BY 4.0](#)
 - [1.3.3.3: Minerals - CC BY 4.0](#)
 - [1.3.3.4: Microbiologic - CC BY 4.0](#)
 - [1.3.3.5: Synthetic and Biosynthetic - CC BY 4.0](#)
 - [1.4: Uses of Drugs and Terminology - CC BY 4.0](#)
 - [1.4.1: Prevention - CC BY 4.0](#)
 - [1.4.2: Treatment - CC BY 4.0](#)
 - [1.4.3: Diagnosis - CC BY 4.0](#)
 - [1.4.4: Curative - CC BY 4.0](#)
 - [1.4.5: Palliative - CC BY 4.0](#)
 - [1.4.6: Replacement - CC BY 4.0](#)
 - [1.4.7: Health maintenance - CC BY 4.0](#)
 - [1.5: Drug Legislation - CC BY 4.0](#)
 - [1.5.1: Food and Drug Administration - CC BY 4.0](#)
 - [1.5.2: Drug Enforcement Agency - CC BY 4.0](#)
 - [1.5.3: Controlled Substances Act - CC BY 4.0](#)
 - [1.6: Drug References - CC BY 4.0](#)
 - [1.6.1: Prescriber's Desk Reference - CC BY 4.0](#)
 - [1.6.2: Package inserts - CC BY 4.0](#)
 - [1.6.3: Nursing Drug References Books and Websites - CC BY 4.0](#)
 - [1.7: Drug Names - CC BY 4.0](#)
 - [1.7.1: Generic name - CC BY 4.0](#)
 - [1.7.2: Trade or Brand Name - CC BY 4.0](#)
 - [1.8: Drug Classifications - CC BY 4.0](#)
 - [1.8.1: Therapeutic Classification - CC BY 4.0](#)
 - [1.8.2: Pharmaceutical Classification - CC BY 4.0](#)
 - [1.8.3: Body System Classification - CC BY 4.0](#)
 - [1.8.4: Other Classifications - CC BY 4.0](#)
 - [1.8.4.1: Prescription Drugs - CC BY 4.0](#)
 - [1.8.4.2: Over the Counter Drugs - CC BY 4.0](#)
 - [1.8.4.3: Herbal and Vitamin Supplements - CC BY 4.0](#)
 - [1.9: Drug Forms - CC BY 4.0](#)
 - [1.9.1: Liquids - CC BY 4.0](#)
 - [1.9.2: Powders - CC BY 4.0](#)
 - [1.9.3: Oral Drug Forms - CC BY 4.0](#)
 - [1.9.3.1: Enteric-coated Tablets - CC BY 4.0](#)
 - [1.9.3.2: Scored Tablets - CC BY 4.0](#)
 - [1.9.3.3: Sublingual and Buccal Tablets - CC BY 4.0](#)
 - [1.9.3.4: Chewable Tablets - CC BY 4.0](#)
 - [1.9.3.5: Effervescent Tablets - CC BY 4.0](#)
 - [1.9.3.6: Capsules - CC BY 4.0](#)
 - [1.9.3.7: Lozenges \(Troches\) - CC BY 4.0](#)
 - [1.9.3.8: Dissolving Film - CC BY 4.0](#)
 - [1.9.4: Other Forms of Drugs - CC BY 4.0](#)
 - [1.9.4.1: Topical Preparations - CC BY 4.0](#)
 - [1.9.4.2: Transdermal Preparations - CC BY 4.0](#)
 - [1.9.4.3: Suppositories - CC BY 4.0](#)
 - [1.10: Chapter 1 References - CC BY 4.0](#)
- [Chapter 2: Drug Safety and Pharmacology Principles - CC BY 4.0](#)
 - [2.1: Main Terms - CC BY 4.0](#)
 - [2.2: Chapter Goals - CC BY 4.0](#)

- 2.3: Drug Safety - CC BY 4.0
- 2.4: Drug Errors Classifications - CC BY 4.0
- 2.5: Factors that Can Influence Drug Errors - CC BY 4.0
- 2.6: Strategies to Reduce Drug Errors - CC BY 4.0
- 2.7: The Nine Rights of Drug Administration - CC BY 4.0
 - 2.7.1: The right drug - CC BY 4.0
 - 2.7.2: The right dose - CC BY 4.0
 - 2.7.3: The right route - CC BY 4.0
 - 2.7.4: The right time - CC BY 4.0
 - 2.7.5: The right patient - CC BY 4.0
 - 2.7.6: The right education - CC BY 4.0
 - 2.7.7: The right to refuse - CC BY 4.0
 - 2.7.8: The right technique - CC BY 4.0
 - 2.7.9: The right documentation - CC BY 4.0
- 2.8: Steps to Take for Drug Errors - CC BY 4.0
- 2.9: Drug Terminology - CC BY 4.0
 - 2.9.1: Drug Actions - CC BY 4.0
 - 2.9.1.1: Indications for Use - CC BY 4.0
 - 2.9.1.2: Desired Effects - CC BY 4.0
 - 2.9.1.3: Side Effects - CC BY 4.0
 - 2.9.1.4: Adverse Effects - CC BY 4.0
 - 2.9.1.5: Systemic and Local Effects - CC BY 4.0
 - 2.9.1.6: Drug-Drug Interactions - CC BY 4.0
 - 2.9.1.7: Potentiation - CC BY 4.0
 - 2.9.1.8: Synergism - CC BY 4.0
 - 2.9.1.9: Agonist - CC BY 4.0
 - 2.9.1.10: Antagonists - CC BY 4.0
 - 2.9.1.11: Drug-Food Interactions - CC BY 4.0
 - 2.9.2: Other Factors Influencing Drug Actions - CC BY 4.0
 - 2.9.2.1: Age – Elderly - CC BY 4.0
 - 2.9.2.2: Age- Infants and Children - CC BY 4.0
 - 2.9.2.3: Sex - CC BY 4.0
 - 2.9.2.4: Genetics - CC BY 4.0
 - 2.9.2.5: Comorbidities and Polypharmacy - CC BY 4.0
 - 2.9.2.6: Diet - CC BY 4.0
 - 2.9.2.7: Mental State - CC BY 4.0
 - 2.9.2.8: Drug Biologic Half-Life - CC BY 4.0
 - 2.9.2.9: Drug Blood Levels - CC BY 4.0
 - 2.9.2.10: Loading Doses - CC BY 4.0
 - 2.9.2.11: Maintenance Doses - CC BY 4.0
 - 2.9.2.12: Pharmacokinetics - CC BY 4.0
 - 2.9.2.12.1: Absorption - CC BY 4.0
 - 2.9.2.12.2: Distribution - CC BY 4.0
 - 2.9.2.12.3: Metabolism - CC BY 4.0
 - 2.9.2.12.4: Excretion - CC BY 4.0
- 2.10: Chapter 2 References - CC BY 4.0
- Chapter 3: Prescriptions, Orders, and Documentation - CC BY 4.0
 - 3.1: Main Terms - CC BY 4.0
 - 3.2: Chapter Goals - CC BY 4.0
 - 3.3: Prescriptions - CC BY 4.0
 - 3.3.1: Parts of a Prescription - CC BY 4.0
 - 3.3.2: Electronic Prescriptions - CC BY 4.0
 - 3.4: Medical Assistant's Role in Prescriptions - CC BY 4.0
 - 3.4.1: Patient Education - CC BY 4.0
 - 3.4.2: Refill Requests - CC BY 4.0
 - 3.4.3: Medication Reconciliation - CC BY 4.0
 - 3.4.4: Documentation in the Medical Record - CC BY 4.0
 - 3.5: Other Types of Drug Orders - CC BY 4.0
 - 3.5.1: Routine Order - CC BY 4.0
 - 3.5.2: Standing Order - CC BY 4.0
 - 3.5.3: PRN Order - CC BY 4.0
 - 3.5.4: Single Order - CC BY 4.0
 - 3.5.5: STAT Order - CC BY 4.0
 - 3.5.6: Verbal Order - CC BY 4.0
 - 3.6: Chapter 3 References - CC BY 4.0
- Chapter 4: Pharmacology Math - CC BY 4.0
 - 4.1: Main Terms - CC BY 4.0
 - 4.2: Chapter Goals - CC BY 4.0
 - 4.3: Drug Labels - CC BY 4.0
 - 4.3.1: Drug Form - CC BY 4.0
 - 4.3.2: Drug Strength - CC BY 4.0
 - 4.3.3: Measurement Systems - CC BY 4.0
 - 4.3.3.1: Metric system - CC BY 4.0
 - 4.3.3.2: Household System - CC BY 4.0
 - 4.3.3.3: Conversions between Metric and Household - CC BY 4.0
 - 4.4: Equivalencies and Conversions - CC BY 4.0
 - 4.5: Healthcare Rules when Writing Numbers - CC BY 4.0
 - 4.6: The Formula Method - CC BY 4.0
 - 4.7: Medications and Pediatrics Doses - CC BY 4.0
 - 4.8: Legal and Ethical Issues - CC BY 4.0
 - 4.9: Chapter 4 References - CC BY 4.0
- Chapter 5: The Gastrointestinal System and Administering Enteral Drugs - CC BY 4.0
 - 5.1: Main Terms - CC BY 4.0
 - 5.2: Chapter Goals - CC BY 4.0
 - 5.3: Anatomy Review of the Gastrointestinal System - CC BY 4.0
 - 5.3.1: Pharynx - CC BY 4.0
 - 5.3.2: Esophagus - CC BY 4.0
 - 5.3.3: Stomach - CC BY 4.0
 - 5.3.4: Small Intestine - CC BY 4.0

- 5.3.5: Large Intestine - CC BY 4.0
 - 5.3.6: Rectum and Anus - CC BY 4.0
- 5.4: Review of Gastrointestinal System Pathology - CC BY 4.0
 - 5.4.1: Conditions of the Mouth and Pharynx - CC BY 4.0
 - 5.4.2: Conditions of the Esophagus - CC BY 4.0
 - 5.4.3: Conditions of the Stomach - CC BY 4.0
 - 5.4.4: Conditions of the Large and Small Intestines - CC BY 4.0
 - 5.4.5: Conditions of the Rectum and Anus - CC BY 4.0
- 5.5: Gastrointestinal System Drugs - CC BY 4.0
- 5.6: Enteral Routes of Administration - CC BY 4.0
 - 5.6.1: Oral Route - CC BY 4.0
 - 5.6.2: Sublingual and Buccal Route - CC BY 4.0
 - 5.6.3: Rectal Route - CC BY 4.0
- 5.7: Chapter 5 References - CC BY 4.0
- Chapter 6: Integumentary System and Other Sense Organs - CC BY 4.0
 - 6.1: Main Terms - CC BY 4.0
 - 6.2: Chapter Goals - CC BY 4.0
 - 6.3: Anatomy review of the integumentary system - CC BY 4.0
 - 6.3.1: Skin - CC BY 4.0
 - 6.3.2: Associated Structures of the Skin - CC BY 4.0
 - 6.3.3: Hair and Hair Follicles - CC BY 4.0
 - 6.3.4: Nails - CC BY 4.0
 - 6.4: Anatomy review of the ears and eyes - CC BY 4.0
 - 6.4.1: Ears - CC BY 4.0
 - 6.4.2: Eyes - CC BY 4.0
 - 6.5: Review of Skin Disorders - CC BY 4.0
 - 6.5.1: Skin Lesions - CC BY 4.0
 - 6.5.2: Impetigo - CC BY 4.0
 - 6.5.3: Fungal Infections of the Skin - CC BY 4.0
 - 6.5.4: Dermatitis - CC BY 4.0
 - 6.6: Review of Ear and Eye Disorders - CC BY 4.0
 - 6.6.1: Otitis Externa - CC BY 4.0
 - 6.6.2: Otitis Media - CC BY 4.0
 - 6.6.3: Impacted Cerumen - CC BY 4.0
 - 6.6.4: Meniere's Disease - CC BY 4.0
 - 6.6.5: Glaucoma - CC BY 4.0
 - 6.6.6: Cataracts - CC BY 4.0
 - 6.6.7: Infections of the Eyes - CC BY 4.0
 - 6.7: Drugs to Treat Skin, Ear, and Eye Disorders - CC BY 4.0
 - 6.8: Routes of Administration - CC BY 4.0
 - 6.8.1: Topical Route - CC BY 4.0
 - 6.8.2: Otic route - CC BY 4.0
 - 6.8.3: Ophthalmic route - CC BY 4.0
- 6.9: Chapter 6 References - CC BY 4.0
- Chapter 7: Parenteral Routes- Intradermal and Subcutaneous - CC BY 4.0
 - 7.1: Main Terms - CC BY 4.0
 - 7.2: Chapter Goals - CC BY 4.0
 - 7.3: Parenteral Supplies - CC BY 4.0
 - 7.3.1: Needles and Syringes - CC BY 4.0
 - 7.3.2: Vials - CC BY 4.0
 - 7.3.3: Ampules - CC BY 4.0
 - 7.3.4: Prefilled Syringes - CC BY 4.0
 - 7.3.5: Reconstituting Powders - CC BY 4.0
 - 7.4: Intradermal Route - CC BY 4.0
 - 7.5: Subcutaneous Route - CC BY 4.0
 - 7.6: Chapter 7 References - CC BY 4.0
- Chapter 8: Parenteral Routes- Intramuscular - CC BY 4.0
 - 8.1: Main Terms - CC BY 4.0
 - 8.2: Chapter Goals - CC BY 4.0
 - 8.3: Intramuscular Route - CC BY 4.0
 - 8.3.1: Aspiration - CC BY 4.0
 - 8.4: Intramuscular Injection Sites - CC BY 4.0
 - 8.4.1: Deltoid Site - CC BY 4.0
 - 8.4.2: Vastus Lateralis Site - CC BY 4.0
 - 8.4.3: Ventrogluteal Site - CC BY 4.0
 - 8.5: Airlock and Z-Track Techniques - CC BY 4.0
 - 8.6: Chapter 8 References - CC BY 4.0
- Chapter 9: Immune System, Allergies, and Vaccines - CC BY 4.0
 - 9.1: Main Terms - CC BY 4.0
 - 9.2: Chapter Goals - CC BY 4.0
 - 9.3: Review of the Anatomy of the Immune System - CC BY 4.0
 - 9.3.1: Antigens and Antibodies - CC BY 4.0
 - 9.3.2: Innate and Adaptive Immunity - CC BY 4.0
 - 9.3.3: White Blood Cells (Leukocytes) - CC BY 4.0
 - 9.3.4: Lymphatic System - CC BY 4.0
 - 9.3.4.1: Immunological Memory - CC BY 4.0
 - 9.3.4.1.1: Primary and Secondary Responses - CC BY 4.0
 - 9.3.4.1.2: Memory Cell Formation - CC BY 4.0
 - 9.3.4.1.3: Rapid and Robust Secondary Response - CC BY 4.0
 - 9.3.4.1.4: Long-lasting Protection - CC BY 4.0
 - 9.3.4.1.5: Vaccination - CC BY 4.0

- 9.3.4.2: Allergies - *CC BY 4.0*
 - 9.3.4.2.1: Anaphylactic Shock - *CC BY 4.0*
- 9.3.4.3: Autoimmune Disorders - *CC BY 4.0*
- 9.3.5: Vaccines - *CC BY 4.0*
 - 9.3.5.1: Centers for Disease Control and Prevention (CDC) - *CC BY 4.0*
 - 9.3.5.2: Vaccine Schedules - *CC BY 4.0*
 - 9.3.5.3: Vaccine Information Statement (VIS) - *CC BY 4.0*
 - 9.3.5.4: CDC Pink Book - *CC BY 4.0*
 - 9.3.5.5: Vaccine Administration Documentation - *CC BY 4.0*
 - 9.3.5.6: Immunization Information Systems - *CC BY 4.0*
 - 9.3.5.7: The Vaccine Adverse Event Reporting System (VAERS) - *CC BY 4.0*
- 9.4: Chapter 9 References - *CC BY 4.0*
- Chapter 10: Infections and Drugs to Treat Infections - *CC BY 4.0*
 - 10.1: Main Terms - *CC BY 4.0*
 - 10.2: Chapter Goals - *CC BY 4.0*
 - 10.3: Infectious Agents and Infections - *CC BY 4.0*
 - 10.3.1: Common Pathogens - *CC BY 4.0*
 - 10.4: Infections and Healthcare - *CC BY 4.0*
 - 10.5: Antibiotic Resistance - *CC BY 4.0*
 - 10.6: Sepsis - *CC BY 4.0*
 - 10.7: Drugs for Infectious Diseases - *CC BY 4.0*
 - 10.7.1: Bacterial Infections - *CC BY 4.0*
 - 10.7.2: Viral Infections - *CC BY 4.0*
 - 10.7.3: Fungal Infections - *CC BY 4.0*
 - 10.7.4: Parasitic Infections - *CC BY 4.0*
 - 10.8: Antibiotic Patient Teaching - *CC BY 4.0*
 - 10.8.1: Most Prescribed Antibiotics - *CC BY 4.0*
 - 10.9: Antiviral Drugs Patient Teaching - *CC BY 4.0*
 - 10.10: Chapter 10 References - *CC BY 4.0*
- Back Matter - *CC BY 4.0*
 - Index - *CC BY 4.0*
 - Glossary - *CC BY 4.0*
 - Detailed Licensing - *CC BY 4.0*