



Eighth Edition

Human Diseases

A Systemic Approach

Zelman · Raymond · Holdaway · Dafnis · Mulvihill



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EIGHTH EDITION

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Cover Printer: Lehigh Phoenix
Text Font: ITC Bookman Std Light 10/12

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Library of Congress Cataloging-in-Publication Data

Zelman, Mark, author.

Human diseases : a systemic approach. — Eighth edition / Mark Zelman, Jill Raymond, Elaine Tompany, Paul Holdaway, Mary Lou Mulvihill.

p. ; cm.

Includes bibliographical references.

ISBN 978-0-13-342474-4 — ISBN 0-13-342474-X

I. Raymond, Jill, author. II. Tompany, Elaine, author. III. Holdaway, Paul, author. IV. Mulvihill, Mary L., author. V. Title.

[DNLM: 1. Disease. 2. Clinical Medicine. QZ 140]

RB111

616—dc23

2014011113

10 9 8 7 6 5 4 3 2 1

PEARSON

ISBN 10: 0-13-342474-X
ISBN 13: 978-0-13-342474-4

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Preface

Welcome to the Eighth Edition

The eighth edition of *Human Diseases: A Systemic Approach* has been thoroughly updated and revised for accuracy, organization, and currency. A complete set of multimedia ancillaries accompanies the text and provides a multimedia learning experience. Students and instructors will enjoy the text's accessible and engaging approach to human diseases.

Every chapter has been entirely rewritten for this edition.

Organization

The text remains organized in two parts. Part I, *Mechanisms of Disease*, introduces students to terminology, immunity and inflammation, inheritance, cancer, and infectious diseases. Part II, *Diseases of the Systems*, discusses the major diseases of the body systems. Also returning is the popular *Side by Side* feature; *Prevention Plus!*; *Diseases at a Glance* charts; and *Interactive Activities*, including case studies and multiple-choice, true/false, and fill-in-the-blank exercises.

New to the Eighth Edition

- **“Healthy Aging” feature.** Throughout the text, highlights practical information about aging and disease prevention.

- **“Promote Your Health” feature.** Throughout the text, highlights useful information, tools, and behaviors that reduce the risk for selected diseases and disorders.
- **Consistent coverage of disease topics.** Throughout the text, the authors attempted to include, for each disease, information on incidence, prevalence, risk factors, symptoms, etiology, diagnosis, treatment, and prevention.
- **New chapter on Diseases and Disorders of the Special Senses.** This chapter expands and brings together in one place diseases and disorders of the eye and ear.
- **Resources/references.** Updated professional and credible resources have been included at the end of each chapter.

Instructor's Resource Manual

This manual contains a wealth of material to help faculty plan and manage the human disease course. It includes lecture suggestions and content abstracts, learning objectives, a 693-question test bank, and more for each chapter.

Image Library

A collection of 198 images is available for instructors to download for presentation purposes. This library encompasses each of the high-quality images contained in the text and may be used in any way that instructors wish.

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Jill Raymond, PhD, is a Professor in the Department of Life Science at Mesa Community College in Mesa, Arizona, where she teaches microbiology. She received her PhD in Microbiology from the University of California at Davis and completed a postdoctoral fellowship in infectious diseases at the University of California at San Diego, where she studied the parasite *Giardia lamblia*.

Dr. Raymond is proud to dedicate the eighth edition to her husband, Andy. Without his continual support and encouragement, this edition would have been almost insurmountable.

Paul Holdaway, MA, a native Hoosier, is a graduate of Indiana State University and was an instructor there for two years. He is retired from the Biology Department at Harper College in Palatine, Illinois, where Dr. Mary Lou Mulvihill was an admired fellow biologist and friend. Holdaway takes pleasure in a wide range of biological and clinical interests, as well as sports and family activities.

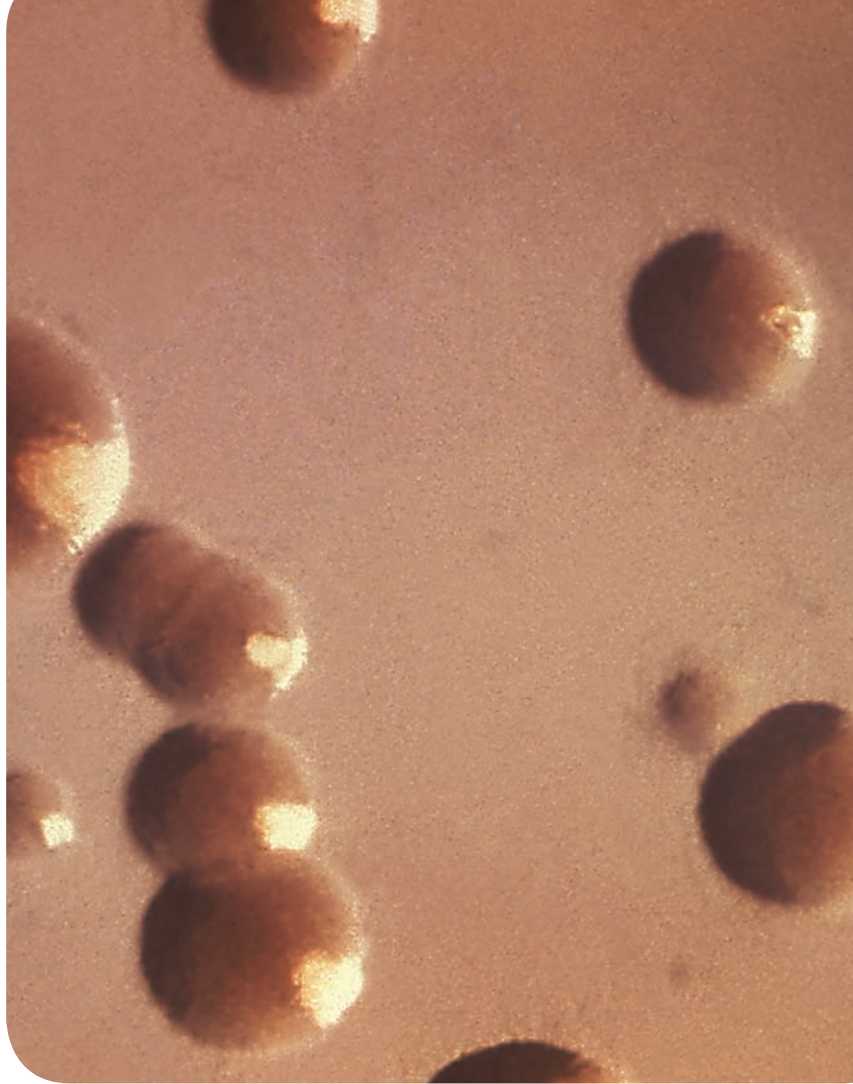
Elaine Dafnis, PharmD, MS, received her degree from the University of Illinois at Chicago. She taught courses in pharmacology, pathophysiology, pharmacy law, and pharmaceutical calculations at William Rainey Harper College and the College of Lake County in Illinois. She has served as a mentor and preceptor for pharmacy students at the University of Illinois and Drake University.

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Part I

Mechanisms of Disease

How do we define and describe disease? What causes disease? In Part I, we discuss the manifestations, terminology, diagnosis, and mechanisms of disease.



Chapters

1. Introduction to Disease
2. Immunity and Disease
3. Infectious Diseases
4. Cancer
5. Heredity and Disease

Chapter 1

Introduction to Disease

Learning Objectives

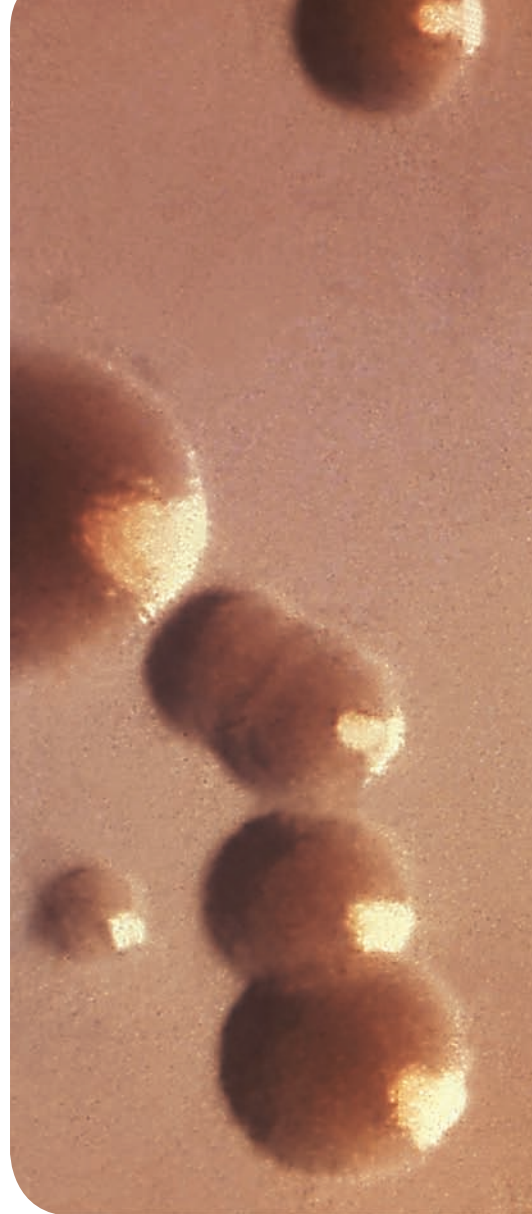
After studying this chapter, you should be able to

- Define basic terminology used in the study of human disease
- Identify the major causes of disease
- Identify risk factors related to disease
- Describe how health promotion and disease prevention reduce the burden of disease

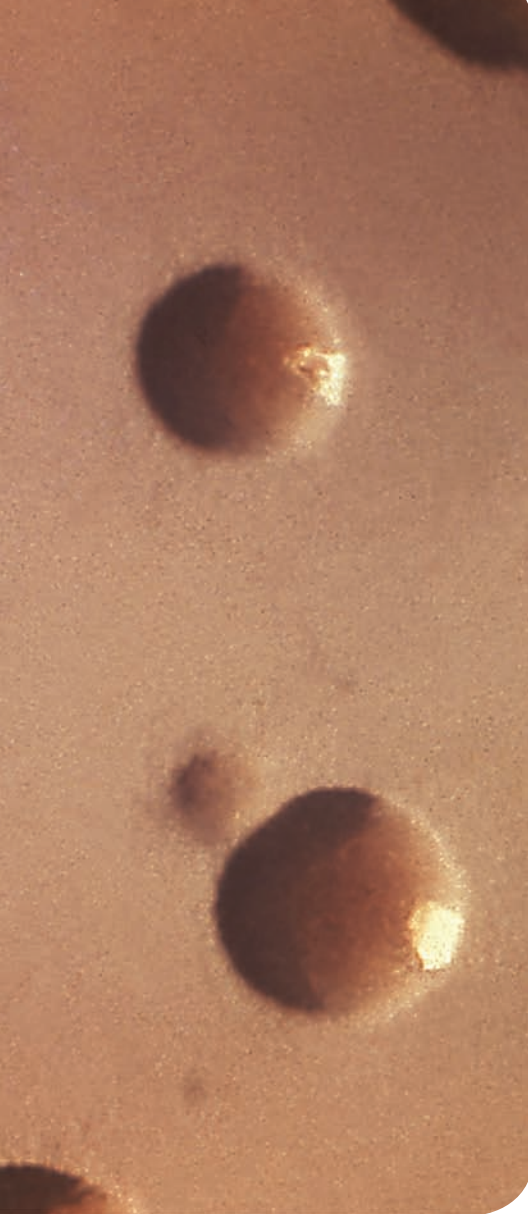
Fact or Fiction?

Plague does not occur in the United States.

Fiction: Plague first reached the western United States around 1900. In recent decades, an average of seven human plague cases are reported each year in the United States. Plague is most common in the southwestern states, particularly New Mexico, Arizona, and Colorado.



A heart infusion agar culture growing colonies of *Yersinia pestis* bacteria. (Courtesy of the CDC/Dr. Brodsky, 1966)



Disease Chronicle

The Black Death, also known as the plague, was one of the most devastating pandemics in human history. The Black Death arrived in Europe in October 1347 when 12 Genoese trading ships docked at the Sicilian port of Messina. Most of the sailors aboard the ships were dead. Those still alive were gravely ill and were covered in mysterious black boils that oozed blood and pus. Over the next 5 years the Black Death killed approximately 25 million people or a third of Europe's population. That is equivalent to killing everyone who lives in the 10 largest cities in the United States in only 5 years. In the 14th century there was no rational explanation for what happened. No one knew what caused the Black Death, how it was transmitted, or how to prevent or treat it. Today we know that plague is caused by *Yersinia pestis* bacteria, is usually transmitted to humans through fleas, and can be successfully treated with antibiotics.

Disease Concepts and Terminology

“From the bitterness of disease man learns the sweetness of health.”

—Catalan proverb

In this chapter you embark on the exciting and challenging study of human disease. This chapter of your journey introduces you to key terms and concepts that you will use throughout the text. We first consider the nature of health and disease.

Health and Disease

We all can recognize a state of **health**. Health is the condition in which the human body performs its vital functions normally. In health the body’s various organ systems function optimally and a person can participate fully in his or her life. Health depends on the body maintaining **homeostasis**, relatively stable internal conditions under fluctuating environmental conditions. In homeostasis, the body’s organ systems normally maintain temperature, pH, blood composition, and fluid levels within a precise range and correct any fluctuations before they threaten the body’s health.

We also can recognize the presence of disease. Employing the concept of homeostasis, we can more precisely describe disease. A significant disturbance in the homeostasis of the body leads to **disease**. Disease is a deviation from normal structure or function in the body that interrupts or modifies the performance of vital functions. For example, the amount of glucose in the blood is tightly regulated to ensure that organs receive an adequate supply of energy. Insulin is a chemical messenger that helps maintain the level of glucose in the blood, increasing or decreasing glucose as the body’s needs dictate. If the pancreas were to make no insulin, the amount of glucose in the blood would rise, leading to a number of health problems we associate with the disease diabetes.

Pathology is the study of disease, especially the structural and functional changes associated with disease. The study of disease includes study of its causes, mechanisms, signs and symptoms,

treatments, and prevention. A **pathologist** is a physician who studies and interprets the changes caused by disease. Pathologists act as detectives, examining cells, tissues, organs, and lab test results to find clues about the nature of disease.

Recognizing Disease

A disease can be recognized through its characteristic **signs** and **symptoms**. Signs are evidence of disease observed on physical examination, such as abnormal pulse or respiratory rate, fever, and sweating. Symptoms are indications of disease reported by the patient, such as pain, dizziness, and itching. For example, signs and symptoms of type 1 diabetes mellitus include frequent urination, extreme thirst, excessive hunger, and weight loss. A disease that causes no signs or symptoms is called an asymptomatic disease. An example of an asymptomatic disease is chlamydia, a sexually transmitted infection.

The terms **syndrome** and **disorder** are occasionally used when discussing human disease. A syndrome is an abnormal structure or function characterized by a group of signs and symptoms that usually occur together. Examples of syndromes include acquired immunodeficiency syndrome (AIDS), malabsorption syndrome, and Down syndrome. A disorder is a functional abnormality not necessarily linked to a specific cause or physical abnormality. Examples of disorders include attention-deficit/hyperactivity disorder, premenstrual dysphoric disorder, and hemorrhoids. Disorders might be accompanied by specific signs and symptoms; however, their presence is not required for a condition to be termed a disorder.

Diagnosis of Disease

Doctors identify types of diseases in order to treat them effectively. **Diagnosis** is the process of identifying a disease or disorder. Several types of information are used for diagnosis, including signs and symptoms, which can be quite specific and therefore helpful for diagnosing certain diseases. Signs and symptoms can be ascertained

through physical examination and interviews with a patient or with a patient's family. Frequently the course and history of the signs and symptoms yields important diagnostic information. Similarly, family disease history may give insight into genetic risk for developing certain diseases.

A physical exam includes a number of procedures:

- Inspection refers to a visual examination of the external surface of the body, its movements, and posture for abnormalities or evidence of disease.
- Palpation, feeling the body with fingers or hands, allows examination of the size, consistency, texture, location, and tenderness of an organ or body part.
- Auscultation, listening to the lungs, heart, and intestines, allows evaluation of the frequency, intensity, duration, number, and quality of sounds originating in the body.
- Percussion, producing sounds by tapping on specific areas of the body with fingers, hands, or a small instrument, allows evaluation of the size, consistency, and borders of the body organs, and the presence or absence of fluid in body areas.
- Vital signs (pulse, respiratory rate, blood pressure, temperature) are measures of various physiological statistics in order to assess the most basic body functions. Normal vital signs vary with age, sex, weight, exercise tolerance, and physical condition.

Diagnosis also relies on results of laboratory tests that analyze the composition of urine, blood, throat swabs, stool, sputum, and other patient samples. A biopsy, surgical removal and analysis of tissue samples, yields information about changes at the cellular level. Biopsy can reveal valuable information about tumors.

Other commonly used diagnostic procedures allow physicians to visualize the structure or function of internal organs. These procedures

are discussed in more detail throughout the text. Imaging technologies include:

- Electrocardiography reads the heart's electrical impulses.
- Radiography uses x-rays to visualize internal structures.
- Computed tomography (CT) scan uses computers and x-rays to create three-dimensional images of internal structures.
- Magnetic resonance imaging (MRI) analyzes tissue responses to a strong magnetic field to create images of internal structures.
- Ultrasound analyzes the interaction of low-frequency sound waves with tissues to create moving images of internal organs.
- Nuclear medicine uses radioactive materials to create contrast in the body and help form images of the structure and function of organs.

The Course of a Disease

The physician, having made a diagnosis, may state the **prognosis** of the disease, or its predicted course and outcome. The prognosis may state the chances for complete recovery, predict the permanent loss of function, or give probability of survival.

The course of a disease varies. An **acute** disease has a sudden onset and short duration. Influenza, measles, and the common cold are examples of acute infections. Diseases that will end in death are called **terminal**. A **chronic** disease has a slower, less severe onset and a long duration of months or years. Examples of chronic diseases include heart disease, cancer, stroke, diabetes, and arthritis.

Chronic diseases are a significant cause of death, accounting for 7 in 10 deaths in the United States, and 6 in 10 deaths worldwide each year (Table 1-1 ► and Table 1-2 ►). The leading causes of death differ among countries and are closely tied to a country's income level and economic development. Chronic diseases are among the leading causes of death in wealthy Western countries. Infectious diseases are more important causes of death in low income countries

TABLE 1–1 Ten Leading Causes of Death in the United States, 2010

Disease	Number of deaths
Diseases of the heart	597,689
Malignant neoplasms (cancer)	574,743
Chronic lower respiratory diseases	138,080
Cerebrovascular diseases (stroke)	129,476
Accidents	120,859
Alzheimer's disease	83,494
Diabetes mellitus	69,071
Nephritis, nephrotic syndrome, and nephrosis	50,476
Influenza/pneumonia	50,097
Intentional self-harm (suicide)	38,364

Source: www.cdc.gov/nchs/data_access/Vitalstatsonline.htm.

TABLE 1–2 Ten Leading Causes of Death in the World, 2011

Disease	Number of deaths
Ischemic heart disease	7,000,000
Stroke and other cerebrovascular disease	6,200,000
Lower respiratory infections	3,200,000
Chronic obstructive pulmonary disease	3,000,000
Diarrheal disease	1,900,000
HIV/AIDS	1,600,000
Trachea, bronchus, lung cancers	1,500,000
Tuberculosis	1,400,000
Diabetes	1,300,000
Road traffic accidents	1,200,000

Source: World Health Organization, Fact Sheet No. 310, updated July 2013

(Table 1–3 ► and Table 1–4 ►). It is predicted that the four leading causes of death in the world in 2030 will be heart disease, stroke, chronic obstructive pulmonary disease (COPD), and lower respiratory infections (mainly pneumonia).

Some diseases enter a period of **remission** during which its signs and symptoms subside or disappear. However, a remission is not considered a cure. A remission may last days, months, or years, after which the disease can recur. At times, signs and symptoms may grow more severe, a period of **exacerbation**. Certain diseases (leukemia and ulcerative colitis, for example) are characterized by periods of remission, recurrence, and sometimes exacerbation. A **relapse** describes the return of a disease weeks or months after its apparent cure.

A **complication** is a related disease or other abnormal state that develops in a person already suffering from a disease. For example, a person confined to bed with a serious fracture may develop pneumonia as a complication of the inactivity. The complication may interfere with recovery from the original disease. Anemia is a common

complication of leukemia, cancer, and chronic kidney disease. Anemia makes it harder to recover from those diseases. The aftermath of a particular disease is called the **sequela**, or sequel. A sequela of rheumatic fever is permanent damage to the heart and a sequel of polio is paralysis. Sterility may be a sequela of pelvic inflammatory disease and sexually transmitted infections.

Describing the Occurrence of Disease

Public health agencies gather data about how, when, and where diseases occur. The data give public health officials and physicians an idea of how serious a disease is and thus help direct resources toward prevention and treatment. The number of deaths caused by a disease is important to monitor. **Mortality** is the number of deaths that occur among people with a certain disease.

Even if a disease causes very few deaths, it is still important to monitor the presence of that disease. Illness causes lost days of work and school, leads to disability, incurs medical expenses, and can have a big impact on the economy. Thus,

TABLE 1–3 Ten Leading Causes of Death in Low-Income Countries, 2008

Disease	Number of deaths
Lower respiratory infections	1,050,000
Diarrhea disease	760,000
HIV/AIDS	720,000
Ischemic heart disease	570,000
Malaria	480,000
Stroke and other cerebrovascular disease	450,000
Tuberculosis	400,000
Prematurity and low birth weight	300,000
Birth asphyxia and birth trauma	270,000
Neonatal infections	240,000

Source: World Health Organization, Fact Sheet No. 310, updated June 2011

officials monitor **morbidity**, the **incidence** of disease. Morbidity is the number of cases of a disease in a population. For example, in 2009 there were an estimated 48,100 new human immunodeficiency virus (HIV) infections in the United States. By monitoring the incidence of HIV infections, researchers and officials can track changes in the occurrence of HIV and respond with appropriate interventions to control it.

Prevalence is the percentage of a population that is affected with a particular disease at a given time. For example, at the end of 2009 an estimated 1,148,200 persons aged 13 and older were living with HIV infection in the United States. Prevalence data allow the determination of the impact and significance of a disease for a given population and these data are used to direct health care resources and research. Prevalence data also help doctors see the significance of certain diseases for certain demographics. In this way we learn that cancer, cardiovascular disease, and diabetes are more prevalent in older adults than in adolescents.

TABLE 1–4 Ten Leading Causes of Death in High-Income Countries, 2008

Disease	Number of deaths
Ischemic heart disease	1,420,000
Stroke and other cerebrovascular disease	790,000
Trachea, bronchus, lung cancers	540,000
Alzheimer's and other dementias	370,000
Lower respiratory infections	350,000
Chronic obstructive pulmonary disease	320,000
Colon and rectum cancers	300,000
Diabetes mellitus	240,000
Hypertensive heart disease	210,000
Breast cancer	170,000

Source: World Health Organization, Fact Sheet No. 310, updated June 2011

Epidemiology is the study of the occurrence, transmission, distribution, and control of disease. Epidemiologists use prevalence and incidence data and information about the geographic distribution of disease to develop methods to prevent and control diseases. The Centers for Disease Control and Prevention (CDC; www.cdc.gov) in Atlanta, Georgia, is the chief epidemiologic institution in the United States. The World Health Organization (WHO; www.who.int) in Geneva, Switzerland, acts as a coordinating authority on international public health.

Causes of Disease

An important aspect of any disease is its **etiology**, or cause. A related concept, **pathogenesis**, describes how the cause of a disease leads to anatomical and physiological changes in the body that ultimately result in the disease. If the cause of a disease is not known, it is said to be **idiopathic**. You will learn about several idiopathic diseases as you read this text.

TABLE 1–5 Major Categories of Diseases

Category	Disease
Hereditary diseases	Hemophilia, sickle cell anemia, cystic fibrosis
Congenital diseases	Tetralogy of Fallot (heart abnormality)
Degenerative diseases	Arteriosclerosis, osteoarthritis, Alzheimer's disease
Inflammation/autoimmunity/allergy	Asthma, systemic lupus erythematosus, hay fever
Infectious diseases	Tuberculosis, influenza, syphilis
Neoplastic diseases	Lung cancer, malignant melanoma, breast cancer
Metabolic diseases	Diabetes, hypothyroidism, gigantism
Trauma	Burns, frostbite, bone fractures
Nutritional-imbalance diseases	Iron-deficiency anemia, scurvy, obesity

Causes of disease are often divided into several categories (Table 1–5 ►). Some diseases seem to have a single cause, while many diseases actually have several causes. The chief causes of disease are:

- Hereditary. Abnormality in an individual's genes or chromosomes.
- Congenital. Exist at or date from birth; can be acquired through heredity or acquired during development in the uterus.
- Degenerative. Function or structure of the affected tissues or organs progressively deteriorates over time.
- Inflammatory, autoimmune, and allergic. Result of abnormal immune function; infectious diseases are caused by pathogens such as bacteria and viruses.
- Neoplastic. Result from abnormal growth that leads to the formation of tumors.
- Metabolic. Disruption of normal metabolism, the process of converting food to energy on a cellular level.
- Traumatic. Physical or chemical injury.
- Nutritional. Over- or underconsumption of nutrients.

Risk Factors

Risk factors increase a person's chance of developing a disease. Note that a risk factor is not equivalent to etiology. While an individual with

risk factors for a certain disease has an increased chance of developing that disease, that person will not necessarily acquire the disease. However, by eliminating known risk factors for a disease, a person may reduce the chance of developing that disease.

Risk factors may be environmental, chemical, physiological, psychological, or genetic. A well-known risk factor for lung cancer is cigarette smoking. The development of coronary artery disease has multiple well-established risk factors, such as high cholesterol and lipids, high blood pressure, diabetes, obesity, and physical inactivity. Four modifiable risk factors (lack of physical activity, poor nutrition, tobacco use, and excessive alcohol consumption) are responsible for much of the illness, disability, and premature death related to chronic diseases.

Health Promotion and Disease Prevention

“The function of protecting and developing health must rank even above that of restoring it when it is impaired.”

—Hippocrates

The United States spends significantly more on health care than any other nation, more than twice the average of other developed countries. More than 75% of U.S. health care dollars go

Prevention PLUS!

Four Modifiable Risk Factors for Chronic Disease

1. Poor nutrition

Before you eat, think about what goes on your plate. Vegetables, fruits, whole grains, low-fat dairy products, and lean protein contain the nutrients you need without too many calories.

To build a healthy plate:

- Make half your plate fruits and vegetables.
- Switch to skim or 1% milk.
- Make at least half your grains whole.
- Vary your protein choices.
- Cut back on foods high in solid fats, added sugars, and salt.

2. Lack of physical activity

Be physically active. Adults should do strength and flexibility training at least two times per week and engage in at least 150 minutes of moderate-intensity aerobic activity or 75 minutes of vigorous-intensity aerobic activity or a combination of both each week.

3. Tobacco use

Smoking is the leading cause of preventable death in the United States. Mark Twain said, “Quitting smoking is easy. I’ve done it a thousand times.” It’s hard to quit smoking, but you can do it. There are resources

available to help you quit using tobacco (e.g., www.smokefree.gov).

4. Excessive alcohol consumption

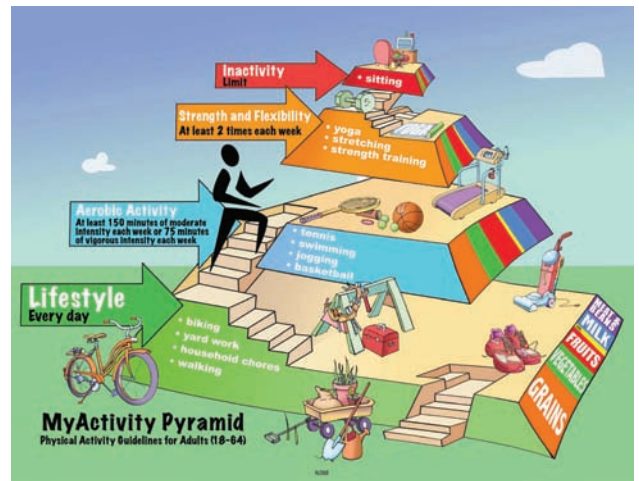
If you choose to consume alcohol, The U.S. Department of Agriculture *2010 Dietary Guidelines for Americans* recommends moderate alcohol consumption, defined as up to one drink per day for women and up to two drinks per day for men. This definition is referring to the amount consumed on any single day and is not intended as an average over several days.

Think Critically

1. What are the four modifiable risk factors for chronic disease?
2. Moderate alcohol consumption is defined as how many drinks per day for men? For women?
3. How many times per week should you engage in strength and flexibility training?
4. How many minutes of vigorous-intensity aerobic activity does an adult need to do per week?
5. How much of your healthy plate should be fruits and vegetables?



Source: www.choosemyplate.gov/print-materials-ordering/graphic-resources.html



Source: University of Missouri Extension